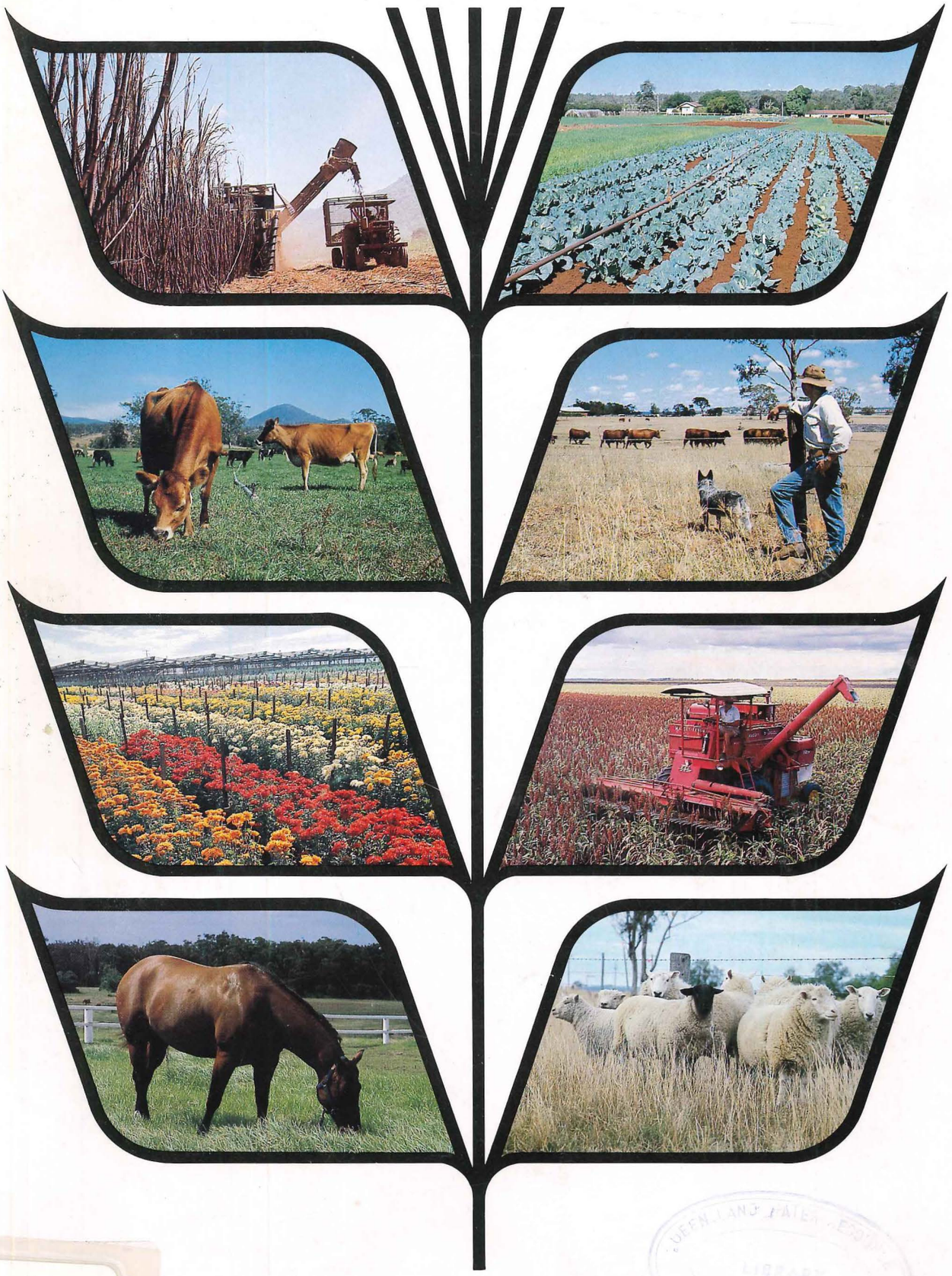
QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

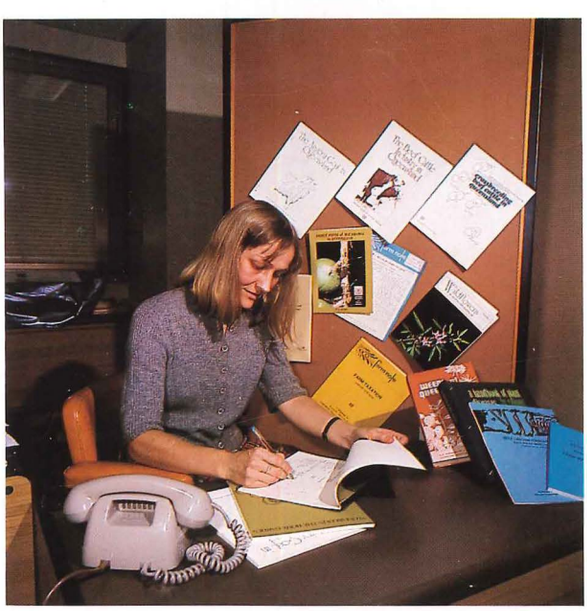


Annual Report 1981–1982

Presented to Parliament by Command

Recognition of the value of professionally prepared posters and conference displays has led to a call on Information Branch for more work of this type. The picture shows commercial artist Lindy Brennan at work on a poster.

Displays at shows, field days and other DPI events have become an effective means of drawing attention to the Department's extension message. Besides the RNA Exhibition, display artist M. I. Aldous, of Information Branch, handled displays at 14 district shows and 10 DPI presentations during the year.



Sustained demand for semi-technical and technical information from primary producers, agribusiness and hobbyists lifted book sales to almost 10 000 volumes last year. Book editor Tanya Kooznetzoff, of Information Branch, works on one of the 13 new titles in press, surrounded by some of the 30 titles already printed.

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QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Annual Report 1981–82

Presented to Parliament by Command

By Authority: S. R. HAMPSON, Governmen

19701—**A. 89—1982**

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as at 30 June 1982

MINISTER FOR PRIMARY INDUSTRIES	Hon. M. J. Ahern, B.Agr.Sc., M.L.A.
DIVISION OF ADMINISTRATION—	
Director-General and Under Secretary	G. I. Alexander, B.V.Sc., M.S., Ph.D., F.A.C.V.Sc.
Deputy Director-General	A. Hegarty, B.Sc., Q.D.A.
Assistant Director-General	D. P. Lapidge, B.Com., A.A.V.Q.
	B. Oxenham, B.Agr.Sc., F.A.I.A.S.
	J. W. Ryley, B.V.Sc., F.A.C.V.Sc.
Director, Administration	J. Gibb, B.V.Sc., Dip.Agr.Ext. (Acting)
Assistant to Director-General	C. P. Hamilton, M.Agr.Sc., B.Econ., Q.D.A.H.
Accountant	P. G. Griffin, A.A.S.A
Director, Information and Extension Training Branch	M. D. Littmann, M.Sc., M.Pub.Ad.
Director, Biometry Branch	B. J. White, B.Econ., Ph.D.
Executive Officer, Research Stations Section	B. A. T. Rodda, B.Agr.Sc., Dip.Agr.Ext.
Executive Officer, Extension Services Section	H. S. Briggs, M.Agr.Sc. (Acting)
Executive Officer, Special Projects	H. A. Bonney, B.Com., LL.B.
Executive Officer, Organizational Services Branch	R. G. Nimmo, B.Agr.Sc.
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Director of the Division	B. A. Woolcock, B.V.Sc., M.A.C.V.Sc.
Deputy Directors	S. G. Knott, B.V.Sc., Dip.Agr.Ext.
	L. Laws, M.V.Sc., M.A.C.V.Sc.
Animal Research Institute	
Director of Animal Laboratories	R. J. W. Gartner, B.Sc., F.R.A.C.I. (Director)
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Pathology Branch	L. L. Callow, B.V.Sc., Ph.D. (Director)
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Veterinary Services Branch	I. D. Wells, B.V.Sc. (Director)
Sheep and Wool Branch	P. S. Hopkins, M.V.Sc., Ph.D. (Director)
Veterinary Public Health Branch	B. Parkinson, B.V.Sc., M.A.C.V.Sc. (Director)
Pig and Poultry Branch	R. V. Byrnes, Q.D.A., Dip.Bus.Admin., M.Sc. (Director)
DIVISION OF DAIRYING AND FISHERIES—	
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	G. G. Crittall, Dip.Ind.Chem., A.R.A.C.I. (Acting)
Deputy Director (Dairying)	J. G. Miller, B.Agr.Sc., Dip.Bus.Admin., Q.D.D.M. (Acting)
Deputy Director (Fisheries)	N. M. D. Haysom, B.Sc.
Dairy Cattle Husbandry Branch	I. H. Rayner, B.Econ., Dip.Agr.Ext., Q.D.A.H. (Director)
Field Services Branch	N. S. Juffs, Ph.D., B.Agr.Sc., Q.D.D.M., Grad. Dip.Bus.Admin. (Acting Director)
Dairy Research Branch	Ailsa J. Gillies, M.Sc.App.(Med.) (Director)
Fisheries Research Branch	— (Director)
DIVISION OF LAND UTILISATION—	
Director	B. J. Crack, B.Sc., M.S., A.A.C.I.
Deputy Director	K. G. Trudgian, B.Sc., Grad.Dip.Bus.
Development Planning Branch	N. M. Dawson, M.Agr.Sc. (Director)
Soil Conservation Branch	R. Berndt, B.Agr.Sc. (Acting Director)
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Director of Marketing	D. R. J. Densley, B.Agr.Sc., B.Econ.
Deputy Director of Marketing	—
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Marketing Services Branch	W. Kidston, B.Com., A.A.S.A. (Director)
Standards Branch	W. V. Mungomery, B.Agr.Sc. (Director)
DIVISION OF PLANT INDUSTRY—	
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Deputy Director	J. K. Leslie, Ph.D., B.Agr.Sc.
Agriculture Branch	D. A. K. McNee, B.Agr.Sc., Dip.Agr.Ext. (Director)
Horticulture Branch	N. S. Kruger, M.Sc. (Director)
Agricultural Chemical Laboratory Branch	R. C. Bruce, B.Sc. (Director)
Botany Branch	R. W. Johnston, M.Sc., Ph.D. (Director)
Entomology Branch	T. Passlow, M.Sc.Agr. (Director)
Plant Pathology Branch	R. C. Colbran, M.Agr.Sc., Ph.D. (Director)

Queensland Department of Primary Industries

Annual Report 1981–82

To the Honourable the Minister for Primary Industries

Sir,

I have the honour to report that the gross value of rural production in Queensland for the year 1981–82 is expected to be $2,555m compared with $2,416m for the year 1980–81. This is an increase of 5.7% in money terms. However, when the inflation rate of 10.7% is taken into account, it represents a decline of approximately 4.5% in real terms.

Preliminary estimates indicate a substantial increase in the value of production of principal grains from $252m to $420m. This increase mainly results from improved wheat and barley harvests and, as the figure below shows, the proportional contribution of principal grains has increased from 10.7% to 16.4%.

Small increases are also expected from cattle and calves, horticultural crops, wool, and dairying.

However, there has been a dramatic fall in prices on the world sugar market as a result of which the value of sugar-cane produced is expected to decline from $772m to $561m. The proportional contribution of sugar to the gross value of rural production is expected to decline from 31.4% to 21.9%. Unfortunately, the drop in value of sugar production will largely nullify the gains made in other industries.

Weather conditions

Seasonal conditions throughout the State have been variable. Very good summer rainfall was received in the south east area and on the far north coast, and drought conditions were relieved on the Darling Downs and the northern portions of the Maranoa and Warrego districts. However, a general wet season did not eventuate in the remainder of the State, rainfall coming mainly from scattered storms.

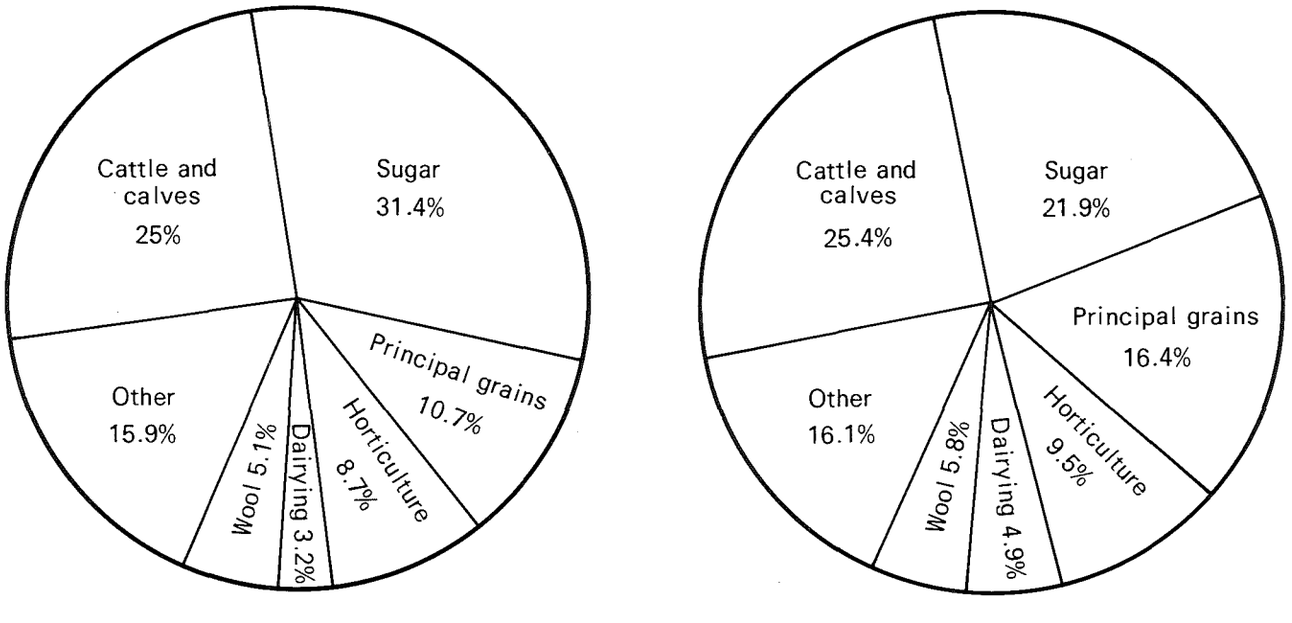
The far south west region remains drought stricken and many other areas, particularly on the central coast, the Central Highlands and in the far west, are once more facing the onset of drought. I am acutely aware of the need to streamline procedures for providing assistance to those in need. Officers of the Department have been examining various aspects of drought administration and are in the process of developing a new approach to drought declaration.

World economic outlook

Queensland agriculture is highly export oriented and is, therefore, particularly vulnerable to adverse international economic influences. Despite the recent announcement of a 1.7% rise in the United States Gross National Product in the June quarter, forward predictions of world economic activity continue to be gloomy. The Bureau of Agricultural Economics in Canberra is forecasting that the real net value of rural production for Australia will be 30% lower in 1982–83 than in 1981–82—based on a projected inflation rate of 9.5%. If this prediction proves accurate, then the value of rural production will be at its lowest level since 1977–78.

Recent trends in rates of exchange between the Australian dollar and the currencies of some of our major trading customers provide grounds for cautious optimism. For example, falling world wheat prices in the first 6 months of 1982 have been offset in Australia by a nominal depreciation of about 10% in the Australian dollar relative to the US dollar since the beginning of the year. However, in the longer term, the interaction between exchange rates, interest rates, and international money movements is a matter of continuing concern.

Investment in agriculture has always depended upon the availability of long-term financial arrangements and the minimizing of market risk. The absence of any clear long-term strategy for currency exchange control both in Australia and overseas, coupled with the upward volatility of interest rates, has intensified the rapid international movement of massive amounts of capital. This type of speculative money movement adds to market uncertainty for internationally traded goods, which tends to inhibit longer term investment in sectors such as agriculture.



(Preliminary as at 21 June, 1982)

Gross value of rural production showing the proportional contribution by industry groups. (Source: Australian Bureau of Statistics).

Domestic interest rates

Continuing upward movements in domestic interest rates are also of major concern to agriculture. Apart from becoming an insurmountable barrier to long-term investment expenditure, current interest rate levels are creating difficulties where urgent carry-on finance is required. The supply of overdraft funds, where some interest rate control is exercised, is severely limited because major lending sources find other outlets for funds more remunerative.

The Commonwealth Government's industry assistance measures announced recently represent a mixed package for Queensland agriculture. The increased taxation depreciation allowances for investment in plant and equipment will assist individual farmers but will be of little direct assistance to most grower controlled marketing organizations in Queensland. These organizations are, however, well placed to take advantage of the expanded Export Market Development Grant Scheme.

On the negative side, the abolition of the Export Expansion Grant scheme will adversely affect a small number of rural industries. Of more general significance, however, is the Commonwealth Government's rejection of proposals to reduce protection measures currently afforded to domestic manufacturing industries. This decision will have an adverse influence on the costs of agricultural production which are expected to rise by some 8% during the coming year.

To date, the various rounds of the General Agreement on Tariffs and Trade (GATT) have failed to come to grips with the proliferation of world wide impediments to trade in agricultural products and with the massive subsidies which are applied to agriculture in Europe, North America and Japan. In the absence of some Commonwealth Government offset, these trade barriers and subsidies are a continuing and severe handicap to the competitiveness of Queensland's efficient agricultural industries. The rural sector in Queensland will watch with a good deal of interest the GATT ministerial meeting in November when plans for multilateral reductions in tariff levels will again be discussed.

Staff structure reorganization

It is clear that, during the next decade, the environment in which primary industries will have to operate will become increasingly complex and competitive and that the Department of Primary Industries must be able to meet the challenges which will arise in a rapidly changing environment. With this in mind, I have recently completed a review and reorganization of the senior staff structure of the Department to ensure that we are ready to meet these challenges efficiently.

I have also taken action to ensure that, within the constraints of Government policy with regard to manpower and budget ceilings, the highest possible numbers of officers are deployed in the field to provide direct advice and assistance to producers. For example, a major committee to inquire into the adequacy of extension, research and regulatory services provided by the Department to western Queensland primary producers has just begun work. Their report will guide the Department on the present needs of western graziers as well as look at the future requirements to the year 2000.

The major expansion of summer and winter grain and oilseed crops throughout the State has shown up the need to foster sound land management systems based on soil conservation practices, particularly in regions such as the Central Highlands where high intensity summer rains create havoc with bare fallow croplands. The Department of Primary Industries is responding to this challenge by employing more specialist field and research staff in soil conservation and agricultural fields.

Research backing

Modern food production is capital intensive and demands a high level of technical expertise if it is to remain competitive. In order to provide appropriate advice and assistance, advisory officers require a substantial backing of high level research and laboratory services if they are to be fully effective. Modern laboratory facilities represent a large capital investment and must, therefore, be centralized for maximum cost effectiveness.

The work of the research divisions of the Queensland Department of Primary Industries is highly regarded and my officers are in heavy demand to provide advisory services, particularly to developing countries. These contacts are valuable, not only in terms of the technical expertise of the Department, but also in terms of the good will which is created and which generates significant possibilities for future exports of Queensland agricultural products.

I believe that my appointment to the Policy Advisory Council and to the Board of Management of the newly formed Australian Centre for International Agricultural Research is a tribute to the professionalism of the Department and demonstrates the respect which its work commands both throughout Australia and in many centres overseas.

Farm mechanics and welding are among the practical subjects in the course at the Longreach Pastoral College. In the picture, student Genene Bates shows visitors, the Premier (Hon. J. Bjelke-Petersen) (left), the Director-General of the DPI (Dr G. I. Alexander) and the Minister for Primary Industries (Hon. Mike Ahern), material shaped on a cutting disc.

Grain storage study

The first steps have been taken to implement the findings of the recent study on the future handling and storage needs of the grain industry. Innovations currently under way as a result of this report include improvements in storage facilities in southern and central Queensland, more efficient methods of moving grain from country storage to ports for export, and improved methods of pest control in the stored grain.

Queensland leads other Australian States with two significant marketing initiatives which should help the beef industry. Consumer acceptance of the new colour strip branding system of identifying tender young meat is already well under way throughout the State. Carcass classification has also begun to prove its worth in export meatworks. Already, some major abattoirs are using the system to streamline their operations and processors are buying and selling cattle which have been classified under carefully researched criteria.

A new fish marketing and management authority will be established in the near future. This organization is designed to give fishermen a say in the restructuring and revitalization of their industry, as well as increasing the viability and financial stability of the fishing industry in Queensland.

Tropical fruit crops

The Department of Primary Industries has also stepped up its research into both established and new tropical fruit crops to satisfy growers who wish to take advantage of the rapidly expanding markets for these products.

I would like once again to thank all those primary producers who have co-operated in field trials during the year. Once again, they have unselfishly permitted my officers access to their facilities and resources. Their contribution to primary industry throughout the State is greatly appreciated.

I also wish to acknowledge the co-operation the Department has received from other Government agencies in Queensland and interstate and from Commonwealth Departments and agencies. The co-operation of universities and other educational institutions is also appreciated as are the contributions of the many organizations and private firms that have provided finance for projects and research activities during the year.

Finally, Sir, I commend to you the staff of the Department of Primary Industries for their work during the year. Many staff members have worked and continue to work long hours without additional financial reward in order to provide essential services to primary producers in our State. Primary producers, both individually and through their various organizations, have made clear to me that their efforts have been widely appreciated.

I therefore take pleasure in presenting to you the Annual Report of the Queensland Department of Primary Industries for 1981–82.

Yours faithfully,

G. I. ALEXANDER,
Director-General.

An overview of Queensland's primary industries in 1981–82

by G. I. Alexander, B.V.Sc., M.S., Ph.D., F.A.C.V.Sc.; Director-General, Queensland Department of Primary Industries

THIS section of my report reviews briefly the weather conditions in Queensland during the year and the financial returns from the principal pastoral, agricultural and horticultural industries. It is followed by accounts of the major achievements and problems in the animal, dairying, fishing and plant industries and in land utilisation.

The technical sections that follow are necessarily restricted in the amount of data that can be presented. Persons seeking greater detail are invited to contact the appropriate Branch of the Department.

Division of Marketing

Weather conditions

Above average winter rainfall was recorded throughout most of Queensland during July 1981, with only the Peninsula South receiving no rainfall at all and the Central Coast East, South Coast Curtis and South Coast Moreton districts receiving slightly less than average. Some widespread heavy frosts were recorded in the southern and central inland and in the Moreton district. In August, above average rainfall was recorded in the Southern Peninsula, Upper Carpentaria, Central Lowlands and Central Coast West. Elsewhere the State recorded below average rainfall.

September was a dry month with only the North Coast Barron and Herbert receiving above average falls. Some districts in the remainder of the State received 25% of average but most were down to less than 10% of average with some districts recording no rain at all. These dry conditions prevailed into October with only the Peninsula South, the North Coast Herbert and the Maranoa recording average to above average rainfall.

During November, there was some relief from the dry conditions, with all districts except the Lower Western recording well above average rainfall. The dry conditions returned during December, however, with all regions except the Northern Peninsula, South Coast Moreton and the Darling Downs receiving below to well below average rainfall. High temperatures were also a significant feature of the month with temperatures being above normal in many districts.

The hot, dry conditions continued into January with only the Peninsula North, Central Lowlands, South Coast Moreton, Darling Downs West, Maranoa, and Warrego districts receiving average to above average rainfall. February was also a hot dry month and no districts recorded above average rainfall.

During March, most central and southern districts received above to well above average rainfall. Elsewhere rainfall was below average and ranged between 10% in the Lower Western district to 35% in the North Coast Barron district.

As at 31 May 1982, the Shires of Paroo, Quilpie, that part of the Booringa Shire south of the Eastern Dingo Barrier Fence and that part of the Murweh Shire south of the Western Railway line were declared drought stricken.

Pastures and fodder crops

In 1981, pastoral areas of Queensland experienced one of the best winter seasons for a number of years. Early spring prospects looked promising. However, little effective rain was received during September and pasture conditions declined in the southern half of the State. Conditions in central western and northern areas, however, were still above average for the time of the year.

During October, pastures continued to decline in most regions because of continuing dry conditions. In November, good rainfall in the eastern half of the State gave this area the best start to a summer season for some time. In western districts, although there were some scattered falls during the last quarter of 1981, by the end of the year relief rain was still needed, particularly in the south west.

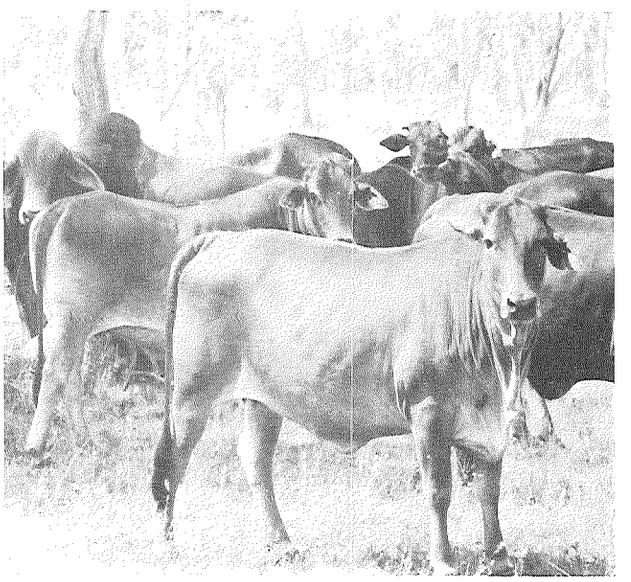
By the end of May 1982, pastoral conditions varied widely throughout the State. In the south east corner where summer conditions were the best for many years, pastures had began to hay off at the onset of the colder weather and declined rapidly in nutritive value. Much of the central and northern regions was very dry and carried only a light to moderate body of feed. Surface water supplies were below a safe level and some drought areas were developing. Parts of the south west and western border regions were already droughted as the result of another summer rainfall failure. These dry and drought areas face poor winter-spring prospects.

Because of the present reduced profitability of the beef market, the production of forage crops has declined and this situation is expected to be reflected in reduced plantings of winter oats for grazing.

Beef

Queensland's beef cattle herd at 31 March 1982, estimated at 9.552 million head, was marginally down on the 9.561m head recorded a year earlier.

The gross value of cattle and calves slaughtered in Queensland during 1981–82 is estimated at $591.5m, an increase of 1.9% on the preliminary level of $580.6m in 1980–81 but 27.9% below the level of $820.4m for 1979–80.



High grade Sahiwal cows at 'Swan's Lagoon' Research Station in north Queensland. The State's beef herd stands at 9.5m head and slaughterings last year returned $591.5m.

The number of cattle and calves slaughtered in Australia decreased from 8.89m in 1979–80 to 8.43m in 1980–81. Beef and veal production decreased from 1 564 335 tonnes in 1979–80 to 1 465 858 t in 1980–81. Beef and veal exports decreased from 580 346 t in 1979–80 to 518 396 t net shipped weight in 1980–81.

The number of cattle and calves slaughtered in Queensland decreased from 2.61m head in 1979–80 to 2.15m in 1980–81. Production of beef and veal decreased from 515 733 t in 1979–80 to 434 041 t in 1980–81. Exports of beef and veal decreased from 266 276 t net shipped weight in 1979–80 to 210 800 t in 1980–81.

The fat cattle market weakened further as values for most descriptions eased. The weakening trend, which persisted for most of 1981, continued into 1982 before a slight improvement occurred in prices in April following widespread rain. The store cattle market remained strong with values buoyant relative to fat cattle values.

At Cannon Hill, the price for cows, (321 to 480 kg) score 3, fell from an average of 55c per kg liveweight in July 1981 to 52c by the end of the calendar year. A similar trend was evident for bullocks, (561–640 kg) score 4, with the average market price falling from 72c per kg to 64c per kg over the same period. The decline in prices continued into 1982 with the average price for cows down to 47c per kg in February before recovering to 50c per kg by the end of April while bullock prices eased to 61c per kg in February before improving to 64c per kg in April.

The lower prices recorded for all descriptions of both trade and export cattle were a result of generally larger yardings as well as the continued depressed export market, particularly the United States. The USA market remained weak throughout 1981 because of subdued economic activity, high interest rates, increased supplies of domestic cow beef and strong competition from pork and poultry products.

Following allegations concerning meat substitution, the Federal Government announced a Royal Commission into the Australian meat industry. The Royal Commission has been investigating the administrative arrangements and procedures involved in the handling of meat for export and malpractices alleged to have occurred in the exportation of meat and in the Victorian domestic meat market. The Commission is required to present its final report before 1 September 1982.

Japan reduced its global beef import quota for the second half of the 1981–82 financial year to 58 000 t, a decline of 4 000 t on the corresponding period last year. This, together with the first half year quota of 68 000 t, which was also down by 4 000 t, puts the total global quota for 1981–82 at 126 800 t compared with the 1980–81 quota of 134 800 t.

The USA did not impose meat import quotas for the 1981 calendar year following the slump in the level of meat entering that country. The level of meat imports into the United States for 1981 estimated at 560 000 t was well below the trigger level of 656 000 t. This level is well down on the 704 800 t and 645 000 t imported in 1979 and 1980 respectively. Australian exports of beef and veal to the United States for 1981 were estimatd at 260 000 t compared with 359 000 t in 1980 and 396 000 t in 1979.

A voluntary system of colour branding of meat was agreed to by the Australian Meat and Livestock Corporation and the Queensland Meat Industry Organization and Marketing Authority. The system based on colour ribbon branding of beef, lamb and hogget carcasses will be supervised by meat inspectors. It will identify for the consumer the carcass characteristics and any treatments, such as electric stimulation or tenderstretching, which may have been given.

The Sydney Futures Exchange established Queensland's first live cattle delivery centre at Miles with deliveries beginning from October 1981. A 5c per kg location discount applied on deliveries made to Miles up to June 1982 to compensate those contracts for trade steers entered into for delivery before the announcement that Miles had been designated as a delivery centre.

The Exchange also established an export bullock contract which will benefit Queensland producers. Trading commenced on 17 May 1982. The contract is of 10 000 kg liveweight (tolerance 9 500 to 10 500 kg) of 20 bullocks weighing 500 kg each (tolerance 460 to 540 kg) of a condition score of 4 and a dressing percentage of 55. Delivery points are Cannon Hill, Homebush and Newmarket.

The Federal Government announced in February that it had removed controls on the export of meat and bone meal. Meat and bone meal had been maintained on the Third Schedule of the Commonwealth Customs (Prohibited Exports) Regulations to ensure adequate domestic supplies of meat and bone meal. It was considered that the continuation of the controls was unwarranted in view of the adequate supply situation in regard to all meals, including meat and bone meal. Queensland does not agree with this policy.

The Australian Meat and Livestock Corporation is seeking to amend its Act to give it the power to act as a sole trader on the export market or to restrict the number of export licences where there is a single buyer. The intent of the powers is to ensure that the Australian industry, at producer and export levels, does not sustain financial losses. Only organizations of integrity, competence and sound financial standing will be able to obtain export licences.

Wool

The minimum reserve price of the Market Indicator for the 1981–82 season was set at 410c per kg clean, an increase of 45c on the average floor price for 1980–81. The first half of the selling season closed with the market indicator at 422c, 5c below the opening quote of 427c but 4c above the low of 418c recorded in late October. The sluggish world economy and substantial currency revaluation kept demand for Australian wool depressed for the first half of the season.

However, the second half of the season saw a dramatic improvement in the market. From 423c per kg clean for the first sale in 1982, prices increased to a record 446c by mid March before easing slightly to reach 443c in mid May. The buoyant market can be attributed largely to a deferment of purchasing from the first half of the season when commercial stocks were allowed to run down to low levels as well as to an improvement in orders from Japan and Europe in expectation of better economic conditions.

The Australian Wool Production Forecasting Committee estimated that Australian shorn wool production for 1981–82 would decrease by 0.6% to 533.8m kg, while production of dead and fellmongered wool and wool exported on skins would decrease by 8.5% to 57.2m kg.

The Australian Bureau of Statistics reported that Queensland's wool production in 1980–81, at 46.5m kg, was about 20% below the previous year's production of 59.0m kg. Queensland's wool production in 1980–81 realized an estimated gross value of $117.0m, a decrease of 15.5% on the gross value of production from the previous season. Preliminary estimates indicate a value of $135.5m for all wool produced in Queensland in 1981–82.

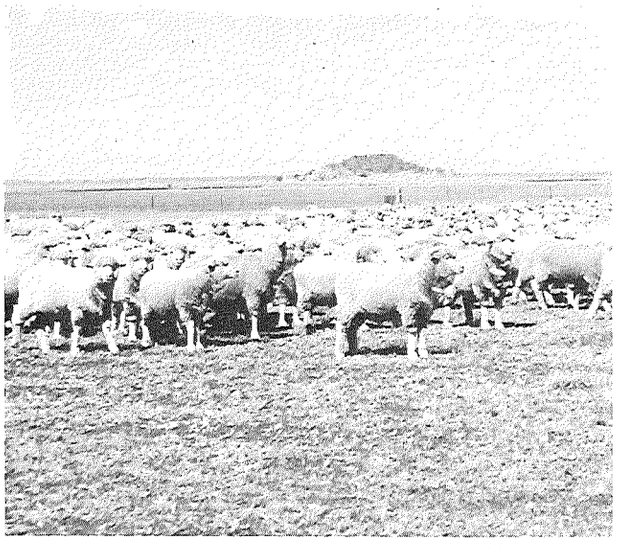
A total of 229 434 bales of wool valued at $102.6m was sold at the nine auctions held by Brisbane wool brokers during 1980–81 compared with 290 025 bales valued at $116.0m in the previous year. The average price obtained was a new record of 264.26c per kg greasy compared with 239.06c in 1979–80. The previous record was 260.83c during the 1950–51 wool boom.

The number of sheep and lambs shorn in Queensland during 1980–81 was 10.633m, 11.6% below the 12.027m head shorn in the previous year. The average fleece weight was 4.07 kg, compared with 4.58 kg in the previous year.

Strong demand at auction resulted in the Australian Wool Corporation continuing as a net seller of wool during 1980–81. Stocks held by the Corporation at the end of the season totalled 188 318 bales compared with the 208 491 bales in store at the end of the 1979–80 season. Purchases by the Corporation during the year totalled 185 002 bales or 5.0% of the total offering compared with 224 178 bales (6.3%) during 1979–80.

The weakened demand in the first half of the 1981–82 selling season led to the Australian Wool Corporation purchasing 342 453 bales or 17.6% of the total offering at wool auctions. For the same period in the 1980–81 season, the Corporation purchased only 3.3% of the offering. As a result of the buoyant market, corporation purchases in the second half of the 1981–82 season fell to about 10% of the total offering to mid May.

Following a recommendation of the Ministerial Committee of Review of Commonwealth Functions, plans for the transfer of the Australian Wool Testing Authority to a new private testing company were finalized. Although the new membership represents all sectors of the wool industry, the Australian Wool Corporation and the Wool Council of Australia control 51% of the new company. The new company, which should commence operation on 1 July 1982, will own the existing wool testing assets and undertake the testing of wool.



Wool prices reached a record 446c per kg in March before easing slightly to 443c in mid May. Preliminary estimates suggest a return of $135.5m for Queensland's wool clip in 1981–82.

Sheep

Preliminary figures released by the Australian Bureau of Statistics showed that the number of sheep and lambs in Queensland at 31 March 1982 increased by 15.4% to an estimated 12.253m head compared with 10.62m in the previous year.

The number of sheep and lambs slaughtered in Australia increased by 4.7% from 30.54m head in 1979–80 to 31.97m in 1980–81. Mutton and lamb production increased by 5.5% from 548 498 t in 1979–80 to 578 632 t in 1980–81.

The number of sheep and lambs slaughtered in Queensland decreased by 3.6% from 1.38m head in 1979–80 to 1.33m head in 1980–81. Production of mutton and lamb in Queensland fell 1.9% from 23 796 t in 1979–80 to 23 341 t in 1980–81.

Following a strong market at the commencement of the season, lamb prices began their annual price slide before recovering in January when numbers started to ease. Average monthly values for lambs, (16 to 19 kg) score 4, fell from 160c per kg in July to 114c by December before recovering to close at 146c per kg at the end of April.

A mission comprising representatives of trade unions, exporters and sheep producers undertook a study of Middle East sheep meat markets in March 1982 with the purpose of establishing the demand for sheep meat in both live and carcass form. Recommendations of the mission include that sales efforts be backed up by a special market development and promotion programme; consultation between the Government and industry on the establishment of funding arrangements including a Commonwealth financial contribution; and that Middle East officials and consumers be assured of the reliability of Australian Muslim slaughter procedures. The mission considered that general mistrust of the religious reliability of imported meat is impeding the expansion of sheep meat sales.

Pigs

The number of pigs slaughtered in Australia increased from 3.9m in 1979–80 to 4.2m in 1980–81. Pig meat production also increased from 219 565 t in 1979–80 to 234 131 t in 1980–81.

The number of pigs slaughtered in Queensland increased from 813 200 in 1979–80 to 838 000 in 1980–81, while pig meat production increased from 50 322 t in 1979–80 to 50 575 t in 1980–81.

An upward movement in pig values, plus adequate feed supplies at relatively stable prices, restored producer confidence within the industry. In response to the improved situation, some herd rebuilding and expansion have been evident. The market is expected to remain strong due to a general shortage of pigs and strong consumer demand.

The official opening and first auction sale of pigs by description in Queensland were conducted on 3 September 1981 by the Queensland Pork Producers' Organization and Dalgety-Winchcombe. In the period to the end of April, more than 24 500 pigs were catalogued for sale by description. Numbers varied from 500 to 1 200 pigs per week, with the monthly average price ranging from 197c to 209c per kg for pigs 40.5 to 50 kg dressed weight with 9 to 15 mm backfat, and from 178c to 205c per kg for pigs 60.5 to 80 kg dressed weight with 12 to 21 mm backfat.

Poultry meat

Chicken slaughterings in Queensland during 1980–81 decreased by 3.5% on 1979–80 figures to 32.4m. Queensland chicken slaughterings represented 14.6% of total Australian slaughterings in 1980–81. Total Australian poultry slaughterings decreased by 0.5% in 1980–81 to 221.5m compared with 222.5m in 1979–80.

Chicken meat production in Queensland decreased by 5.9% to 41 630 t in 1980–81 compared with 44 242 t in 1979–80. Total Australian chicken meat production decreased by 2.1% from 281 898 t in 1979–80 to 275 917 t in 1980–81.

Continued high prices for red meats in the 1980–81 season resulted in increased consumption of poultry meats. Per capita consumption increased from 20.3 kg during 1979–80 to 20.9 kg in 1980–81 for Australia as a whole.

At the February 1982 meeting of the Australian Agricultural Council, a Working Party comprising representatives of each State Department of Primary Industries or Agriculture was established to examine chicken meat industry legislation and to report on legislative amendments and their implication to the August 1982 meeting of Standing Committee on Agriculture.

Dairying

Queensland wholemilk production increased by about 8% on the previous year's production. This increase has resulted in a 12% increase in butter production over last year. Cheese production was up by 20%.

Sales of the more profitable market milk which includes pasteurized low-fat, modified, flavoured and long-life milk increased by 4.6% to 319 ML.

The Butter Marketing Board continued to obtain supplies of butter from Victoria for its domestic market shortfall and for exports of butterfat. In addition, southern dairy manufacturers have continued to penetrate the Queensland market and their share of the market is estimated at 20% of all pat butter sold in Queensland.

Total butter consumption in Queensland has stabilized at about 8 000 t a year.

During the year, the Milk Entitlements Committee continued its programme of redistributing market milk excess among processors, and hence producers, in south east Queensland.

Stage 2 of this programme began on 1 October 1980. An amount of $800,000 of Government funds was allocated (in addition to carry-over funds of $275,064.50) to enable the purchase and distribution of a further 20 000 L of 'drop-out' milk. At 1 May 1981, 11 978.25 L of 'drop-out' milk had been distributed to eligible processors.

Assessing choice Cooloola cheese developed at the Otto Madsen Dairy Research Laboratory in Brisbane. Queensland's cheese production rose by 20% in 1981–82.

Fisheries

Changes occurred in the operations of the Queensland Fish Board during 1981–82. The depressed nature of the industry and the continuing breakdown in the orderly marketing system have led the Board to embark on a major rationalization programme.

The Board has withdrawn from processing and retailing and has curtailed operations in its service division. The State-wide marketing network has been reduced from 22 depots to 10 and the major emphasis has been placed on trading in fresh product for the local market.

The Government agreed to a re-organization of the Board's financial structure. The transfer of responsibility for the management of the Board's land holdings and fixed assets and associated debt servicing to the Department of Primary Industries has left the Board free to concentrate on its commercial role in the market place.

The passage of the *Fishing Industry Organisation and Marketing Act* has complemented the Board's rationalization programme as the new legislation requires the Board to take a commercial stance in the seafood industry. The Board will no longer be involved in regulatory functions.

As a direct result of the rationalization of Board activities, Queensland fishermen have moved to form local co-operatives to market their catch. Advice and assistance in the formation of these co-operatives have been provided by officers of the Division of Marketing. By the end of 1981–82, 12 local co-operatives had been formed and many had commenced operations in depots previously operated by the Board.

The marketing sector of the industry continued to face difficulties during the year as a consequence of strong competition from cheap imports.

Egg industry

Egg production in Queensland in 1981–82 is estimated at 4.3% above that for 1980–81. Egg sales by The South Queensland Egg Marketing Board are estimated to be 6.0% above those for 1980–81. Sales by The Central Queensland Egg Marketing Board are estimated to be 7.4% above those for 1980–81. The substantial sales increases achieved in Queensland markets this year can be attributed to increased marketing efficiency and improved promotional campaigns by the marketing boards.

The egg industry stabilization scheme continues to have an important influence on the outlook of the industry, with a continuation of improvement in returns to growers.

A seasonal quota reduction applied during the period August 1981 to January 1982. Quotas were reduced by the Hen Quota Committee by about 15% in both south and central Queensland. Quota reductions in south east Queensland were staggered to reduce peaking of demand for hatchery and abattoir facilities. Those in central Queensland were introduced as two separate cuts of 7% each.

A controlled transfer of quota scheme has continued to operate. This gives producers the ability to dispose of their quotas to the Committee separately from the land and enables certain smaller producers to increase their quotas to more economic levels. Since the inception of this scheme, some 46 341 quota hens have been re-allocated to smaller producers as a result of the surrender mechanism.

Wheat

In 1981–82, Queensland produced an estimated 1 400 000 t of wheat from a planting of some 911 000 hectares. This was only second to the record crop of 1 962 235 t in 1978–79.

The distribution of receivals at State Wheat Board depots by grades in 1981–82 (with 1980–81 figures shown for comparison) was as follows:—

Proportional receivals by State Wheat Board

Classification	Percentage	
	1980–81	1981–82
Prime Hard	23.4	42.8
No. 1 Hard	25.0	11.3
Australian Standard White	13.2	14.4
No. 2 Hard	21.4	12.4
General purpose	13.8	17.8
Seed	3.2	1.3
	100.0	100.0

The export market for Australian wheat remained strong throughout the season. However, because of a large carry-over of grain stocks in the USA and good growing conditions for Northern Hemisphere winter crops, world wheat prices have remained depressed. The Australian Wheat Board's asking price for Australian Standard White wheat opened at a low of $135.65 per t on 1 July 1981 and rose to a high of $154.50 per t in February 1982. For most of the year the price ranged between $145 and $150 per t.

Exports of Australian wheat during the 1981–82 season are expected to reach 15m tonnes compared with 9.45m tonnes in 1980–81. Currently shipping delays are resulting in failure to meet monthly shipping schedules. This is expected to result in a higher carry-over of wheat at the beginning of the 1982–83 season than was originally expected.

Growers' returns from the 1981–82 crop are expected to be lower than the previous season's estimate of $120 per t, port basis. In fact, given the current world wheat price, the guaranteed minimum delivery price first advance payment may be the final advance for the 1981–82 crop.

Barley

The 1981–82 barley season was characterized by ideal growing conditions although wet weather delayed harvesting in many areas. Eventual production was 390 000 t compared with the drought affected 1980–81 crop of 170 000 t. Average yields in 1981–82 were 1.81 t per ha compared with 1.06 t per ha in the previous season.

Receivals by The Barley Marketing Board totalled 320 000 t compared with 95 000 t in 1980–81. Approximately 245 000 t were exported, principally to Saudi Arabia and Japan. Saudi Arabia has now developed as a major and consistent market for Queensland barley as the result of the marketing efforts of The Barley Marketing Board.

A first advance payment of $92.50 net per t was paid on all deliveries to the Board. In addition, the Board operated a discounted cash payment scheme whereby growers could elect to receive a cash payment upon delivery in lieu of the normal pool payments spread over 15 months. The cash payment is a discounted version of the pool payments system. Approximately 42% of all Board deliveries were made for cash payment, with payments ranging from $101 net per t for feed grade to $113.27 net per t for malting grade.

The high response rate to the cash payment scheme is a clear indication of the growers' desire for early payment systems.

Grain sorghum

Grain sorghum production in 1981–82 is estimated at 1 160 000 t, a 10% increase over last year's output. Most areas experienced favourable growing conditions with the exception of a dry pre-harvest period in central Queensland. Yields were slightly up on those of last season, with a State average yield of 2.09 t per ha compared with 1.99 t per ha in 1980–81.

On a regional basis, central Queensland production including the Upper Burnett is estimated to total 415 000 t with an estimated south Queensland production of 745 000 t.

It is expected that most of the grain sorghum production, particularly from central Queensland, will be exported. Japan remains the principal export market for this grain.

Maize

Maize production in 1981–82 is expected to reach 157 000 t, an increase of 27% over 1980–81. Growing conditions have generally been above average in most growing areas.

On a regional basis, production in the principal growing area, the South Burnett, is expected to be 51 600 t with 21 700 t from the Atherton Tableland and 83 700 t from other areas.

Rice

The rice industry had a mixed year in 1981–82, with higher production being offset by dimmer market prospects. Production in 1981–82 should be around 23 000 t, compared with last year's level of 21 588 t.

The rice cropping year is divided into two seasons: the summer harvest crop and the winter harvest crop. The 1981–82 summer harvest produced 13 941 t compared with 14 613 t in 1980–81. A smaller planting in the Burdekin district and disappointing yields in the Mareeba district were responsible for the lower production. However, good yields for the winter crop are expected to produce some 9 000 t, well above last year's rain affected harvest of 6 727 t.

Market prospects for rice have been dampened by the depressed state of the world rice market. About 85% of Queensland's rice is sold domestically, giving the industry some insulation from world market fluctuations. However, the domestic market itself is not totally isolated from the world market and low-priced imports, and increased domestic marketing activity by southern rice producers have had an adverse effect on domestic market returns. Consequently, grower returns for both crops in 1981–82 will be below those of 1980–81.

The Queensland rice quota for the 1982 season remains unchanged at 30 000 t.

Oilseeds

Production of the two principal oilseed crops, sunflower and soybean, is expected to be 81 500 and 47 000 t respectively in 1981–82.

Sunflower production is expected to be down almost 21% on 1980–81 with most of the crop planted late due to the lack of planting rains in some districts and excessive pre-planting rains in other areas. Market prospects for sunflower remain depressed, principally because of the low prices being offered by oil and meal users which, in turn, relates to the level of stocks being held by the users.

Soybean production is estimated at being 11% down on 1980–81 with plantings also delayed due to moisture conditions. As with sunflower, the soybean market is depressed due to high levels of stockholdings, particularly meal.

Returns to growers are estimated to be around $200 to $215 per t on farm for these oilseed crops.

The 1981–82 safflower crop totalled 9 000 t, while linseed, which is now only a minor crop, totalled 1 200 t.

The 1981–82 statistics for oilseed production are shown below:

Crop	Area (ha)	Production (t)	Yield (t/ha)
Sunflower	112 000	81 500	0.7
Soybean	23 500	47 000	2.0
Safflower	14 000	9 000	0.6
Linseed	1 500	1 200	0.8

Sugar

Despite delays in crushing during the early part of the 1981 season, the Queensland sugar industry produced another record harvest in 1981. The weather also had an adverse impact on harvesting and in some areas led to cane being stood over.

A total of 23.59m t of cane was crushed in Queensland during 1981 which represented a 4.7% increase over the record crop of 1980. The crush yielded 3.25m t of 94 n t sugar, an increase of 1.3% over the 1977 record and 100 770 t more than in 1980.

Queensland's average c.c.s. was down 0.11 unit to 13.59, reflecting the crushing delays through industrial disputes and adverse weather.

The 1981 productivity values were 78.19 t of cane and 10.77 t 94 n t sugar per ha compared with the 1980 results of 82.17 t of cane and 11.47 t of 94 n t sugar per ha.

Total cane harvested in Australia reached 25.15 t in 1981 which produced a record 3.425 t of 94 n t sugar.

Despite these record results, the severe downturn in world sugar prices due to a rapidly increasing sugar surplus is expected to result in significant downward movements in total industry returns.

Peanuts

The area sown to peanuts in Queensland for the 1982 season has been estimated at 32 500 ha, about 21% up on the 26 773 ha grown in the previous season but still below the industry's record planting of 36 601 ha in 1979.

Excessive soil moisture caused some problems in a number of areas but growers were generally successful in overcoming these and above average yields are expected for the season. Overall, the Queensland peanut crop has experienced a favourable season and total output should be around 56 000 t, nut-in-shell basis. If achieved, this will represent an increase of 32% on the 1981 performance, but still below the record 61 464 t grown in 1979.

Although The Peanut Marketing Board remains the major sheller of peanuts in Queensland, increasing quantities appear to have been diverted to the private shelling organizations operating in the South Burnett area and on the Atherton Tableland. From the 1981 season, the Board received approximately 32 000 t of nut-in-shell, or 75% of the 42 386 t crop.

The 1981 marketing year was a favourable one for Queensland peanut growers as world prices reached what could only be described as astronomically high levels following a disastrous 1980 crop in the USA. The Peanut Marketing Board was able to capitalize on this situation and growers received an average total payment of 70c per kg for their 1981 deliveries.

The marketing situation has since changed dramatically, with world prices returning to pre-boom levels. Suppliers to the Board will be paid a first advance of 40c per kg in 1982 but the total payment is likely to be well below the 1981 achievement.

Navy beans

The area planted to navy beans for the 1981 season of 3 478 ha was the smallest area planted since 1975 (3 349 ha) and 14% down on the previous year's plantings. Higher gross margins and favourable seasonal conditions for the alternative crops were the main reasons.

The average yield was 589 kg per ha, well up on the yield of 337 kg in the previous year. The total production for 1981 was 2 050 t estimated cleaned weight, which is well below the Australian domestic requirement of 6 000 t a year.

So far, The Navy Bean Marketing Board has paid 50c per kg on the 1981 crop and expects to pay a third and final advance of 8c per kg early in the 1982–83 financial year.

Plantings for the 1982 season are estimated at 6 300 ha. Seasonal conditions have favoured the crop and, by the end of June 1982, a total of 4 500 t, estimated clearance weight, had been delivered. The Board is hopeful of a total intake of 6 000 t. A first advance of 45c per kg is being paid on the 1982 crop.

Direct drilling of crops is of increasing interest as a surface management system in areas prone to soil erosion. The picture shows a crop of barley direct drilled into sorghum stubble at Jondaryan. The 1981–82 barley crop yielded 390 000 t.

Cotton

Cotton production in Queensland continues to increase in line with the expansion of cotton plantings of recent years. For the 1981–82 season, the area planted to cotton in Queensland increased to 29 687 ha from 23 850 ha in 1980–81. The latest estimate by The Cotton Marketing Board puts production of ginned lint cotton in Queensland for the 1981–82 season at a record of 110 000 bales, nearly 13 500 bales more than the previous record of 96 511 bales in 1980–81.

There was some deterioration in prospects for the Emerald irrigation area, but this was compensated by an upward revision in output for the Darling Downs. Insects also constituted major problems at Emerald, and the crop was affected by unfavourable weather conditions in the major cotton producing areas of southern Queensland. In the St. George district, severe flooding caused setbacks in yields of cotton per ha and hail on the Darling Downs reduced yield prospects in several areas. However, good weather conditions late in the season, combined with a successful insect control programme, increased cotton production on the Darling Downs for the second consecutive season.

Cotton production prospects for the 1982–83 season are for another record crop, possibly reaching 130 000 bales.

In Queensland, the total volume of cotton available for export this season is estimated at 92 000 bales or some 13 500 bales more than the record 1980–81 level. Exports of Queensland cotton have been affected by uncertainties about prospective textile demand, and buying interest has been extremely quiet. However, nearly three-quarters of the crop has been contracted forward by the end of June, with Japan taking more than 50% of the total exports.

The gross value of the 92 000 bales available for export this season is expected to reach $30m, about the same as in 1980–81. Despite the increased volume, the value of exports this season had declined because of depressed cotton prices.

The Cotton Marketing Board's quota of cotton for sale on the Australian market for the 1982–83 marketing year remains unchanged at 18 000 bales. The gross value of these domestic sales is estimated at $6.0m, bringing the value of the season's expected production of 110 000 bales of cotton in Queensland to an estimated $36m, compared with $38m in 1980–81.

In addition, gross proceeds from the sale of oil mill products are expected to realize around $4m. Thus, the gross value of the 1981–82 cotton crop is likely to reach $40m.

Ginger

Ginger production in 1981 was 7 834 t from an area of 228 ha. This represents an increase of almost 20% on the previous season's production of 6 540 t from 230 ha.

The 1982 crop is expected to yield about 6 410 t from a planted area of 172 ha. The early harvest intake for the 1982 crop amounted to 1 701 t, down significantly from the record intake of 3 935 t of the previous season. Adverse weather conditions experienced during the growing period affected intake and quality of the early crop.

Fruit and vegetables

The estimated gross value of horticultural crops in 1981–82 is set at $230.7m, an increase of about 4% on the value for the previous season. On the Brisbane Wholesale Market, the State's main terminal market, prices for most fruit and vegetable products have maintained levels similar to those of the previous season.

Queensland apple and pear production has been estimated at 2m and 241 500 boxes respectively and compares with the previous season's production of 1.9m and 227 000 boxes. Total Australian apple exports during 1981 amounted to 2.9m boxes, of which Queensland contributed 36 155 boxes.

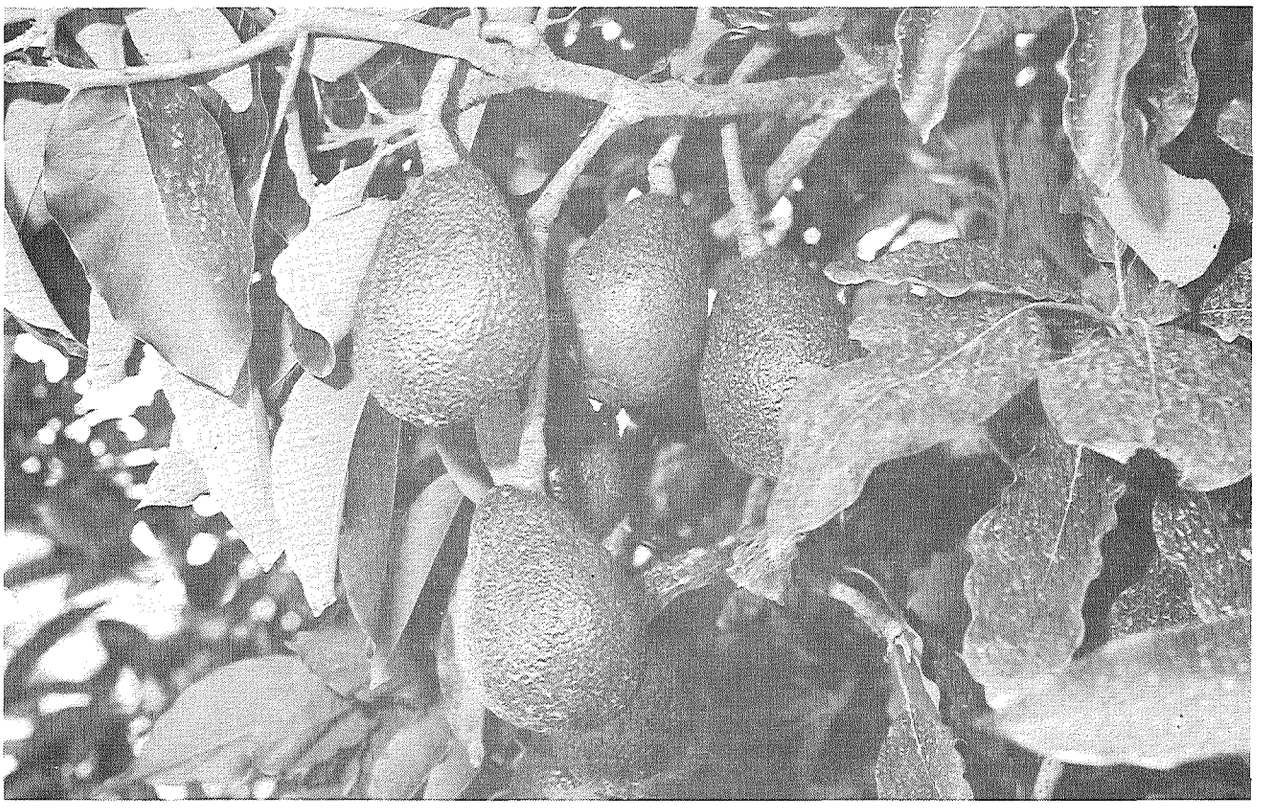
The Processed Apple and Pear Committee, which comprises processor and grower representatives, has established recommended minimum prices to be paid for apples and pears for processing during the 1982 season. The prices are—

At factory gate within 48 km of mainland capital city

Juice apples	$90.75 per t
Juice pears	$75.35 per t
A grade canning apples	$110.00 per t
B grade canning apples	$98.10 per t

Other major fruit products are expected to result in values of production similar to the levels of the previous season. For bananas, value of production is set at $25.4m while, for pineapples and citrus, values of production have been estimated at $18.3m and $14.8m respectively.

The results of a review of importation requirements for oranges by Japanese authorities will enable Queensland exporters to have access to this market in future. In the past, imports of oranges from Australia have been banned because of the risk of infestation by the various species of fruit fly.



The avocado is among the most rapidly expanding fruit crops in Queensland. The State's horticultural crops realized $230.7m in 1981–82, an increase of about 4% on the previous year's return.

Queensland's exports of citrus in the 1981 season were 10 600 t, accounting for about 30% of the total Australian citrus exports and earning in the vicinity of $3.75m for the Queensland industry. The main destinations of Queensland citrus are Canada, Middle East, Europe and Asia.

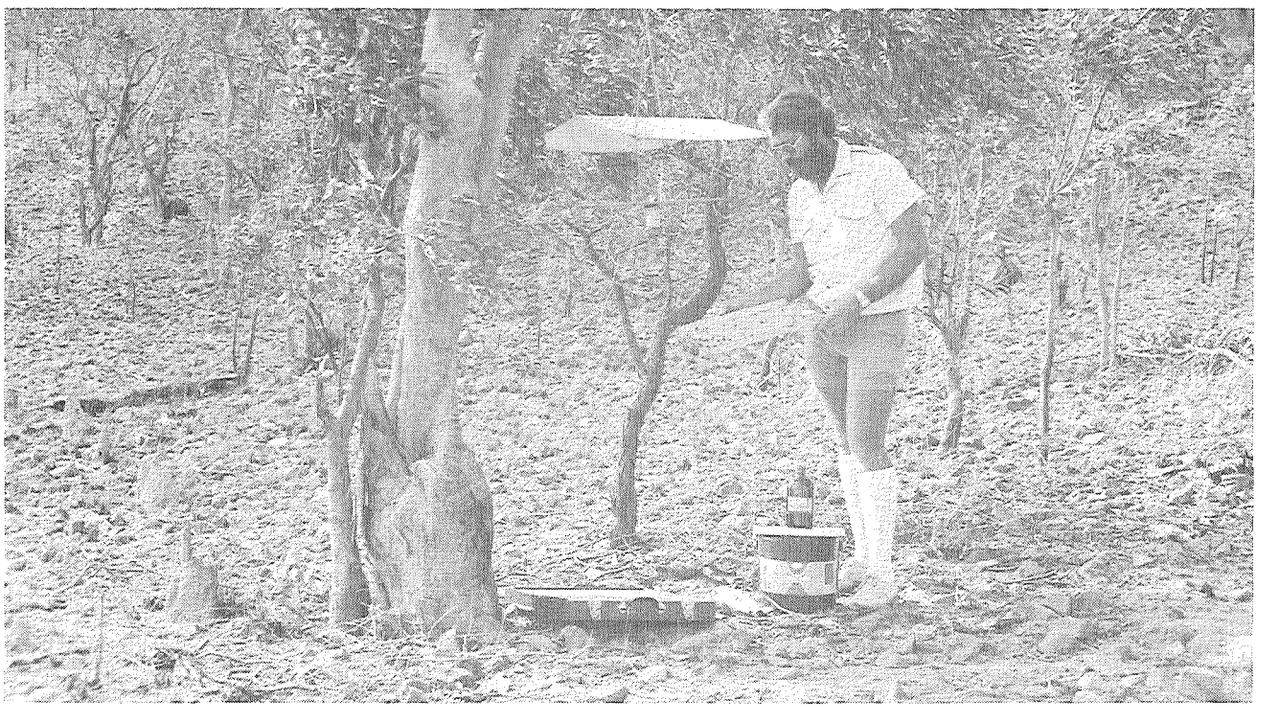
The rising level of canned pineapple imports continues to be a source of concern to the local industry. From fewer than 400 L in 1976–77, imports reached 1 281 906 L in 1980–81. Significant quantities of canned pineapple are continuing to be imported this financial year, with imports in the 8 months ended February 1982 amounting to 1 193 673 L. This represents an increase of more than 21% on the quantities imported in the corresponding period of the previous year.

The Department presented a submission to the Industries Assistance Commission inquiry on future assistance needs of the Australian canning fruit industry. The submission provided an outline of the pineapple industry in Queensland, and commentary and requests in relation to the import situation. Final recommendations by the IAC will be forwarded to the Commonwealth Government in August 1982.

The value of Queensland's potato production is expected to amount to about $31m, 12% above the level of the 1980–81 season. Much of the increase is attributed to increased output, since average price levels have remained similar to those of the previous year.

Higher prices for tomatoes in the first half of the 1981–82 year are expected to result in a crop value of about $40m, significantly more than the $28m crop of the previous season.

On the Brisbane Wholesale Market prices for other vegetable products generally maintained levels similar to those of the previous year.



The DPI is vigilant in its attempts to keep exotic pests and diseases of both animals and plants out of Australia. This officer is monitoring for the presence of screw-worm flies in the Torres Strait. The flies are present in Papua New Guinea and pose a threat of entry into this country.

Tobacco

Sales of tobacco leaf during the 1981 Queensland selling season amounted to 7 894 979 kg of leaf at an average price of 427c per kg and a gross value of $33.7m. A similar quantity was sold in 1980 at an average price of 388c per kg for a gross value of $30.7m.

For the 1982 selling season, the Australian marketing quota has been set at 15m kg, compared with 14.9 m kg for 1981. Queensland's share of the 1982 quota is 8.1m kg which represents a rise of 0.7% on the previous year's quota. The level of the average reserve price for 1982 has been set at 444c per kg which is a rise of 3.5% on the average reserve price for 1981.

Both the quota level and the price movement are reviewed each year, the quota level in accordance with movements in consumption and manufacturers' stock holdings, while the price movement takes into account market conditions and changes in growers' costs of production.

The operation of the Tobacco Industry Stabilization Plan is currently under review by the Industries Assistance Commission. The review covers all aspects of the level and type of protection afforded the Australian industry and, in particular, the methods of setting quota and price. The Commission is due to present its final recommendations to the Commonwealth Government by September 1982.

Division of Animal Industry

Pastoral industries

Most parts of the State enjoyed good winter rain in 1981 easing the drought conditions in many areas. A few areas were still affected by drought through to summer. Rainfall during summer was patchy. Some areas therefore faced a winter with very little feed. Elsewhere, however, rainfall was reasonable with an exceptionally good season in the south east. The far south west area centred on Cunnamulla received no effective summer rain and remained drought stricken.

Prices for beef cattle declined slowly during the last half of 1981 and remained low but static in the first half of 1982. Store prices were high, relative to prices for slaughter cattle. A very good season in southern Queensland and northern New South Wales 'forced' fatteners to keep buying stores. None of the major store sales was based on liveweight selling and, where this was attempted, the prices paid for stores were noticeably lower than at 'per head' auctions. This may have been part of the explanation for the differential between store and fat prices.

A beef carcass classification trial at Mackay led to a price schedule based on classification and was a major breakthrough in this field.

Water was introduced into selling pens of five major saleyards. This came about partly as a result of the activity of animal welfare groups but more because of the research carried out by Beef Cattle Husbandry Branch.

This research demonstrated the ineffectiveness of the dry curfew, which meat buyers had insisted upon as an essential adjunct to liveweight selling. Without exception, saleyard superintendents reported that cattle did, in fact, drink water while in the pens and did not normally foul the troughs. Some commented that cattle were quieter and easier to handle as a result.

Despite general concern at low prices, cattle property development continued in many areas. In north Queensland, one company began a large scale pasture improvement operation involving sowing perennial stylos. In the Collinsville area, it was estimated that more than 30 000 ha were being cleared of timber. Much of this development was by new owners.

On 2 March 1982, the first consignment of 45 cattle arrived in Queensland from the offshore Cocos Island Animal Quarantine Station. Fifty-six cattle had been imported from Canada and the United States of America and were required to spend 90 days in quarantine at Cocos Island before shipment to Australia. Their arrival created considerable public interest.

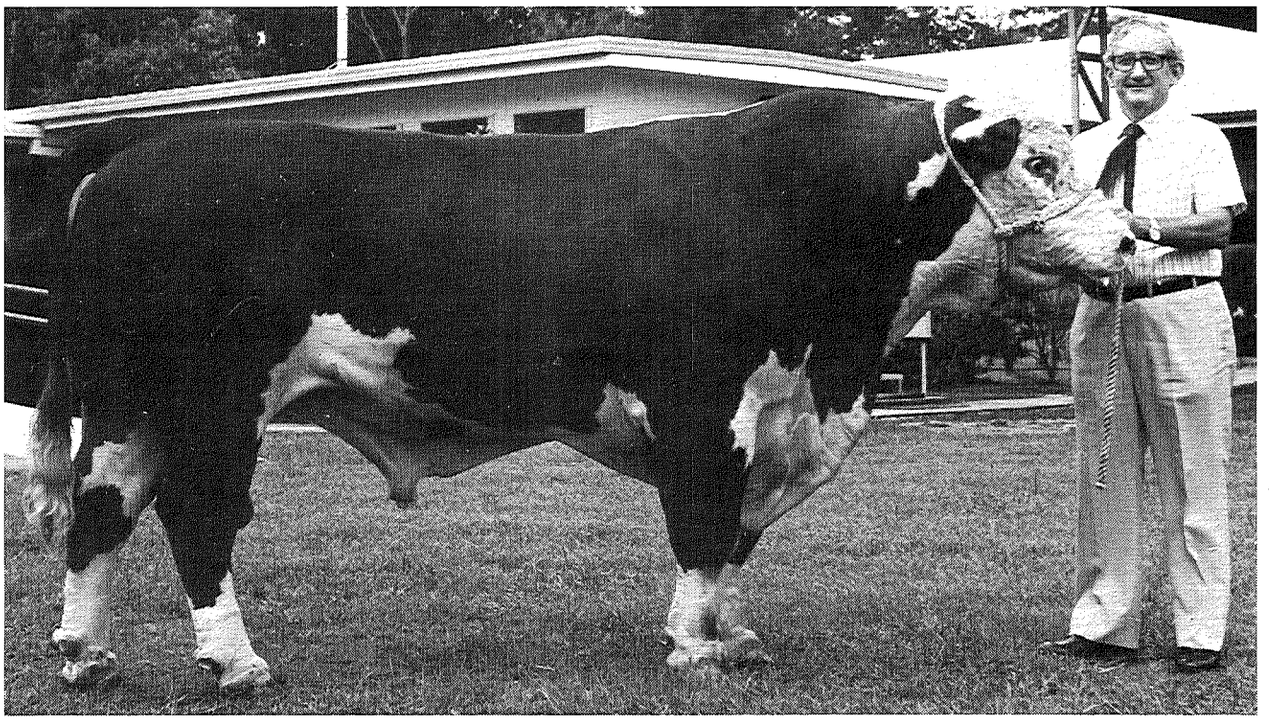
Live cattle exports continued to increase with Indonesia being the largest importer of breeding cattle. Other importing countries were the Philippines, Malaysia, Korea, Japan and Papua New Guinea. An additional 17 152 cattle, a 53.3% increase over 1980–81 figures, were exported. Animal welfare groups, the Royal Queensland Society for the Prevention of Cruelty, industrial workers and Animal Quarantine continued to co-operate to ensure the humane handling of export livestock.

Testing of Aberdeen Angus stud herds in Queensland for mannosidosis was concluded. An estimated 900 cattle in 15 herds were tested and 66 heterozygotes detected. Twenty-five of these reactors involved a Red Angus herd. If this herd is excluded, the heterozygote reactor rate was approximately 5%.

At the end of March 1982, 94.66% of all cattle herds in Queensland were free from brucellosis and herd and cattle prevalence figures were 1.26% and 0.11% respectively. Understandably, the progress made in the more extensive western region of the State was not as spectacular as in the closer settled and more easily accessible eastern regions. For many areas in the west, the only practicable method of eradicating brucellosis appears to be by complete destocking of the property and then restocking with confirmed free stock.

On 3 April 1982, legislation declaring the State of Queensland a Protected Area was revoked and in its stead an Eradication Area in regard to bovine brucellosis was proclaimed consisting of the Shires of Burke, Cloncurry, McKinlay, Boulia, Diamantina, City of Mount Isa, and that portion of each of the Shires of Barcoo, Bulloo and Quilpie located west of the Western Dingo Barrier Fence. A Provisionally Free Area was also declared consisting of the whole of the State of Queensland with the exception of the shires comprising the Eradication Area.

At the end of March 1982, 97.91% of all cattle herds in Queensland were free from tuberculosis. Better progress in eradication was made in the closely settled eastern regions of the State. Destocking of large properties in the extensive areas of western Queensland followed by restocking with confirmed free stock, proved to be a very suitable method of eradication.



One of the first bulls imported through the Australian Government's new $6m Cocos Island Quarantine Station. The DPI Director-General (Dr G. I. Alexander) parades the Poll Hereford Beartooth Advancer 12H at the A. I. Export Centre, Ormiston. The last cattle imports were in 1956.

Numerous outbreaks of ephemeral fever occurred following widespread and heavy falls of rain during the early and midsummer months. Cattle in areas adjacent to the eastern coastline and the Burnett, Darling Downs and Maranoa areas were involved. Animals of the 12 to 24-month age group were mainly affected and a death rate of 1% of affected animals was reported.

The Queensland strain of enzootic bovine leukosis virus (EBLV) was used to produce antigen in co-cultures for the agar gel immuno diffusion (AGID) test. This was used to survey 8 560 cattle selected from all statistical divisions in the State for antibodies to EBLV. The prevalence of positive reactors was 1.7% in the Brisbane division, but only 0.2% for the rest of Queensland. Sheep inoculation experiments confirmed the oncogenicity of the Queensland EBLV isolate.

The prevalence of tick fevers was higher than usual because of increased cattle tick activity caused by the heavy and widespread falls of rain during the winter and summer months. A total of 115 outbreaks was investigated by Government officers of which 91 were caused by *Babesia bovis.* Of these outbreaks, 24 occurred in central and north Queensland during the winter months. Fourteen properties had outbreaks of anaplasmosis while 10 outbreaks were caused by *Babesia bigemina.*

The toxic principle of *Bryophyllum tubiflorum* (Mother of Millions) was isolated and its structure partially identified.

A preliminary survey of the filaroid parasite, *Stephanofilaria,* in north Queensland revealed infection in all northern shires except Boulia. Ayr shire was the highest with 17%.

A project to adapt modern technological developments to the detection of oestrus in dairy cattle was initiated. Officers of Biochemistry Branch in co-operation with officers of the Division of Dairying and Fisheries are adapting electronic data logging equipment to automatically monitor milk temperatures.

Wool receivals in Queensland improved in the current season. The wool market maintained a steady level throughout the season and at all times the market indicator remained above the Australian Wool Corporation's minimum reserve price of 410c per kg clean.

This year, Queensland's wool clip, and particularly wools from areas that had good winter rain, was considerably contaminated with vegetable fault and buyers increased the discounts which apply for this fault.

Action has been taken to improve the standard of preparation of the Queensland wool clip following criticism at the October–November sales. The picture shows a Sheep and Wool Branch officer classing a sheep as part of wool production experiments.

The standard of preparation of the wool clip was criticized at the October-November wool sales mainly because of the poor standard of skirting in many lots. Some lots were rejected for sale and reclassed, causing considerable expense to producers. Remedial action was taken to improve the standard of clip preparation.

The easing of drought conditions and consequent excellent lambings resulted in an estimated 15% increase in the sheep population to 12.25m.

Sheep and Wool and Biochemistry Branches developed a simple test to measure the rumen ammonia concentration in sheep, particularly those on dry pasture. The test can be used in the field and helps officers to make an immediate decision on the need for nitrogen supplementation. Care is needed in interpretation if the animals are grazing green feed.

Sheep and Wool and Pathology Branches developed a simple field test to determine worm parasite egg counts in faeces. With this test, field officers can make an on-the-spot assessment of worm burdens in sheep and advise producers immediately if drenching is required.

An experimental technique was developed which enables biological substances to be perfused into a discrete area of the skin. It involves the cannulation of a cutaneous branch of the deep circumflex iliac artery. The advantage of the technique is that direct effects of biological compounds on wool growth can be measured. Results are not masked by secondary feed-back effects resulting from the influence of the experimental treatment on other body tissues. Autoradiography measurements used in this technique enable wool growth to be estimated at 2 to 3-day intervals.

The Department established a committee comprising Messrs J. Heussler, chairman, H. Slaney, P. Thurbon and A. Wisseman, secretary, to review the Departmental services to the traditional sheep areas of Queensland. This committee called for submissions from interested bodies and held meetings with producers and Departmental staff in the major centres in western Queensland.

During the year, the Wool Biology Laboratory ceased processing wool samples and has subcontracted the processing to the Australian Wool Testing Authority. This has allowed the redeployment of staff into higher priority areas.

Blowfly activity was generally low for most of the year, but a fly wave occurred in March and April, particularly in sheep flocks in south eastern districts where strikes of 10 to 40% were reported. A fly trapping programme in western Queensland suggested that in these areas *Lucilia cuprina* concentrated around watercourses and only a few flies were found in traps 0.5 to 1 km from water.

There was an upsurge in the number of cases of enterotoxaemia in goats confirmed by the demonstration of *Clostridium perfringens* type D toxin in intestinal contents.

Meat industry

A Royal Commission into the Meat Industry was established to investigate existing administrative structures for meat inspection and malpractices in the meat industry. The Commission is still in session. No evidence emerged to demonstrate any malpractices in Queensland involving State services.

Consumer meat identification was advanced when a new colour strip branding system for beef and lamb was introduced in March. It has received extensive publicity and is being well accepted by industry and the public.

Proposals for uniform regulatory control over the marketing of pet flesh were supported by the Australian Agricultural Council and are in the process of being implemented. Flesh will be identified by staining with brilliant blue. Moves made by the pet food industry to allow the sale of frozen wrapped raw pet food in supermarkets have been opposed by retailer and pastoral interests.

Examination of fresh meat samples by the isoelectric focusing electrophoresis technique to identify the species of origin was undertaken. Samples were collected from retail outlets, from meats received at smallgoods manufacturers and from miscellaneous sources. Of approximately 500 samples examined, none contained meat from species which are not acceptable.

Intensive animal industries

The pig industry entered a period of renewed prosperity as pig prices rose and feed prices declined. At March 1982, the pig price/feed cost ratio reached 10.71; this compares with 7.66 a year earlier. Profitability of pigs naturally captured the attention of new investors: a 2 000-sow unit was established and a further large unit is planned. Establishment costs and difficulties with obtaining capital tended to discourage other significant expansion.

The Queensland Pork Producers' Organization introduced Sale by Description auctions to Queensland in 1981 with Dalgety-Winchcombe as their agent. Since the initial sale, almost 25 000 pigs have been marketed through 35 weekly sales. A key factor in the success of this sale method is the accuracy of fat measurement monitored by officers of the Department.

A total of 206 boars from the 423 tested at the Central Boar Performance Test Station, Rocklea, was approved for future breeding. For the first time crossbred boars were tested alongside purebreds. The Station evaluated the progeny of local and imported sires to measure the impact of the imports on the industry.

The importation of boars of four breeds from Ireland, Canada and New Zealand has focused attention on A.I. as a means of maximizing the use of imported and locally bred sires. The introduction of frozen semen from overseas has also created much interest in A.I. techniques.

Abscesses due to *Pseudomonas pseudomallei* have been regularly detected in pigs in tropical north Queensland and muddy water has been considered the source of infection. Melioidosis has been a rare disease in animals outside the tropics. However, during the year, this disease was diagnosed at slaughter of pigs from six intensive piggeries in south east Queensland. Its public health significance demands close inspectorial supervision. Chemical treatment of the water supply is recommended as the best method to prevent its occurrence.

This year's chicken meat production declined by 7.6% on the previous year's level. The downturn in chicken meat production was the most prolonged and serious of any that has occurred in the last 20 years. The effects of the downturn were not spread evenly across all processors and some difficulty was experienced by the Chicken Meat Industry Committee in reaching agreement on growing fees.

In the egg industry, further fine tuning of the hen quota system resulted in a closer match between the demand and supply of eggs on the local market than has been achieved in previous years. As a consequence, the Queensland egg industry achieved further gains in stability, productivity and profitability.

The most significant disease development in the poultry industry was the increased awareness of the importance of infectious bursal disease and its immunosuppressive effects. Problems associated with this virus were seen more in the broiler industry where there is a quick, constant turnover of chicks which can maintain high levels of the virus in the environment.

Research study demonstrated that shell quality, which is easily and accurately measured, responds readily to selection and should be included among the selection criteria of egg-laying stock.

Facilities and staff

In a major re-organization of the Division of Animal Industry, Husbandry Research Branch was disbanded and the staff incorporated in Sheep and Wool, Beef Cattle Husbandry and Pig and Poultry Branches. The Slaughtering and Meat Inspection Branch was renamed the Veterinary Public Health Branch in recognition of its wider areas of responsibility.

Construction of a new raised board shearing shed with four stands was completed at Toorak Research Station, Julia Creek, and will greatly improve the efficiency of shearing at Toorak. It has been so designed that it is able to house animals for research trials.

Chemical residues in animal products

Monitoring of organochlorine and organophosphate residues in cattle slaughtered in Queensland continued using a selective sampling programme aimed at detecting actual or potential problem areas.

A total of 5 731 samples of fat was analysed for 23 pesticides and, as a result of traceback by field staff, a further 225 samples of either biopsied fat, milk, grass, soil, water, vegetables or dip sludges were examined. The analytical and traceback work indicated a generally responsible use of pesticides with a compliance rate of 99%.

The Pig Section co-operated in a Commonwealth Department of Primary Industry survey of pesticide residues in pig meat.

Division of Dairying and Fisheries

Dairying

Trends and production. The downward trend in dairy farm numbers, which has been evident for many years, has continued. The total number of dairy farmers in the State was 2 711 in June 1982.

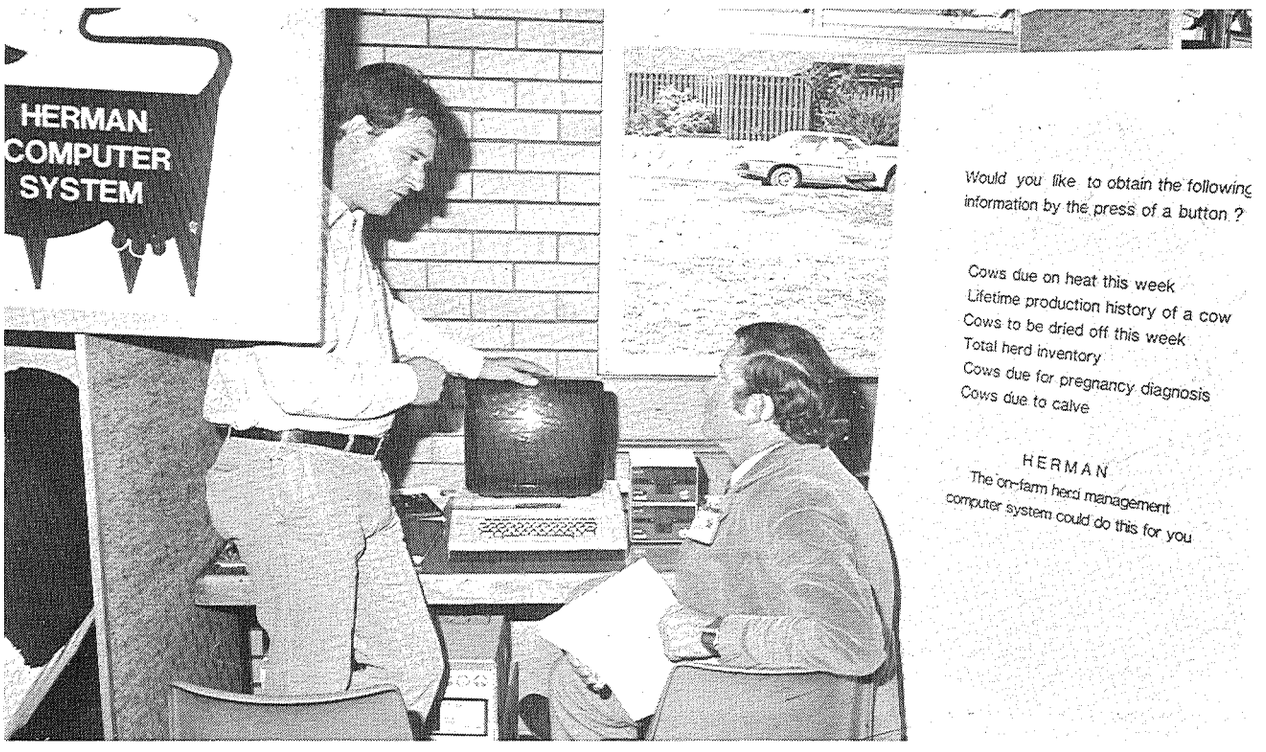
In spite of reduced numbers, the economic performance of dairy farmers in 1981–82 was very good. An increase in milk production of approximately 8% was noted. This indicated a substantial increase in production per farm. Farm gate returns have improved by approximately 18% over those of the previous year and this is well in excess of increases in costs.

The domestic market for dairy products remains strong. There has been a substantial increase in market milk sales of 4.6% across the State. Increasing demand for products such as yoghurt and cheese has also been noted. Table cream sales have increased by approximately 8%.

Queensland still needs to import substantial quantities of butter to meet market requirements. Almost all of the butter was brought in from Victoria, with a small quantity from New South Wales. Some degree of uncertainty exists over the effect of the Closer Economic Relationship Programme with New Zealand on access of New Zealand dairy products to the Australian domestic market. In the short term, however, it is not expected to substantially affect Queensland dairy farmers, but there may be some disruption of domestic markets in the long term.

A significant change in industry policy during the year was the announcement by the Minister in February 1982 of the reopening of the dairy industry to new suppliers in the south east Queensland area. At this stage, 25 new suppliers have been accepted into the industry by associations in south east Queensland. In central Queensland, the registration of eight new suppliers has been approved. No new registrations have been issued in north Queensland.

Approval was also announced for suppliers to transfer from one supply group to another while retaining a portion of their market milk entitlement. Only a few transfers have occurred in recent months but it is expected that more will occur in 1982–83.



Demonstrations of the value of on-farm computers in herd management were given at the seminar, Dairy management in the 80s.

Extension activities. A most significant extension event held during the year was a joint Queensland Dairymen's Organisation and DPI seminar—Dairy Management in the 80s. This was held in Toowoomba and attracted wide support from all sections of the industry. More than 400 farmers and other industry personnel attended the seminar, the discussion groups and the associated trade display. There is now clear evidence that dairy farmers are accepting improved production technology. This is evident in the interest in new dairy sheds, in better pasture production and in herd improvement techniques.

During the year, 11 Dairy Industry Liaison Groups were set up to improve the consultative process between industry and the Department in both the extension and research areas.

Artificial breeding. Seven bulls from the first importation through the Cocos Island Quarantine Centre were delivered directly to the Department's A.I. Export Centre. This action was taken by owners to ensure that supplies of semen were placed in storage before further movement of the animals to their properties or other locations.

Negotiations are in progress for the direct entry of nine additional sires which are due to enter Australia in late 1982 and early 1983.

Interest in the imported bulls was extensive as more than 100 cattle breeders visited the Centre to inspect them during the 2 days following their arrival.

Herd production services. Herd recording registrations increased by 17% this year. There are now 782 herd owners (approximately 30% of all dairymen) making use of this service.

The Mastitis Cell Count Service which began in July 1981 is being used regularly by more than 400 dairymen. This early popularity of the service indicates the importance placed on mastitis detection and control in the management of dairy herds.

The bulk herd cell count service continued and results indicate that generally good control is being maintained over mastitis.

Fisheries

The Fishing Industry Organisation and Marketing Bill was passed on 25 March 1982 setting the stage for the establishment of the Queensland Fish Management Authority which will have the responsibility and power to manage the catching, processing and marketing of seafoods. Fisheries management in the future will be achieved by the exercise of the licensing powers of the Authority.

Industry review. Improved prawn prices during 1981–82 have alleviated some of the economic problems being experienced by fishermen but continued high interest rates remain a significant factor affecting the viability of units employed in prawn trawling.

The number of vessels engaged in prawning increased to 1 412 at 31 December 1981. It has become clear that prawn stocks along the Queensland coast are fully exploited and further capital investment in the catching sector is undesirable. Efforts are being made to locate stocks of royal-red prawns in deep water off southern Queensland. A deep water trawl survey is to begin on the continental shelf east of the Great Barrier Reef in 1982–83.

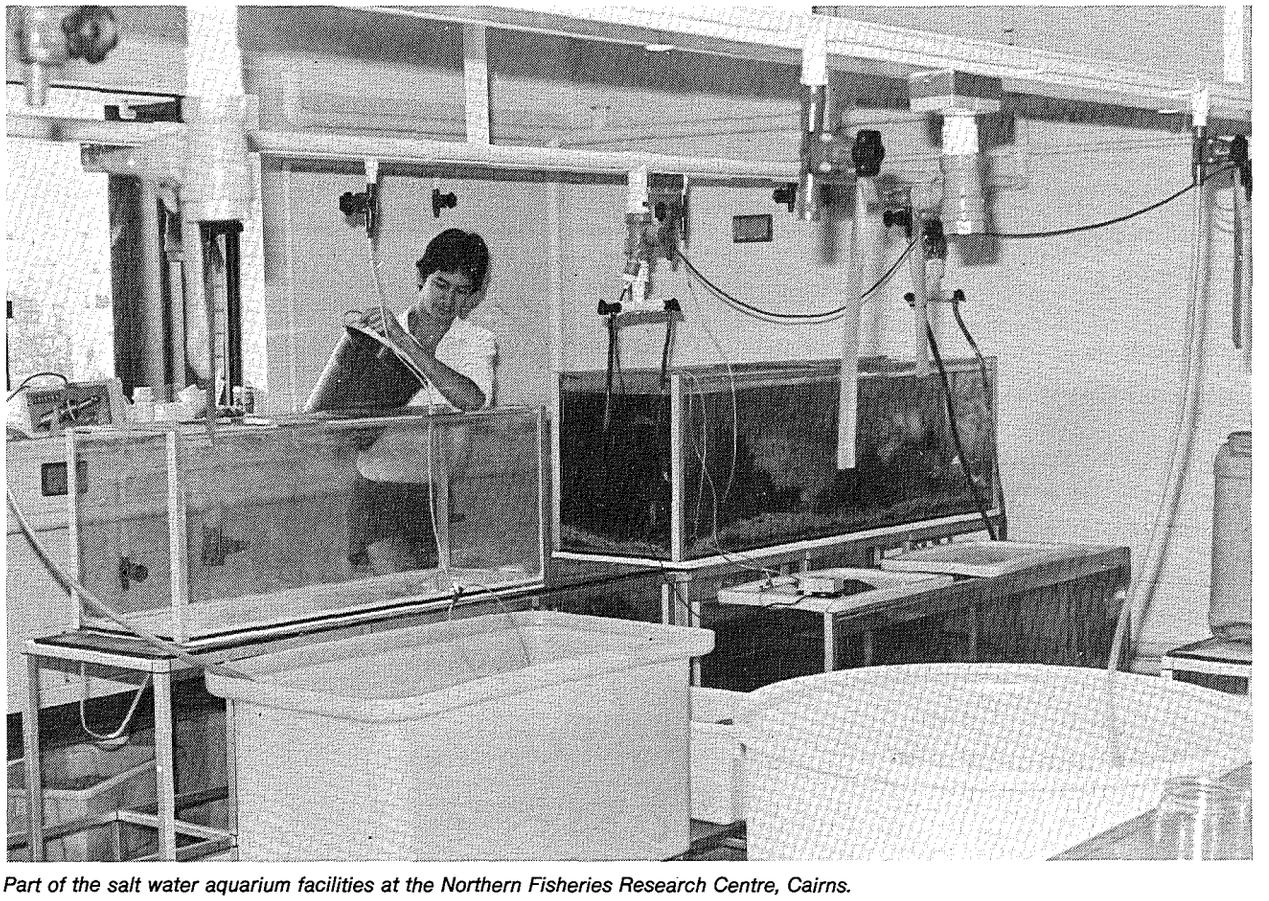
During October–November 1981, nine converted prawn trawlers operating 80 miles offshore from Cairns demonstrated that it would be possible to take yellow-fin and big-eye tuna in commercial quantities using hand-lines and poles. Fisheries officers were placed on Japanese fishing vessels during the same period to compare their operations with those of the Queensland boats.

One of the problems which will affect this embryonic fishery is the marketing and handling of the catch. At present, the tuna is being transported to southern canneries. It is hoped, however, that an increasing proportion of the tuna catch in north Queensland will be destined for the Japanese 'sashimi' market. Fisheries Research Branch is planning to examine bait-fish resources in the Cairns area to assist poling operations in the 1982 season.

The pearling industry continues to be one of the most valuable sections of the fishing industry apart from prawning. Pearl culture farms in the Torres Strait and Escape River areas use wild stock pearl oysters collected by islanders using diving apparatus. The industry is currently being investigated to ascertain whether it needs any form of assistance.

Native fish stocking programme. The Freshwater Fisheries Research Station at Walkamin on the Atherton Tableland has been developed to the stage where mass production of fingerlings is possible. Improvement of pond and hatchery facilities has allowed a massive 1 100% increase in fingerling production over that in the previous year. The principal species bred for stock were sooty grunter (*Hephaestus fuliginosus*), sleepy cod (*Oxyeleotris lineolatus*) and silver perch (*Bidyanus bidyanus*).

Most of this year's production was released in the Tinaroo Dam (Atherton), Awoonga Dam (Gladstone) and Monduran Dam (Gin Gin) bringing to 15 the number of rivers and storages stocked with fish bred at Walkamin. Fingerling production is expected to increase over the next few years and is expected to exceed 250 000 a year as additional improvements at Walkamin are carried out.



Part of the salt water aquarium facilities at the Northern Fisheries Research Centre, Cairns.

Fisheries research vessels. The 18-metre trawler 'Iron Humphrey', one of the top producing fishing vessels in the southern Queensland prawning fleet, was acquired in June 1981. During 1981–82 the vessel was refitted and converted to a research trawler. She has since been relocated at the Northern Fisheries Research Centre, Cairns, which has jetty facilities to accommodate vessels of this size.

This vessel will be used for research and exploratory fishing in the Gulf of Carpentaria and a deep-water trawl survey on the continental shelf east of the Great Barrier Reef. The trawler will be renamed 'Gwendoline May' and commissioned on 14 July 1982.

The 12-metre trawler 'Bar-ea-mul', previously based at Burnett Heads, was moved to Moreton Bay in December. It is presently attached to the Southern Fisheries Research Centre at Deception Bay and is being employed to support studies on the effect of beam trawling on the bay prawn fishery as well as exploratory trawling for squid.

Introduction of Nile perch. Funds have been allocated to assess the suitability of introducing Nile perch (*Lates niloticus*) into Queensland. Nile perch is a native freshwater fish endemic in some rivers and lakes in Africa and is very much like barramundi in appearance. Fingerlings of Nile perch are to be imported into Queensland after they undergo stringent quarantine and examination for exotic diseases. It is planned that special ponds in a quarantine area will be constructed during the 1982 dry season.

Division of Land Utilisation

Soil erosion affects an estimated 30% of non arid grazing land in Queensland and as much as 90% of the land currently used for cropping. This is a staggering amount of land being damaged by something which is quite capable of being controlled, at least to a marked degree. In some cases, this damage will be irreparable. At present, treatments of some kind have been applied to less than 42% of the estimated area being now cultivated.

It is estimated that land is being opened up for cultivation particularly for grain and sugar-cane, at a rate in excess of 65 000 ha a year. This year, Departmental officers treated a record area of 69 000 ha. Not much progress is being made in the face of expansion. In addition, this expansion is primarily onto fragile, shallow soils which, if not protected soon after break-up, will be useless for cropping in a very few years.

Directly, of course, the cost of land degradation is felt by individual primary producers because their yields decrease and their costs of production increase. Off site, there is a cost to the community through damage to public utilities like dams and harbours and to other landholders through floods caused by silted stream beds. Indirectly, the effect is felt by everyone through increased commodity prices and increased taxes and, in the long run, through serious effects on the agricultural productivity of the State.

Landholder involvement

With the development of cropping on large areas of previously uncultivated land, and with increased concern about erosion in almost all parts of the State, emphasis in soil conservation activities has been placed on the steps that landusers could take themselves. This includes encouraging them to use the most suitable land for cultivation and establishing appropriate cropping practices to minimize erosion. Land management practices can be instituted by landusers with minimal assistance from soil conservation officers.

Within the farming community, there is now much greater interest in preventing soil erosion. Interest is so great that Departmental officers are unable to service the demand for assistance and most farmers who wish to avail themselves of expert help to install structures must wait months for survey teams to visit them. As a result, the limiting factor in farm protection is no longer farmer demand but officer availability. Steps have been taken to attempt to make each officer's time as productive as possible. Most of them already work many hours outside their normal span.

Planning of group and catchment plans has gone ahead. Much time is needed to develop and organize fully documented project plans within Areas of Soil Erosion Hazard because of the difficulty involved with reaching agreement from all the interested parties. As a result, interest in this method of approach lagged behind during this year and more time was spent with group or provisional project plans among those growers who indicated a desire to move ahead with implementation. This has allowed more time to be spent on more immediately productive field work. These provisional plans are designed, however, to fit into full catchment project plans at a later date.

The first landholder poll to seek support for a Soil Conservation Project area was held in the Cherry Creek catchment area of the Atherton Tableland in 1980–81. The project area has now been set up. The first project plan has been completed and has gone forward for advertising. The scheme received solid backing from the Atherton Shire Council. Catchment planning is the only way of organizing an integrated drainage system for runoff water and all planning should fit within its total catchment.

The Governor of Queensland (Sir James Ramsay), accompanied by Soil Conservation Officer Tom Crothers, looks over a conservation cropping awareness display at the Warwick Show.

Extension

Interest in soil conservation continues to grow, and requests for upgrading the service continue from industry groups, local authorities and individual landholders. Both grain and cane industries are anxious that advantage be taken of this interest while it exists, otherwise it will wane and it will be necessary to develop it again. Further interest from the Queensland Grain Growers' Association was seen this year in the formation of another very active Soil Conservation Advisory Committee by its Dawson–Callide Branch. This parallels the one established earlier in the Central Highlands.

The co-operative approach developed between Soil Conservation Branch and Agriculture Branch to handle development and extension of conservation tillage is now working well. Pilot farms have been established on commercial properties in the South Burnett to provide practical experience for farmers and Department officers alike and to serve as centres for demonstration of individual practices and complete systems to local farmers.

There is a change of management thinking that goes with these systems and a requirement for more precise management decisions. As a result, many farmers are taking practices out of the system and using them. This is at least a step in the right direction and the extension programme is being adjusted to deal with this situation. Conservation cropping is not the answer in itself. Structures are required as well but there does seem a future for this idea as a way of 'holding the fort' while lagging structure implementation catches up.

Branch officers continue to attempt to educate the community about erosion and the need to conserve the soil resource. Emphasis to landholders has been on the maintenance requirements of soil conservation activities and on the need to protect new cultivation at the time of development.

A total of 461 landholders implemented soil conservation measures on their land for the first time this year compared with 493 last year. This was due to the inability of officers to comply with requests in the face of increased follow-up of work commenced last year.

The total number of landholders now employing some form of soil conservation is 20 281, about half of the properties affected by erosion in the cropping areas of the State. Clearly there is still a considerable need for greater landholder adoption of both soil conservation works and practices.

During the year, 4 811 requests were made by landholders for information about the control of soil erosion or for assistance in the planning and setting out of soil conservation measures. This is nearly as high as the record last year, despite the realization that

access to officers remains very difficult. Of these, 756 were from landholders who had not previously implemented soil conservation measures, while the remaining 4 155 inquiries were from established co-operators.

A total of 6 878 visits was made to properties to provide advice and assistance, yet many hundreds of inquiries remain unanswered. A record area was treated by officers in 1981–82: a total of 69 000 ha.

Two successful field days were held during the year. One was the Royal National Association's 'Producer of the Year' field day held on the properties of Messrs H. Tod, Jondaryan, and M. Mason, Mount Irving, who received first and second places in that competition. Soil conservation was the major theme of this day, particularly the strip cropping rotations as a control on low sloping land on Mr Tod's property. The second demonstrated conservation cropping in the Wooroolin district of the South Burnett.

The situation in the future is expected to improve somewhat next year with the addition of three extra staff at Biloela, Atherton and Roma. Approval to employ these extra staff was received during 1981–82.

Soil Conservation Branch officers were able to undertake a joint project with the University of Queensland to assess the readiness of farmers to adopt soil conservation measures. At the same time, an attitude survey of canegrowers was conducted.

Considerable emphasis was placed on the conservation cropping theme, especially on the Darling Downs, in the South Burnett and in the Central Highlands. The South Burnett programme is now an integrated development and extension project between Soil Conservation Branch and Agriculture Branch, and this has proved very successful.

Equipment

A highlight of the year was the receipt of an additional $450,000 from Treasury for soil conservation. This represented the amount made available by the Commonwealth Government in its general disbursement to the States. This has allowed an improvement in the services offered.

Among other things, the additional funds allowed the purchase of some sophisticated survey equipment. Two electronic tacheometers were purchased to assist in the gathering of base topographic data on which surveys for drainage structures are based. A laser beacon was also purchased for trial for laying out contour banks. Studies before this equipment was purchased indicated that several times the area could be laid out over the same time.

These funds also allowed the manufacture of a number of much cheaper units for the same purpose, designed and tested by a member of the field staff. Each of these at least doubles the present area which one officer can survey. It is expected that these units together will make a distinct difference to the time in the field required to cover a given area. They will be particularly useful in extensive areas of reasonably uniform topography.

The Division was also able to participate in the design of a zero-till planter suitable for heavy clay soils. Costs were shared with a commercial manufacturer who showed interest in the development of such a prototype machine. It is now in use in field experimentation.

Planning Committee for Soil Conservation

During 1981–82, Cabinet agreed to the formation of a Planning Committee for Soil Conservation. The purpose of this Committee is to recommend systems for management of soil conservation throughout the State. It is especially concerned with the responsibilities of landusers, local authorities, grower organizations, State and Commonwealth Governments, and how these organizations might best contribute to an increase in the efficiency of Soil Conservation officers. No doubt they will also report on equipment, staff and other items.

The Committee is chaired by Mr D. R. Eather, General President of the Queensland Grain Growers' Association and comprises representatives of the sugar industry, local authorities, Advisory Group Committees and this Department. Some changes to the procedures applying at present are envisaged.

The Committee has already met a number of times in country centres to hear the views of local landusers including local authorities. It is expected to report to Cabinet late in 1982.

Other organizations

Discussions continued throughout the year with mining companies, the Mines Department and the Queensland Grain Growers's Association on the prevention of erosion caused by mining exploration. Guidelines for technical assistance are being drawn up.

Co-operative work for the Central Sugar Cane Prices Board has taken a good deal of time. The Department, on the request of Local Assignment Committees, has been involved with the inspection of land for suitability for cane growing during the expansion of assignments.

Land use advice has been given to the Land Administration Commission in the subdivision of Crown Land, and its development, in the Mount Ossa area near Mackay. Considerable time is being spent in obtaining and interpreting topographical data for this district so that soil conservation measures can be implemented early in the development of the site.

Excellent co-operation was received in this and in other areas around Mackay from the Mackay Land Use Committee, set up to study and act upon recommendations from a very large land use survey of the whole Mackay sugar growing district.

Land use studies

This Mackay study was finalized from a field point of view in December 1981. Digitizing of map units and land use categories is currently in progress. Similar studies are in progress around Plane Creek.

In the north of the State, land use and soil mapping studies are in progress along the coast north of Ingham in association with CSIRO. This information will be of immense value, not only to indicate development potential and to help prevent loss of good agricultural land, but also to help resolve conflicts between land uses and to plan catchment development. Excellent co-operation is also being received from the Bureau of Sugar Experiment Stations as well as CSIRO Division of Soils.

In the southern cane growing areas, a rapid study around Isis Central Mill was undertaken. The local sugar industry indicated its intention to concentrate expansion activities on freehold and leasehold land located as suitable for cane by the study. Tentative agreements were reached about future Crown land allocations which might provide efficiency and stability within the sugar industry without seriously affecting the viability of timber based industries.

The Maryborough Steep Lands Study identified 53 farms with a total of 719 ha of suitable land currently assigned to sugar-cane.

A map indicating suitability for horticulture in the Maroochy Shire was completed and field work in the Landsborough and Caboolture areas was also completed. These data are in demand and efforts will be made to publish results in the coming year.

Studies of the resources of the South Burnett are in publication while those in the Central and North Burnett are continuing. Some of the detailed studies of major resource areas on the eastern Darling Downs are complete. The study will provide recommendations on the agricultural and soil conservation management requirements of the important agricultural management units. An inter-branch programme is being developed to determine the extent of cropping in the Near South West and to develop practical management guidelines.

A highlight of this year has been the completion of the mapping programme for the Western Arid Region Land Use Studies. Draft maps are now available for 60m ha in the arid and semi-arid grazing areas of the State. These maps are already in high demand from a number of Departments and from other organizations.

Development evaluation

A large number of irrigation projects has now been evaluated and activity in this area has declined as a result of limited funding for water resources. There is, however, an upsurge of interest in water for urban and industrial uses. Efforts are being made to see that agriculture obtains a reasonable expectation in any reallocation of water resources.

Information has been provided to an interdepartmental study of the consumption and needs of water in south east Queensland on the potential requirements for irrigation for the next 20 to 30 years.

An assessment of the State's resources indicates a large potential within the State for development. Despite the large areas of prime land still available, considerable areas of more marginal land are now being developed beyond its current suitability. There will need to be significant co-operation between government, producer organizations and farmers to solve the problems inherent in this situation. A discussion statement listing a range of possibilities to help in improving and stabilizing productivity was produced. A National Conservation Strategy for Australia is being developed as a co-operative effort between the Commonwealth and the States.

Environmental impact studies have been evaluated. For the first time, such a study was carried on an agricultural development. This was for a large irrigation development at Dalby. Three other major projects were also reported on for the Co-ordinator-General's Department.

Land management research

A land management project was established near Capella in central Queensland aimed at assessing the effects of cultivation and soil cover on soil erosion, runoff and yield of wheat, sunflower and sorghum on the black earths of the open downs. The possibilities of conservation cropping as a way to minimize

soil loss, especially in association with structures, make experiments of this kind important. Studies of this kind are receiving considerable attention.

Catchment studies on Brigalow Research Station have been extended to assess the effects of developing virgin brigalow land for pasture and crop. The studies will measure runoff, soil erosion, soil salinity and soil nutrients.

A trash management programme was developed on the canelands with the Bureau of Sugar Experiment Stations. This approach, like conservation cropping in grainlands, has much to offer in reduction of soil loss. The programme will indicate and solve problems associated with the acceptance of these practices by cane farmers.

An opportunity for an officer to train with Griffith University on a joint project will greatly enhance the work and evaluation of data from experiments on the Darling Downs. These experiments are central to research on surface management.

A report on priorities for action was produced by the Salinity Co-ordinating Committee following an overview of salinity problems in the State. Salinity is part of the land degradation occurring in Queensland. A Soil Conservation Research Committee, of which this Department is a member, was established as an advisory committee to the Standing Committee on Soil Conservation.

Research continued to show the value of Indian bluegrass (*Bothriochloa pertusa*) as a species for waterway stabilization in many parts of southern Queensland. The value of sowing this with a cover crop of oats was established.

A Soil Conservation Branch van display features the Dalby floods and strip cropping practices. It is being viewed by the Minister for Primary Industries (Mr Mike Ahern), right, and Messrs N. F. Fox, formerly Deputy Director-General, and Mr T. Stirling, chairman of the Central Downs Advisory Group Committee and the Pittsworth Shire.

Engineering

One of the highlights of this year has been the presentation on loan of a large tractor by a firm for demonstration of methods of producing fuel economy. The tractor has been fitted with instrumentation which prints out rpm, torque, power and fuel consumed. Several successful field days have already been arranged by Queensland Grain Growers' Association to demonstrate the effects of driving techniques on fuel economy. More are planned for the next 18 months.

A dynamometer has also been developed to indicate forces produced by tines and other implements. This has been used to test 30 commercially available implements to assist farmers in selecting tool types for their situations.

A lot of time has been spent on the design and development of no-till and minimum-till planting equipment. Two rigs using easy-to-change components were designed and built for CSIRO as part of a co-operative no-till evaluation study. Components involved embody all major no-till concepts from around the world.

A commercial no-till planter was also designed in co-operation with representatives of an equipment manufacturer and this unit is being tested. Another Darling Downs manufacturer has also used the Department's data to help develop a machine which is also at prototype testing stage.

Germination tests on bean seed harvested with a modified pea viner have produced excellent results. The modified harvesting methods have been accepted by several growers in the Burdekin and Biloela areas with most satisfactory results.

A demonstration-research grain dryer has been designed for the peanut industry in north Queensland in an effort to improve the quality of the product. Testing and sampling methods have been selected as the most promising way of improving receival sampling methods for sunflowers for the Queensland Grain Growers' Association.

A bed former for the tomato industry was designed and developed for testing and information was collected on fruit fumigation rooms in south and north Queensland.

An engineer has been heavily involved in developing a handbook on spray application technology. This handbook is designed to be a resource for extension officers and farmers alike. Several engineers are now stationed in country areas where they operate, not only as designers of equipment, but also as resource officers to extension personnel and advisers to the farming community.

Division of Plant Industry

Agronomy research

Departmental crop breeding and selection programmes have again had a prolific year with the release of six new varieties and one breeding line.

Two wheat varieties, Flinders and Hartog, were released in 1982. Flinders is a mid season wheat with similar yield to Oxley but with better quality. Hartog is a strong strawed, quick-maturing variety which yields at a similar level to Cook, Banks and Kite and has adequate quality. Flinders and Hartog are both resistant to stem and leaf rust.

Grimmett, the new barley variety, is earlier and higher yielding than Clipper. In micro-malting tests, it compared favourably with Clipper, but its position as a commercial malting barley has yet to be clarified.

The soybean variety Nessen contains a major gene for resistance to *Phytophthora megasperma*. As it also has a high yield capability, Nessen will be a most useful addition to the list of approved soybean varieties and will enable soybean production to continue in infected fields in southern Queensland.

The sweet corn variety Aztec was bred and released to replace QK467S. Seed production of Aztec is much simpler than production of QK467S so growers will be able to obtain seed readily. Aztec has quality equal to or better than that of QK467S.

The sesame variety Palmetto was introduced from USA. This variety is non-shattering and capable of producing reasonably good yields: up to 1.2 t ha^{-1} have been secured in experimental plantings in Queensland. Its release followed the determination of successful harvesting methods including optimum timing of application of pre-harvest desiccant.

The breeding line was a male sterile, midge resistant grain sorghum line, designated QL23. This line has been taken up by commercial breeding programmes and is making a significant contribution to the Department's effort to breed female midge resistant lines.

Physiological research determined that wheat yields are closely associated with evaporation rates and mean daily temperatures during flowering. In the absence of frost damage or other factors, maximum grain yields will be obtained if flowering occurs in midwinter (July). Thus early plantings of wheat in the Central Highlands would capitalize on diminishing levels of soil moisture stored from summer rains and the frost risk is less than in southern Queensland.

Following publicity of research findings, about 60% of the Central Highlands wheat crop in 1981 was planted in March–April. These early plantings, which flowered in June–July, gave farm yields in the vicinity of 3 t ha^{-1} compared with 1.8 t ha^{-1} from normal May planted crops that flowered in August–September.

If early plantings continue to give higher and more reliable wheat yields, this may stimulate the planting to wheat of a greater percentage of the cropping area in the Central Highlands. This has important implications in the control of soil erosion as the stubble from wheat gives far better protection to the soil surface than alternative crops currently occupying a major portion of cultivation in the region.

Farmers have often been disappointed with the lack of response, particularly of summer grain and oilseed crops, to applications of phosphorus (P) fertilizer even when soil tests using acid and/or bicarbonate extractable P indicated that the soil was deficient.

On the red soils of the South Burnett, research on soybeans has shown that equilibrium phosphorus concentration (EPC) of the soil is a much more reliable predictor of grain yield response ($r^2 = 0.89$) to applied P fertilizer.

The South Burnett results have stimulated investigation of the application of the technique on other soil types and a range of other crops including sunflowers, grain sorghum and potatoes.

Agrostology

The Fitzroy cultivar of shrubby stylo *(Stylosanthes scabra),* released by the Queensland Herbage Plant Liaison Committee in 1979, continues to command considerable interest from graziers in central Queensland and seed stocks are slowly building up, some 300 ha now having been planted for this purpose.

It continues to perform well in all experimental plantings and substantial commercial plantings are expected as soon as seed stocks permit.

Substantial progress is being made with the development of a series of simulation models to permit the expansion of experimental results to a much wider range of seasonal conditions than those under which they were obtained. Pasture yields can be accurately predicted for 'Brian Pastures' Pasture Research Station and these used to predict monthly liveweight gain from a range of pasture types.

These models use historical climatic records, especially daily temperature and rainfall data, to predict likely animal performance over long time periods and can indicate the likely effects of such management decisions as variations in stocking rate on animal performance.

In time, it is hoped to expand these simulations to cover whole property situations and to include a nitrogen model to take account of varying soil nitrogen fertility and its effects on pasture production.

Testing of imported American and Australian bred lucernes for adaptation and aphid resistance under Queensland conditions continues. The CSIRO-QDPI bred Hunter River based material, presently known as APC Cycle 3, incorporates resistance to the various aphids, *Phytophthora* root rot and *Colletotrichum* crown rot in a Hunter River type lucerne. It has been outstanding in initial field trials. Multiplication and further testing with a view to early release are being pushed forward rapidly.

Horticulture projects

Release of cold tolerant French bean cultivars. Winter and spring French bean production is a most important industry in the Gympie district, with a large proportion of the crop being consigned interstate. The environmental conditions are marginal for French bean production, but prices are generally good and the industry is quite viable.

However, yields per hectare are relatively low and growers have been forced to rely on stringed bean cultivars during the coldest months of the year. The release of Redlands Wintercrop and Redlands Wintergreen will provide stringless varieties capable of far out-yielding the present winter stringed variety during the cold months of the year.

Tomato Fusarium Race 3 resistance breeding programme. The appearance of a new race of Fusarium wilt in tomatoes at Bowen represents a most serious threat to the future of the industry in that area. The identification of two separate forms of resistance to the new race has been a most important stage in the development of resistant cultivars.

The development of the first true-breeding tomato lines carrying resistance to Fusarium wilt Race 3 indicates the rapid progress which has been made in this programme. It is expected that a commercial release will be possible at the end of this year.

Tomato F_1 hybrid with bacterial wilt resistance. An F_1 tomato hybrid developed at Redlands will soon be released to industry. The hybrid is especially suitable for production during the warmer months of the year when bacterial wilt is a problem.

The hybrid has firm fruit with excellent flavour. It also carries resistance to Verticillium wilt Race 1, and is also expected to have resistance to Fusarium wilt Races 1 and 2. Testing for Fusarium wilt resistance is in progress.

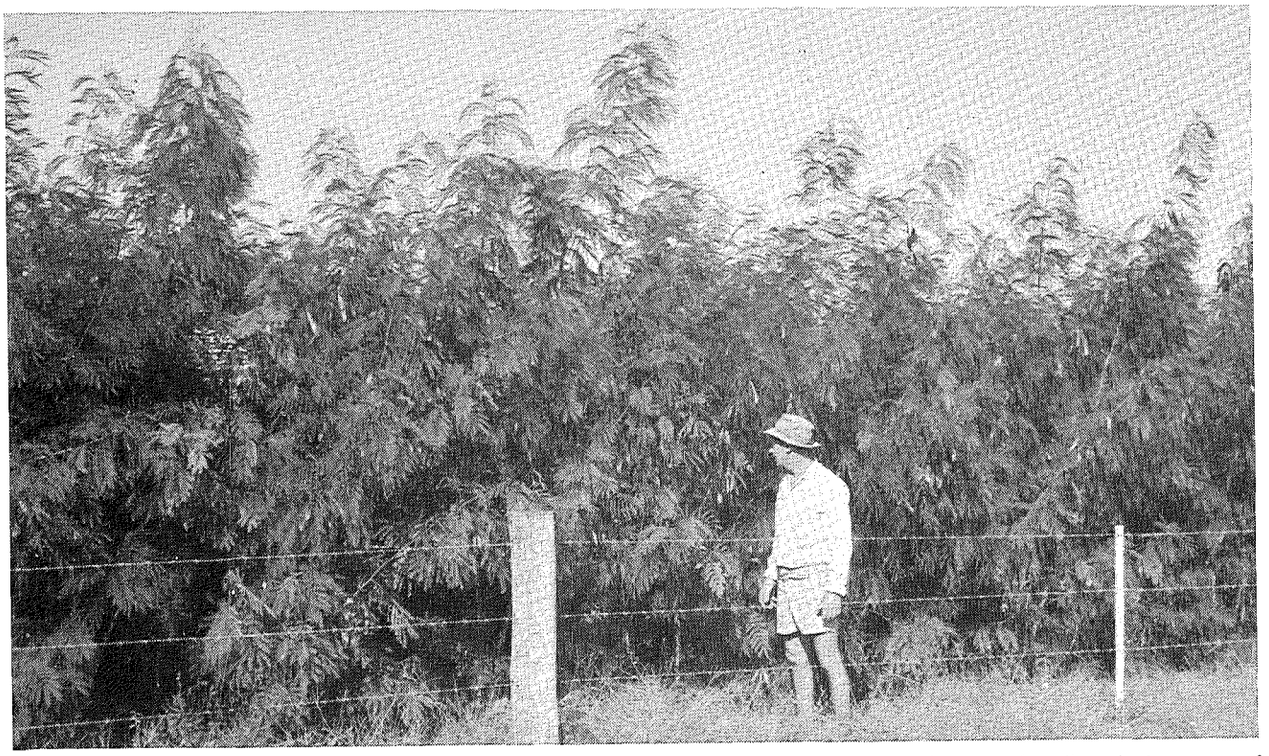
Expansion of the tomato breeding programme. Major new initiatives in the tomato breeding programme this year are designed to tackle some additional production problems being experienced in the Queensland industry.

Resistances to PVY virus, bacterial speck and Verticillium wilt Race 2 have been identified and included in the breeding programme. In addition, genes for a compact bush type and for high fruit quality have been incorporated into the breeding programme.

Avocado virus-indexed block and rootstock releases. A field block of virus-indexed avocado trees at the Maroochy Horticultural Research Station has been registered with the Australian Avocado Growers' Federation and is supplying high quality propagating material to industry. In addition, two Guatemalan rootstock clones have been indexed and released to the industry for seed production for rootstocks.

Sub-tropical fruit tree breeding initiatives. The past year has seen a number of major new initiatives in breeding of subtropical fruit crops in Queensland. Breeding programmes in custard apple, macadamia, and pineapple have been initiated or made major changes in direction.

By the end of 1982, approximately 1 450 breeding progeny of macadamia will have been planted in the first major organized planting for progeny testing of macadamia in Australia. Approximately 2 100 seedling progeny of pineapples were also planted out this year.



The browse shrub leucaena (Leucaena leucocephala) *is showing value in the Burnett district and as a reclamation plant in areas of land slip and high water tables. This 17-month-old stand is at Tinana, near Maryborough.*

The past year has seen new initiatives in assessing tropical and subtropical fruit crops in Queenland. The picture shows an officer assessing a persimmon variety at the Maroochy Horticultural Research Station.

The development of a technique for the recovery of high performance macadamia rootstocks opens the way for the development of clonal rootstocks with potential for high, uniform production in commercial orchards.

Ethephon thinning of Imperial and Murcott mandarins. The use of ethephon for thinning Imperial and Murcott mandarins has continued to gain acceptance in the industry for regulating crop load and for overcoming biennial bearing patterns experienced with these varieties. Work was extended with Murcott mandarins this year and the very favourable results are expected to accelerate increased plantings of Murcott as a highly profitable late variety.

Low chilling peach industry development. The programme of introduction, evaluation and industry development of low chilling peaches and nectarines has been most successful. These low chill varieties mature earlier than standard varieties and can be grown in warmer districts.

It is estimated that there are now more than 30 000 trees of low chilling peaches and nectarines planted in various parts of the State. A number of promising new varieties was distributed for district evaluations this year.

Tomato eating quality. Research with tomatoes has shown that, contrary to popular belief, optimum eating quality at the ripe fruit stage occurs if the fruit are harvested mature green. Harvesting the fruit before green maturity or after colour has developed results in a reduced fruit quality.

In addition, mature green fruit ripened with ethylene are of higher eating quality than mature green fruit allowed to ripen naturally.

Guava processing and storage technology. The development of improved post-harvest handling and processing techniques for guava will allow for correct handling of this crop. Techniques for control of fungal rots, and optimum conditions for storage have been developed. This, together with the identification of GA 11–56 as the outstanding variety for processing, and the development of processing technology for producing juices and other products, has allowed the development of a new important fruit crop industry.

Development of horticulture at Chinchilla. Departmental extension at Chinchilla and encouragement of the Local Producers' Association has brought significant changes to the district's horticultural industry. In the last 3 years, the supply of grapes from Chinchilla to the Brisbane market has risen from 2 000 to 24 000 cartons and plantings are now approximately 100 ha. Rockmelons and a range of vegetables have shown a similar trend and peaches are also being planted.

Work by the Department has determined suitable varieties, introduced pre-cooling and stimulated better transport facilities which have been critical factors in the success of the Chinchilla horticultural industry.

Testing farm spray equipment. An extension system using fluorescent dyes to evaluate the performance of spray application equipment has been developed, and officers have been trained in its use. Associated work showed that growers' spray equipment usually requires changes in management, adjustment and design to achieve efficient spray application.

Trickle irrigation in vegetables. At a well attended field day near Bundaberg, growers were shown the latest developments in the management of trickle irrigation in vegetables. The information provided has assisted some 50 local growers to utilize this new irrigation technique efficiently.

Spray thinning Murcott mandarins. Research in the Central Burnett has developed techniques for thinning fruit on Murcott mandarins using ethephon sprays. To facilitate adoption of the technique by growers, a simple method was devised for determining the amount of fruit on the trees.

Banana diseases in Cape York. Black sigatoka disease of bananas was discovered at Bamaga on Cape York Peninsula in June 1981 and subsequently on some of the Torres Strait islands.

In 1981–82, action was taken to eradicate it from the Australian mainland, along with an exotic freckle disease that was also found at Bamaga and Lockhart River. From subsequent inspections, officers are hopeful that the diseases have been eradicated from the treated areas. Banana planting material to replace the plants eradicated will be provided in late 1982.

Returnable crate pool closed. The plastic returnable crate pool introduced by CHEP for evaluation in early 1981 was closed in October. This decision became necessary when fruit and vegetable wholesalers and retailers expressed dissatisfaction with the attendant security and recording problems, although the growers and transport operators were keen to adopt the innovation.

Queensland leads in fruit and vegetable cooling. Growers and industry are adopting forced air cooling of horticultural produce at an increasing rate, and improvements in market quality are obvious. Other States have shown interest in the technology and an officer of the Market Extension Service accepted an invitation from the Governments of Western Australia and Northern Territory to lecture growers, industry and Departmental officers on the subject.

Coffee is a crop which is receiving increasing attention and interest in Queensland. As part of the research project, improved lines are being brought in from overseas.

Agricultural chemistry

Agricultural Chemistry Branch has developed an instrument for the rapid determination of sunflower oil quality. Environmental conditions strongly influence the degree of unsaturation of sunflower oil. Oil quality is judged in terms of degree of unsaturation, which depends on the fatty acid composition of the oil. Conventional analytical methods for oil quality assessment can be expensive and time consuming.

The mathematical relationship between refractive index and the degree of unsaturation of sunflower oil has been used to develop an analytical instrument which, after injection of a sample oil, automatically displays the refractive index (25°C), iodine value, % linoleic acid and % oleic acid of the oil. Refractive index is measured using a differential refractometer. Calculation of results, control of the digital displays and continual updating are microprocessor controlled.

The Oil Quality Analyser displays results within 2 min of sample injection (1 mL). A fully working prototype has been built and a provisional patent application has been made. Negotations for licensed manufacture are proceeding.

Entomology

Lucerne aphid control studies. Over the past 5 years, lucerne aphids have been transformed from a potentially disastrous to a controlled problem. The future will see a further diminution of the problem and the establishment of varieties with greater stand life and yield than 'Hunter River' the cultivar that was most commonly planted before the appearance of the lucerne aphids.

The first significant onslaught on the problem was made by native natural enemies which multiplied rapidly and greatly reduced the initial aphid populations. These effects were augmented by the establishment of exotic wasp parasites and aphid pathogens.

Strategic use of selected chemical controls minimizes the impact of spraying on parasites and predators. These techniques, combined with detailed observation of crop development, allow management of aphid populations with minimal spraying and no crop losses.

The next stage of the programme is about to be implemented. An inter-branch co-operative programme has identified the imported lucerne cultivars that have adequate aphid and disease resistance and that are adapted to varying climates and soils.

A breeding programme involving the Entomology and Plant Pathology Branches of the Department and CSIRO Division of Tropical Pastures has produced two lines with excellent disease and insect resistance. The one that has been tested in the field is a winter semi-dormant line, and currently it is outyielding all other lucerne varieties in trials in the Lockyer Valley.

When aphid resistant lines are grown commercially, it is expected that the only aphid problem will be occasional, mild attacks from blue green aphids (*Acyrthosiphon kondoi*) during winter.

Plant pathology

An important disease of bananas, black sigatoka caused by the fungus *Mycosphaerella fijiensis* var. *difformis* was detected near Cape York on the Australian mainland and also on several Torres Strait islands. Surveys of most settlements in the Cape York Peninsula and coastal north Queensland showed the disease to be restricted to Bamaga and some of the larger islands.

As the disease has not yet occurred in the major banana growing areas of north Queensland, an attempt is presently being made to eradicate it. Black sigatoka could be far more serious than the existing sigatoka (leafspot) disease caused by *Guignardia musae,* which was also located in Far North Queensland with a distribution as far south as the Lockhart River. The eradication campaign against black sigatoka is a joint Plant Quarantine-Plant Pathology-Horticulture Branch exercise.

In southern Queensland, boil smut disease of maize, caused by *Ustilago maydis,* occurred for the first time in this State. The disease was found on several properties near Beaudesert and Gatton, and incidence was generally low. However, the occurrence of the disease in hybrid maize seed crops has led to restrictions on seed movements out of the affected areas to prevent disease spread to north Queensland.

Boil smut produces spores in galls on stems, leaves, tassels and cobs and the seed-borne spores can remain viable for up to 16 years. All seed is being treated with thiram and other fungicides will be screened as seed treatments. In addition, existing cultivars and breeding lines will be evaluated for possible sources of resistance.

Another potentially serious disease is Panama disease of bananas, caused by the fungus *Fusarium oxysporum* f. sp. *cubense.* This disease has been widespread in Lady Finger type bananas for many years but Cavendish type bananas have been resistant.

Since 1977, small numbers of the Cavendish cultivar Mons Mari on several plantations in the Wamuran Basin near Caboolture have been showing Panama disease symptoms. These occurrences were initially thought to be the result of natural breakdown of resistance in Cavendish, but recent work has confirmed differences in host specificity between fungal isolates from affected Lady Finger and Cavendish.

Rapid screening methods are based on cultural characteristics and inoculation of banana plantlets derived from tissue culture. Co-operative work is also in progress to compare the Wamuran isolate of the fungus with new races of Panama wilt fungus causing serious losses in Cavendish in South Africa and Taiwan.

New restrictions on the movement of planting material from the affected area are being enforced in an attempt to reduce the chance of spread of this new race of the Panama wilt fungus.

Losses caused by Phytophthora stem rot of soybean (*P. megasperma* f. sp. *glycinea*) were less than in the previous year, largely due to increased planting of cultivars possessing field resistance. Laboratory and field research techniques have successfully identified several cultivars, particularly cvv Hill, Collee, Davis and Bragg, with good levels of field resistance. Seed treatment with metalaxyl before planting has been shown to further increase the yield of cultivars possessing some field resistance.

Post-harvest diseases usually cause extensive fruit damage and losses in avocados. In conjunction with Horticulture Branch and the NSW Department of Agriculture, a new fungicide treatment to control losses caused by anthracnose (*Glomerella cingulata* var. *minor*) and several fungi causing stem-end rot, has been developed.

The fungicide is being tested for application as a post-harvest dip and as a spray; both these methods of application are being developed as practical packing shed treatments. Also, in conjunction with the NSW Department of Agriculture, pre-harvest treatment with the fungicide has been shown to be similarly effective in controlling anthracnose. These treatments should soon be registered for use with immediate benefit for both growers and consumers.

Three co-operative projects involving breeding for disease resistance are progressing satisfactorily. A second sweet corn hybrid with resistance to sugarcane mosaic virus has been approved for release. Resistance to Fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici* race 4) in tomato and to watermelon mosaic virus in cucurbits has been identified and incorporated into respective breeding programmes. Both these programmes are attempting to retain these resistance genes and incorporate them into horticulturally acceptable cultivars.

Resistance to watermelon mosaic virus in cucurbits has been identified and incorporated into the breeding programme. Plant breeders are attempting to retain the gene for resistance and incorporate it in horticulturally acceptable cultivars. The picture shows a plant breeder hybridizing pumpkins.

Specialist sections of Plant Pathology Branch continued to provide a high level of diagnostic services on plant diseases and pathogen identification for both Departmental officers and primary industry. Plant disease surveys were conducted in Far North Queensland and the Torres Strait islands, where plant diseases were previously poorly documented.

We have continued to document the plant pathogens occurring in Queensland and are developing new biochemical techniques to detect pathogens in diseased plants and to differentiate closely related organisms. Some of these techniques form the basis of genetic engineering, an exciting field with future potential in plant disease control.

Plant industry extension

Farm machinery management extension activities through field days at St George, Brigalow, Millmerran, Oakey, Inglewood, Taroom, Drillham, Moonie, Binjour and at Farm Fest, Toowoomba, attracted enthusiastic farmer support in the area of tractor performance and machinery matching. These field days were complemented by more than 20 meetings and seminars and a regular column 'Talking Machinery' in the newspaper *The Graingrower*.

This farmer interest reflects the increased cost of owning and operating farm machinery and its effect on grain farm profitability.

Conservation cropping extension activities in co-operation with Soil Conservation Branch were intensified in the Atherton Tableland, Emerald, Biloela, Gayndah, Kingaroy, Toowoomba, Dalby, Warwick, Pittsworth, Miles, Goondiwindi and Roma districts.

These projects are designed to improve farmer awareness and understanding of the importance and cost of soil erosion and the benefits of crop stubble protection of the soil and conservation cropping systems.

The projects are addressing the use of relevant farm machinery, reduced tillage, herbicide usage and crop sequences. They also stress the need to incorporate conservation cropping practices with sound land use involving contour banks, waterways and other structures necessary to combat soil erosion.

Research stations

Completion in September of a new building to accommodate sows and weaners at Biloela Research Station permitted expansion of pig research at that centre. Research with pigs at Hermitage Research Station was progressively phased out and, by the end of May 1982, the transfer of pigs from Hermitage to Biloela had been completed.

Relocation of dairy animals from Ayr Research Station was also completed although delivery of the last heifers placed a strain upon feed supplies at Mutdapilly Research Station. Field developments at Mutdapilly were not helped by the dry conditions that persisted throughout much of 1981. The Mutdapilly dairy unit had been transferred from Ayr and was successfully re-commissioned in its new location.

Administrative responsibility for certain Government parks and gardens in the Brisbane area was transferred to Research Stations Section. A re-equipping programme was initiated and this combined with accelerated replacement of unthrifty perennial plants led to some improvements being made in the appearances of gardens. The co-operation of the Department of Works in capital landscaping activities was welcomed and provided a basis for continued up-grading of parks and gardens.

Irrigation facilities were substantially improved at Gatton, Granite Belt and Kingaroy while new sheds for implements or hay were erected at Brigalow and Gatton Research Stations.

Significant progress was made with the construction of several major buildings. Details are given in the report of the Research Stations Section.

Plant propagating facilities at Redlands were improved, and at Bowen a start was made on the provision of better office, plant propagation and irrigation facilities.

Drainage works undertaken at Walkamin and at Biloela are expected to appreciably increase the areas of land available for experimental purposes. Land levelling operations at Ayr and at Biloela are expected to overcome problems associated with conducting trials on soils of variable depth and fertility.

The declining capacity to finance regular replacements of expensive items such as headers and tractors was recognized. A special effort was made to divert funds and so permit the replacement of several major items including a header at Millaroo and plot-harvester at Biloela. Particular attention was given to replacing tractors and machinery on the Horticultural Research Stations at Kamerunga, Bowen, Maroochy, Redlands and Granite Belt.

Seasonal conditions permitted a higher than normal success rate in the establishment and conduct of experiments. This generally satisfactory performance provided opportunities to conduct field days at most centres. Producer attendance was gratifying at all of these, and the preparedness of field day visitors to enter into discussions continued to intensify.

Division of Administration

ADMINISTRATION Division comprises the Central Administrative and Accounting Services of the Department and also some Technical Support Services. Central Administrative and Accounting Services includes the Departmental Directorate, Organizational Services Branch, Clerical and General Branch and Accounts Branch. Technical Support Services incorporates Information and Extension Training Branch, Biometry Branch, Research Stations Section and Extension Services Section.

Central Administrative and Accounting Services

Staff establishment in the Central Administrative and Accounting Services at 1 July 1982 compared with that of the previous year is shown in the following table—

——	As at 1-7-81	As at 1-7-82
Ministerial staff	7	6
Department directorate and internal audit	9	9
Brisbane administration and records	55	57
Commercial, despatch and stores	13	13
Country support staff	154*	154
Accounting and finance	67	67
Total	305	306

* Includes 44 positions previously funded by the Stock Fund.

Branch complements within the Central Administrative and Accounting Services are—Organizational Services Branch 18; Clerical and General Branch, Brisbane 37, country 154; and Accounts Branch 80. In addition, clerical staff are employed in the Minister's Office (three) and the Branches and Sections forming the Technical Support Services and also in the other Divisions of the Department to provide a range of support services for a variety of purposes. Comments on activity in these Divisions are given in other sections of this report.

General overview

During 1981–82, the Organizational Services Branch, which was set up the previous year, began the task of integrating a number of administrative functions which had been previously undertaken by separate groups.

Organizational Services Branch was the co-ordinator for a training programme introduced specifically for clerical staff of the Department.

The Branch now provides a counselling and referral service, available to all Departmental staff with personal problems affecting their work performance. This service is part of the Employee Assistance Service which is a programme operated by the Public Service Board for all public servants.

Awareness seminars about the Employee Assistance Service have been conducted for DPI staff in the Brisbane area and it is planned to extend this awareness programme to all Departmental staff. A number of staff members has used this service, either on their own account or in their capacity as supervisors.

Courses included communication and management skills, administrative procedures and problem identification. Participants at these courses were from all sections of the Department including clerk-typists, stenographers, clerks and classified clerks. In total, 142 officers participated, of which 49 were from country centres.

Several amended administrative systems, procedures and forms were designed during the year to streamline or simplify internal Departmental information or accounting transactions.

State-wide training sessions with Administrative Officers and their office staff were undertaken during 1981–82 on financial management at each office of the Department. Training regarding requirements under the *Financial Administration and Audit Act* and the Accounting Manual as well as the introduction of improved systems for local financial transactions was the object of this training programme.

One officer attended a 4-week, full-time management training course conducted by the Australian Institute of Management.

In addition to in-service training provided in the Department, officers are helped in undertaking study and/or research to develop their skills and knowledge for careers in the Public Service.

In 1981–82, 199 officers were assisted in part-time or external studies. Of these, 50 were beginning their courses. A total of 28 officers completed their courses which ranged from High School certificates to post-graduate degrees. Assistance took various forms: reimbursement of fees, lecture leave, examination leave and leave to attend residential schools.

Full-time study assistance is currently being provided for 17 Departmental officers. In 1981–82, 19 officers completed their full-time studies.

Furthermore, approval was granted this year for 18 Departmental officers to undertake short overseas study tours primarily of benefit to the Department.

In response to a need which has developed over a number of years, the position of Executive Officer (Special Projects) was created during the year. This position was provided to co-ordinate activities associated with the Department's legislative programme. Before this position was created the programme was handled separately at Divisional level.

Departmental staff

The approved permanent salaried staff establishment of the Department for 1981–82 compared with the previous year is shown below—

——	As at 1-7-81	As at 1-7-82
Consolidated Revenue Fund	*2 388	2 395
Trust and Special Funds	293	299
Commonwealth Funded	†140	143

* Includes 64 positions transferred from Queensland Fisheries Service.

† Includes three positions transferred from Queensland Fisheries Service.

Retirements

A total of 35 staff resigned or retired during 1981–82 after attaining 60 years of age. Officers who retired after more than 25 years' service were: Messrs N. F. Fox, Deputy Director-General; N. H. Hall, Chairman, Brisbane Market Trust; F. N. J. Milne, Director, Pig and Poultry Branch; Miss W. M. Allen, Senior Seed Tester, Standards Branch; Messrs K. C. Beaumont, District Inspector, Veterinary Public Health Branch; F. W. Berrill, Assistant Director (Extension), Horticulture; W. J. Bissett, Senior Agrostologist, Agriculture Branch; H. M. Brouwer, District Experimentalist Division I, Agriculture Branch; K. J. Darcy, District Inspector Division II, Veterinary Public Health Branch; J. D. Elrington, District Adviser Division I, Dairy Field Services Branch; A. E. Fisher, Senior Information Officer, Publications—Primary Industry, Premier's Department; E. F. Gusthart, District Inspector, Veterinary Services Branch; H. T. Green, Principal Chemist, Agricultural Chemistry Branch; J. A. Hinds, District Adviser, Dairy Field Services Branch; R. A. Mann, Inspector, Standards Branch; A. I. Nisbet, District Inspector, Veterinary Services Branch, G. L. Piper, District Inspector, Standards Branch; E. T. Prodonoff, Assistant Director, Standards Branch; S. D. Rippingdale, Attendant, Dairy Research Branch; J. D. Stuart, Clerk, Economic Services Branch; E. Sypkens, District Adviser, Soil Conservation Branch; R. E. Taylor, District Inspector, Horticulture Branch; R. T. Weston, District Adviser, Dairy Field Services Branch.

Accommodation

Country centres experiencing acute accommodation problems continue to receive attention. Two of the centres were Goondiwindi and Charleville. Erection of a demountable building at Goondiwindi has made it possible for officers to be relocated from two floors in the Courthouse building. Extensions to Office Building No. 2 at the Charleville Pastoral Laboratory have relieved overcrowding at that centre.

The DPI Central Library has been relocated within the former DPI building in William Street, Brisbane, into more spacious and enhanced accommodation on the ground floor.

Major construction work has begun at the Maroochy Horticultural Research Station on Stage 1 of an office-laboratory complex which will include suitable accommodation for administrative and extension staff and modern facilities for research officers. Staff presently at the Nambour office will be relocated to the Station.

A major development of the Animal Research Institute at Yeerongpilly features prominently in the Department's plan to maintain effective and efficient service to the rural community.

However, reduced levels of funding continue to frustrate efforts to provide at the appropriate time essential buildings and equipment.

Finance

During 1981–82, the operations of the Department were under considerable restraint due to staff ceilings and funding limitations imposed through Commonwealth and State Government policies and industry economics.

This Department serves diverse and widely spread rural industries throughout the State. It is essential that many of the services offered by the Department are provided in or close to the areas serviced. A number of new or expanded centres in country areas has been developed over recent years. Maintenance and operation of such centres in remote areas is a costly but justified exercise. Fuel costs, which represent a major cost of field staff, have been subject to cost increases far higher than the general inflation index. The effect on existing funds has been significant.

Natural disasters placed considerable demands on finances. Administration of the joint Commonwealth-State Disaster Assistance Scheme inspections and processing of payments were met wholly from Departmental funds. Actual assistance payments made by this Department and subject to cost sharing arrangements amounted to $3,845,938 compared with $11,709,648 in 1980–81.

Departmental expenditure from the Consolidated Revenue Fund as compared with the previous year's expenditure is shown in the following table:—

Vote sub-division	1980–81	1981–82
Payments authorized by special acts	$	$
Grant in aid of the Banana Industry Fund	90,887	95,850
Department of Primary Industries		
Salaries	38,286,438	44,225,876
Contingencies	20,856,452	26,294,704
Total	$59,233,777	$70,616,430

Compensation payments within the Bovine Brucellosis and Tuberculosis Programme amounted to $2,809,933 during 1981–82 compared with $1,515,910 in 1980–81.

The estimated State's share of the Commonwealth-State Bovine Brucellosis and Tuberculosis Eradication Programme amounted to $2,548,659 of a total estimated expenditure from Consolidated Revenue Fund of $8,253,429.

Transactions in respect of the Trust and Special Funds as compared with the previous year are shown in the following table:—

Trust and special funds	1980–81	1981–82
	$	$
Department of Primary Industries Special Standing Fund	13,658,810	8,846,192*
Banana Industry Fund	208,869	221,392
Commonwealth Agricultural Extension Services Fund	1,276,373	303,102
Commonwealth Poultry Industry Assistance Fund	3,354,784	3,557,308
Commonwealth Quarantine and Export Inspections Fund	2,478,936	3,030,921
Commonwealth Rural Industry Grants Fund	2,072,292	2,132,044
Fisheries Research Fund	184,164	358,474
Meat Inspection Account	2,787,543	3,228,173
Poultry Inspection Fund	561,610	645,208
Stock Compensation and Stock Improvement Fund	23,585	20,607
Sugar Cane Prices Fund	1,614,313	1,788,692
Swine Compensation Fund	31,438	2,468
Total	$28,252,717	$24,134,581

* Includes $3,845,938 on account of Disaster Assistance Scheme and $2,385,542 on account of the Queensland Fish Board.

Expenditure of $130,000 was incurred on behalf of Fisheries through the Loan Fund to 30 June 1982.

Technical Support Services

Research Stations Section

FROM January 1982, Research Stations Section assumed administrative responsibility for horticultural research stations. This brought to 17 the number of stations operated by Research Stations Section. The winding down of Coolum Research Station continued as research projects at that centre were completed.

Research Stations Section operates stations at Kairi, Walkamin, Kamerunga, South Johnstone, Ayr, Millaroo, Bowen, Biloela, Brigalow (near Theodore), Maroochy, Coolum, Redlands, Kingaroy, Mutdapilly, Gatton, Hermitage (near Warwick) and Granite Belt.

Facilities and equipment on these stations are used for conducting research projects on the stations and, under approved circumstances, on certain commercial properties in the surrounding districts. The Section also operates a number of sites removed from the major Stations. The most significant 'sub-stations' are Utchee Creek and Redvale which are associated with South Johnstone and Kingaroy respectively.

Certain Government parks and gardens in the Brisbane area came under the Section's control late in 1981. Headquarters for these gardening services are located at Queen's Park, Government House, Museum and Migration.

Administration

The Section's facilities and resources were used to implement experiments which fell within the broad objectives of research projects endorsed by the Research Stations Board. This Board, established in 1961, is under the Chairmanship of the Assistant Director-General responsible for research. Directors of each of the five technical Divisions are members of the Board which met on eight occasions during the year.

Each Station has a Reviewing Committee which is responsible for examining proposals submitted for inclusion in that Station's research programme. The Committees allot priorities to individual project and experiment proposals so that resources and facilities available on Stations can be used effectively.

At Kairi, Brigalow, Biloela, Kingaroy and Hermitage, Reviewing Committees are supported by Industry Consultative Committees which include progressive, influential primary producers.

Facilities and equipment

Concerted efforts to replace and to upgrade aged facilities and equipment began in 1980–81 and were continued throughout 1981–82. Financial limitations which persisted throughout the 1970s prevented earlier replacement of several major items which had become unreliable. Special funds were made available and were used to overcome the most pressing needs. At the end of May 1982, most problems had been eased.

Particular attention was given to the needs to upgrade equipment on the five Horticultural Research Stations.

Acquisitions included: a small tractor and irrigation equipment at Granite Belt; a tractor and orchard mower at Bowen; a tractor and chain saw at Kamerunga; a tractor, motor cycle, generator and spray unit at Maroochy; a tractor, rotary hoe and toolbar at Redlands; a tractor, plot harvester, bed shaper and mobile welder at Biloela; a tractor and post hole digger at Brigalow; irrigation equipment and spray plant at Kairi; a grain harvester at Millaroo; a tractor at Kingaroy; a tipping trailer at South Johnstone, and an irrigation unit and cultivating equipment at Walkamin.

Significant progress was also made with buildings. Major events were: commencement of the office and laboratory complex at Maroochy; commencement of a new dairy and a seed handling facility at Kairi; erection of a residence in the fisheries section at Walkamin; completion of two residences at Mutdapilly; commencement of an additional glasshouse and a seed handling and storage shed at Kingaroy; sheds for mowers and tools for parks and gardens; improvement of plant propagating facilities at Redlands; commencement of improved office facilities at Bowen; erection of an implement shed at Brigalow; completion of the new sow and weaner building in the Biloela piggery; construction of a combined implement storage-amenities shed at Redvale; erection of a hay shed at Gatton.

Substantial improvements in irrigation water supplies and reticulation were accomplished at Mutdapilly, Granite Belt, Hermitage, Gatton and Kingaroy.

Land grading and drainage received attention at Ayr, Walkamin, Granite Belt, Mutdapilly and Biloela. In some cases, these works brought new areas of land into cultivation while in other locations areas of previously cultivated land were made more suitable for the conduct of experiments.

Test drilling for underground water at Mutdapilly was moderately successful.

Notable events

Landscaping of several gardens in the city area and extensive replacements of unthrifty perennial ornamentals improved the appearance of gardens expected to be viewed by visitors to the Commonwealth Games later in 1982.

Pig research was terminated at Hermitage when the last batch of animals was transferred to the new facilities at Biloela in May 1982. Comparatively few problems were experienced in commissioning the Biloela piggery building and serious initial leakages in effluent drains were repaired.

Transfer of the remaining AFS heifers from Ayr in November marked the end of an era during which considerable progress had been made with dairy research in a tropical environment.

At Mutdapilly, the rotary dairy that was shifted from Ayr was recommissioned without experiencing any major difficulties.

Research experiments at Coolum were completed and field improvements were salvaged for use at Mutdapilly.

The survey of soils at the Gatton Research Station was successfully completed and substantial progress was made with soil surveys at Mutdapilly, Biloela and Ayr.

A navy bean breeding project was commenced. This project is based at Hermitage although Kingaroy and Walkamin Stations will co-operate in the series of experiments planned.

South Johnstone staff participated in the establishment of a pasture species demonstration on the Silkwood lease.

The importance of the Redlands workshop was underlined by the successful fabrication of a soils sterilizing unit to be put into operation at Bowen Horticultural Research Station.

The Redlands site was poised for rapid expansion as plans were finalized for a major poultry research unit and extensions were made to the Artificial Breeding Centre.

Expansion of freshwater fisheries research activities at Walkamin was highlighted by the development of techniques for mass production of fingerlings and the successful release of 150 000 fingerlings into sites selected throughout eastern Queensland.

Field days were held at most centres and attracted large attendances of visitors. More than 650 people attended an open day at Brigalow and more than 300 attended a similar day at Mutdapilly. Field days to display pome and stone fruits at Granite Belt, spraying equipment at Bowen and plant propagation techniques at Kamerunga were highly successful. The annual field days on beef fattening at Utchee Creek and on rice research at Millaroo attracted the usual high levels of support and interest.

Following a detailed review of land requirements, an irrigable area of approximately 75 ha of Millaroo Research Station was relinquished.

Achievements

Research Stations Section is predominantly associated with servicing research programmes. Details of research achievements appear in Divisional contributions to this report.

Seasonal conditions were highly variable and some centres reported both droughts and flash floods during the year. Fortunately, trial sites were generally spared and an unusually high rate of success was achieved with experiments conducted throughout the State.

Cassava and starch crop collections were successfully established at Ayr Research Station and a new banana nursery was developed at South Johnstone. New tea gardens were also successfully established at South Johnstone.

Contour banks built at Redvale stood the test of heavy storm rains and preliminary cropping results suggest that this substation will prove to be highly satisfactory for dryland crop research activities.

Subdivisional fencing at Hermitage equipped the station to handle proposed experiments with sheep.

Staff problems were few. No industrial disputes occurred and resignations were fewer than normal. Labour resources generally were taxed close to the limit to cope with expanded experimental programmes, with development projects and with the acceptance of additional responsibilities.

The comparatively smooth acceptance of responsibilities for parks and gardens and for horticultural research stations was made possible only by the co-operation, patience, goodwill and energy of employees at all levels within Research Stations Section, Horticulture Branch and Central Administration.

Information and Extension Training Branch

A growing call for more agricultural information by both the rural and non rural sectors in Queensland led Information and Extension Training Branch to place greater emphasis on producing information to service this need in 1981–82. The Branch is bridging this information gap by concentrating on the specialist rural press and expanding the production of saleable books and booklets.

In 1981–82, as in the past, the principal functions of Information and Extension Training Branch were: 1. to disseminate agricultural information to the community, paying special attention to the rural sector; and 2. to provide training programmes to develop in Departmental staff management and extension method skills.

To carry out its aims in the communication area, the Branch supplies support services to other Branches as well as initiating its own programmes. Support is given in such fields as editorial services in the production of publications, still and cine photography, art, displays and show exhibits, in-house duplicating and liaison with the Government Printer, audio-visual equipment, and library services.

Training needs of the Department are met through a series of formal courses, workshops, seminars and projects conducted by the Branch's training staff.

Total staff of this Branch stood at 61 on 31 May 1982. Of these, eight were officers of Public Relations, Government News and Information Services, Premier's Department; 14 were librarians from the State Library; and one was a printer from the Government Printing Office.

Major achievements were an expansion of coverage in the specialist rural press and a further increase in editorial work on saleable books. Expansion of press coverage was made possible by the appointment of an Agricultural Journalist to fill a long-

standing vacancy. The increase in the editorial work on saleable books was the result of the growing awareness in the Department of the need to provide this assistance.

Information section

Editorial. Six issues of the *Queensland Agricultural Journal* were prepared during the year under review and four were published. The remaining two were in the printer's hands at the end of the year. This magazine remains the Department's principal extension publication and offers a range of half-tone and colour reproductions to support those articles that need illustration.

During the year, both editorial staff and the Government Printer's staff became more familiar with the new technology introduced at the Government Printing Office. This led to changes in typography, improving both the display and readability of the magazine.

In the last year, more than 80 articles were published in the journal. These covered topics as diverse as tick control, feeding club ponies, sharpening butcher's knives, building farm roads, trees on the farm, and growing carnations.

A serious setback occurred during the year when the *QAJ* was without an editor for 6 months. This, together with printing delays, caused the journal to be unacceptably late in appearing. However, since the appointment of a new editor in March, the backlog is being quickly overhauled.

Editorial staff co-operated with Branches in editing, recording and producing 212 new Farmnotes and 20 Refnotes.

Although Farmnotes cannot be regarded as the only means of conveying written information to producers, they are the fastest and most economical means.

Their limitations are that they are of necessity short (a maximum of four printed pages) and they cannot, with present DPI technology, carry photographs or colour. To attempt to provide for longer articles and pictures would, with present equipment and staff, cancel the advantages of timeliness and economy.

However, the *Queensland Agricultural Journal* and special, sometimes saleable, publications are available where comprehensive treatment of a topic is required.

Late in the year, a move was made towards the centralized distribution of Farmnotes through Information and Extension Training Branch instead of through the originating Branches. To set up the organization to handle this innovation, largely through a reallocation of duties of clerical staff, an officer was seconded from Economic Services Branch.

By the end of the period under review, this officer had assessed the situation and was preparing a plan of implementation. The project is expected to be brought to fruition in the coming year.

Appointment of an Agricultural Journalist with the exclusive responsibility for book editing, has filled a long-standing need. It has permitted the setting up of an editorial team consisting of the Senior Information Officer, Editor *Queensland Agricultural Journal* and book editor within the Information Section.

With an officer engaged almost full time on book editing, this re-arrangement of staff permitted the publication of five new titles during the year. In addition, editorial work was at an advanced stage on a further 13 new titles, all of which will be added to the present 30 saleable books.

The regard for the Department's saleable publications by primary producers, agribusiness and hobbyists can be gauged from the increasing volume of sales. In 1981–82, sales totalled 9 595 volumes, compared with 3 988 in the previous year.

The sustained demand for semi-technical and technical information from so many sections of the community suggests that the production of 'for sale' books will become a permanent function of the Branch. Furthermore, rising printing costs make it inevitable that those requiring this information should be asked to meet the cost of production.

Increased book production has created a greater need for Cataloguing-in-Publications data from National Library, and the allocation of ISSN and ISBN. These duties have fallen within the orbit of the book editor, together with the preparation of suitable title pages and other editorial requirements for the various publications.

During the year, DPI publications were reorganized into 13 new and more appropriate series. The change began in January 1982, and is expected to be implemented fully at the end of 12 months. This innovation followed a series of meetings by the librarian and book editor with Branch directors and Branch editors at which consensus was achieved.

This is an important measure for DPI publications as they are now grouped in orderly series and carry their relevant ISSN. Because of this, they are more readily retrievable and their availability more widely known through the National bibliographical services.

The editorial section also had major commitments in handling the work of Information Branch journalists and in preparing for publication the Department's Annual Report to Parliament. Editorial staff also took part in writing training workshops run in conjunction with the training staff.

The Senior Information Officer was again responsible for preparing speech and background notes and special magazine articles for the Governor, the Treasurer and other State Cabinet Ministers, and the Director-General. In the year under review, calls for speech notes and background information from the Governor-General and the Prime minister were also handled.

During the year, the book editor attended a workshop on the design and marketing of small publications at the University of New England as part of the Branch's in-service training programme.

Press. Usage by the rural and provincial press of the agricultural information provided in the Department's weekly bulletin of press items continues at a satisfactory level. This bulletin is now sent to more than 100 media outlets both in Queensland and interstate, made up of 100 metropolitan, provincial and specialist rural press, 25 radio stations and six television stations.

It is gratifying that the wide newspaper and A.B.C. coverage the press items receive is bringing to the notice of all Queenslanders the Department's contribution to primary production and the well-being of consumers.

Besides this coverage, feature articles are prepared for newspapers, both at their request and at the initiation of the journalists.

The weekly agricultural feature supplied by the DPI to *Queensland Country Life* continued and is now in its third year. This worthwhile project gives exposure each week to some facet of the Department's research on behalf of primary production.

Queensland Country Life, with a circulation of 30 000, is an ideal vehicle to publicize DPI achievements.

After a year's trial, the arrangement to supply *National Farmer* with one page of extension-oriented material each month was continued. Since February 1981, this rural newspaper has published about six stories and two photographs a month on a special page headed by the DPI banner.

National Farmer's circulation policy puts a copy free of charge into every farm home in Queensland—some 35 000. The value of this coverage to the Department is enormous.

During the year, a new series 'Crop Research Profiles' was begun in the *Queensland Graingrower.* One profile, prepared by Information Branch journalists, is published in this newspaper each week. Again, this brings to the attention of a specialized audience the Department's research in the interests of primary production.

Radio. The main radio output of the Branch continues to be a weekly 15-min programme which is sent to 16 rural radio stations in Queensland. Through syndication it goes to many others. Last year, the programme was re-organized into five segments—a news report and four interviews. A satisfactory response from radio stations has encouraged the continuation of this type of programme.

Officers of Marketing Services Branch continued to use Information Branch facilities to tape a 2 to 3 min talk each week for the A.B.C. Country Hour.

Practical training in the use of radio in extension work was given at the Department's staff training workshops.

Television. Coverage in this medium has never been effectively achieved by the Department. Metropolitan channels cater mainly for an urban audience with minor interest in rural affairs. Disasters such as drought, flood, fire and disease outbreaks have been covered. The less striking, but more important, stories of achievements of research do not get coverage.

In present circumstances, the coverage of DPI news could best be achieved by appointing a television journalist with a good news sense. This officer would 'find' the stories and interest the channel in covering them.

Provincial television, however, provides limited coverage to cater for the relatively higher proportion of rural viewers.

Regional information. The aim of regional information is to support the Department's extension programmes in the areas served with Regional Information Officers.

Regional Information Officers based at Rockhampton and Toowoomba continued to supply agricultural information to local media. They also handled special assignments required at Head Office.

The three regions in the south-eastern corner of the State—East Moreton, West Moreton and the Near North Coast—were given media support, part-time, from journalists based at Head Office. The satisfying trend for the specialist rural media to call on the Department's journalists for more material is restricting the assistance these journalists can give these regions.

Soil conservationist Louise Hepworth (seated) helps staff the information counter in the Department's exhibit at the 1981 RNA Exhibition. Besides advisory literature on crops, pastures and livestock, 25 000 copies of a 'soil conservation game' were handed out to Show patrons. The game was aimed at increasing general awareness of the soil erosion threat in Queensland.

Art. In 1981–82, commercial artists engaged on publications produced 272 pieces of art work for printing either in-house or at the Government Printing Office.

The call on the artists to prepare the lettering for title pages has increased following the reorganization of the Department's publications and the greater production of saleable books.

Another area of increased activity has been the production of posters and signs for conferences. These posters have been highly commended at interstate and overseas international functions. This important activity cannot be fully serviced with the present staff.

Art work is a growth area in the Branch as electronic technology in printing calls for a greater art input. In addition, the recognition of the value of professionally prepared posters and conference displays has created a call for more of this work. At 31 May, Art Section was staffed by only one commercial artist but it is hoped that the vacancy for another will be filled early in the new financial year.

The display artist again set up a crowd-stopping display at the Royal National Association's Exhibition in August.

This officer also handled the displays for 14 district shows, and set up displays at 10 DPI presentations. These included brigalow development, sheep and wool husbandry practices and management of mulga country.

In-plant duplicating. The requirements of Branches for duplicating continued at a level beyond the capacity of the in-plant facility. Continuing and increasing use is being made of the Government Printer's 'fast print' service. This is used to handle work beyond the capacity of the in-plant facility and workshop papers and proceedings for which a registration charge is made. Handling of 'fast print' work has been facilitated by the experience of the officer seconded from the Government Printing Office.

Production from the in-plant duplicating facility was 7m printed pages in 1981–82. This puts the value of duplicating Branches received in excess of $91,000 on current 'fast print' rates. In addition most of this work was collated and stapled without charge to Branches.

Photography. The photography section operated under difficulties during 1981–82 because of a chronic shortage of staff.

The staff of five photographers was depleted through resignations to two by the beginning of May. The position was eased somewhat by the appointment of a temporary officer late in that month. A return to full strength is expected in the new financial year.

Demand for cine work was again high. Two films 'Living with drought' and 'Parthenium in perspective' were completed during the year and released for viewing.

Four others, on soil conservation, dip moulds, sheep blowfly and header cleaning, were at an advanced stage of production at the end of the year.

A total of 3 000 m of cine film was shot during the year and 890 hours spent on film editing.

To improve their contribution to cine film production, the two permanent photographers attended training courses at the Australian Film and Television School, Sydney.

Despite the staff shortages, the photography section took 8 500 exposures during the year. It produced 9 500 prints for record and publication and 873 display prints.

General inquiries. The reception–general inquiries desk in Information Branch again proved an aid to the public and an asset to the Department.

The average number of inquiries per day at the 'information centre' totalled 43. Of these, 80% were answered with information available at the counter, providing an on-the-spot service to the public and representing a considerable saving in time for technical officers. The remaining 20%, because of their more specific needs, were referred to technical officers.

The secondment of a horticulture adviser to the 'information centre' proved its worth during the year. This officer dealt with about 35 inquiries (phone calls and callers) a day on both general horticulture and ornamentals. He was able to give on-the-spot advice to all backyarders and hobbyists and to most of the producer inquiries as well. Again, this represents a tremendous saving of time for technical officers of Horticulture Branch.

An average of 10 letters a day is sent in answer to requests for agricultural information.

The Branch continued to handle the sale of Departmental publications. It has now had this responsibility for almost 3 years, and the provision of a centralized distribution point has resulted in greater convenience to buyers.

The proposal to enlarge the scope of the distribution centre to handle more publications is being implemented. It is proposed that this centre should handle all Departmental publications, including Farmnotes, in addition to saleable items. The new distribution scheme is expected to come into operation early in the new financial year.

Of the 9 595 book sales from the 30 titles being handled, 2 200 were made over the counter at the 'information centre'.

Audio-visual equipment loan service. The Branch continued to conduct a centralized audio-visual loan service from Brisbane to ensure efficient use and servicing of equipment. Most loans were made in areas close to Brisbane, although equipment was also sent to country centres.

The service made 1 273 loans during the year as well as servicing and repairing the equipment.

An increasing demand is evident for video equipment, slide, cine and overhead projectors and public address systems.

The equipment loan service has been operating in its present form for the last 14 years. It was set up and maintained with CESG funds and, with the abolition of this special grant, finance has become a problem.

A special Treasury allocation of $12,000 in 1979–80 was used to replace obsolete and unserviceable equipment in country centres. In the same year, a final CESG grant of $1,000 was used to replace and upgrade equipment held at Head Office.

The restriction on funds makes it inevitable that the replacement and upgrading of equipment will now proceed more slowly. Users must expect some contraction in the service, with the need to book equipment well in advance of its being required.

Library

With a staff of 26, the library is numerically the biggest section in the Branch.

Library accommodation. Central Library moved from the basement of the William Street building to new accommodation on the ground floor. Planning the move and reorganizing the collection to fit into the new accommodation occupied the time of several librarians from February to April.

The actual move, with help from the Department of Works, took from 19 April to 25 May.

ARI library. In November 1981, representatives from State Library approached this Department about the sub-standard accommodation at the Animal Research Institute Library at Yeerongpilly.

It was agreed that the library would be moved from the galvanized iron building to A Block after the new area had been renovated. At the end of May, these renovations were in progress, and the librarian expected to move into the new area in July 1982.

Serials Accounting Recording Automation (SARA). All subscriptions to journals have been entered on SARA, and this was of assistance in working on the annual estimates in April 1982.

As a project before moving, all monographic series and journals whose titles had changed under the new cataloguing rules (AACR2) were re-catalogued and entered on SARA.

In all, SARA now contains 2 634 records, but this figure does not include multiple copies of journal titles.

Copies of this printout are held in all DPI libraries. It is proving extremely valuable as a listing of Central Library's holdings, as well as holdings of subscription journals in all country centres. Previously, it was necessary to phone Central Library for this information.

Mareeba regional library. The librarian from the Mareeba Regional Library resigned on 10 February 1982. She has not yet been replaced.

Rockhampton library. Two librarians spent a week in Rockhampton last August to move the library collection to new accommodation.

ABOA. The entry of Departmental extension publications in the Australian Bibliography of Agriculture data base has commenced.

Statistics. The statistics of library operations in 1981–82 are—

Accessions: Central Library 1 489 books and 137 journals.

Loans: Central Library 5 690, Branch libraries 10 771.

Inter-library loans: Central Library 899 loans, 1 201 borrowings; Branch libraries 1 711 loans, 3 257 borrowings.

Contents pages circulated: Central Library 24 547.

Articles copied from contents pages: Central Library 6 204.

Bibliographies (manual): Central Library 33, Branch libraries 16.

Computer searches: Central Library 26, Branch libraries 58.

Books catalogued: Central Library 2 360 (new and revised), 476 (added copies).

Pages photo-copied: Central Library 98 908.

Training

The Branch's training activities consisted of a formal, centralized programme and *ad hoc* events arranged for Branches or sections to overcome specific problems.

Centralized training activities 1981–82. This programme fulfils needs that occur over a wide cross section of the Department.

Communication. Two 5-day courses were conducted in communication. One for research workers put the emphasis on seminar presentation and another for regulatory workers concentrated on interviewing in regulatory situations.

Extension methods. One extension methods school, consisting of two 5-day periods of training 6 months apart, was held during the year. The intervening period was intended for reflection on and application of the content of the first week.

The first week consisted of practice in basic communication skills such as public speaking and newspaper writing. The second week contained more material on rural sociology and the psychology of communications.

It is intended to add a third week to the course to deal with conducting meetings and group processes.

Management. The first of a planned series of Management Skills Workshops was conducted. This course will replace the Management Development Course. The Management Skills Workshop caters for officers around the S9 to I–10 level, and contains less theory and more practice in management skills than the Management Development Course.

Administrative development. Training section assisted administrative and clerical staff to design and conduct courses for non-technical staff. The basic course in communication and administration has been supplemented by short courses on writing and time management.

Supplementary management training (MPIPS). One course on time management, two workshops on interpersonal communications and three programmes on stress management were conducted during the year. Priority is given on these courses to nominees who have completed the Management Development Course or a Management Skills Workshop.

Lunchtime seminars. Lunchtime seminars have been introduced as an awareness raising activity for senior management on organizational theory and personnel management. Seminars were conducted on public relations, matrix organizations and the management of power.

Special projects and consultancy. The most common role trainers fill in special projects and consultancy work is as facilitators in meetings at which the goals of sections and the role of staff are discussed.

STATREC (Computerized Staff Training Record). A computerized staff training record is being developed to help overcome difficulties in nominating staff to attend suitable courses. STATREC will give visual or printout records of all training undertaken by DPI staff.

Evaluation of Q.A.J. A survey has been made of the readership of the *Queensland Agricultural Journal.* Current Queensland subscribers, lapsed subscribers, overseas libraries and Departmental staff have been questioned. A report now being prepared will show the results and make recommendations for changes.

Extension Services Section

STAFF of Extension Services Section are responsible for co-ordinating the extension activities of Departmental officers. During the year, this responsibility has been enhanced by the addition of an Overseas Development Unit and a Drought Secretariat Unit to the Section. These units are responsible for co-ordinating the Department's involvement in overseas assignments and in the management of drought in Queensland.

Nine officers are stationed in eight of the 13 extension regions within the State. A further seven officers are stationed in Brisbane. These consist of two officers who form the Evaluation Unit, two officers who form the Drought Secretariat, two officers who form the Overseas Development Unit and an extension officer in training. The Section has a further 12 administrative and clerical staff who support the programmes of the technical officers.

Regional extension programmes

The Extension Services Section is continually examining ways of making the Department's extension programme more efficient and more relevant to producers. Regional Extension Leaders give particular emphasis to extension activities involving groups of officers assisting primary producers to overcome their problems in an organized manner.

The trend towards organizing extension programmes on an 'industry' rather than 'district' basis has continued. There are now seven regions organized on an industry extension group basis, an increase of four over last year, while an eighth region, the Far South West, is making its own unique adaptation to research and extension co-ordination.

Project teams made up of officers from different disciplines are increasing in importance as vehicles for undertaking co-ordinated projects. Examples of projects being undertaken by project teams are the Leucaena Development Programme in the West Moreton, Conservation Cropping Programme on the Darling Downs and in Capricornia, and the Pasture and Cattle Husbandry Improvement Programme in the Peninsula District, Far North Queensland.

As part of his co-ordinating role, each Regional Extension Leader is required to report annually on a number of regional matters. These include the important issues concerned with rural production, land use and the environment; extension priorities and balance between industries and districts; the allocation of Departmental resources; the progress with projects; and the involvement of producers and industry in projects.

It is pleasing to note the increasing involvement of producers in establishing industry and district needs for projects. Grazier involvement in meetings of the Charleville Pastoral Laboratory Consultative Committee and the Beef Industries Consultative Committees in the Near North Coast, Capricornia, North Queensland and Far North Queensland, highlight the degree of producer involvement in but one of the State's primary industries. Similar, but less clearly defined, involvement occurs on a State-wide basis for other industries.

District officers currently produce a number of newsletters on a regular basis. Through these newsletters producers and officers maintain contact, especially in extensive areas where distances make personal contact more difficult. In western Queensland, for example, the 'Mulga Line' performs a most useful communication role. It enables officers to contact producers, to receive feedback on the quality and relevance of their extension activities and to give producers the opportunity to make their own contribution.

Regional extension officers have assisted various industry and producer organizations in the organization and running of field days such as Agrotrend, Bundaberg; Farmfest, Toowoomba; Expo 7 Horticultural Field Day, Gatton; and North Queensland Field Day, Townsville. Assistance has also been given to industry in the organization of workshops and symposiums such as the Agricultural Outlook Symposium, Mareeba.

Evaluation Unit

Current Departmental policy is to encourage its extension field staff to use factual information collected at the farm level as a basis for their extension programmes. The activities of the Evaluation Unit within the Section are directed at assisting field staff in this data collection. Almost all of the projects carried out have been undertaken in conjunction with staff at a district level.

A significant initiative taken during the year was the appointment of a committee to review the Departmental services to producers in western Queensland. An officer of the unit is currently serving as secretary to that committee. This major undertaking will, in addition to its primary goal, increase the technical competence of the Unit in appraising Departmental extension and research needs on a State-wide basis.

One major project involved a survey of sugar-cane farmers in Far North Queensland. This survey assessed growers' use of different soil erosion control methods, as well as their attitudes to various aspects of soil conservation. Another survey, also in north Queensland, collected data relating to beef producers' opinions and use of various management practices.

A comprehensive evaluation report of a beef producers' seminar conducted in 1981 is currently being produced. This report will demonstrate to field staff a number of criteria that can be used in evaluating extension work.

As in previous years, a considerable amount of the time of the officers of the Unit was spent in giving assistance and advice to colleagues on the conduct of surveys and on the analysis of the data collected. A wide range of projects and work areas were involved, indicating a growing need by various sections of the Department for access to reliable data for decision making purposes.

Overseas Development Unit

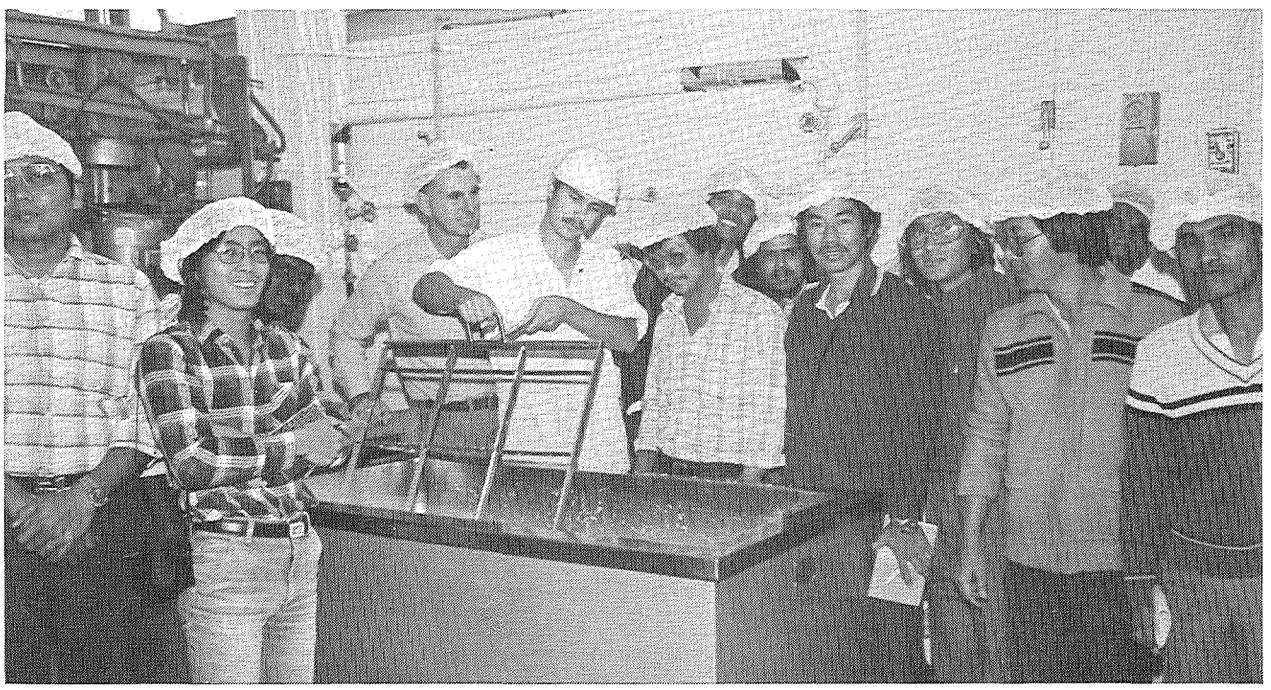
The Overseas Development Unit is responsible for organizing short training courses, consultancies and overseas study programmes undertaken by officers from a number of Branches of the Department. Such undertakings provide valuable training to Departmental officers as well as helping people in developing countries to achieve self-sufficiency.

The Unit's training programme this year consisted of three training courses each of 3 months' duration; one officer visiting Indonesia and two officers visiting Malaysia. The training courses consisted of a dairy technology course; a cattle production and pastoral development course; and a fodder and fodder seed production course.

A total of 60 participants representing Bhutan, India, Korea, Malawi, Malaysia, Nepal, Nigeria, Philippines, Papua and New Guinea, Solomon Islands, Thailand, Tonga, Tanzania and Zambia took part in these courses.

The Unit's consultancy programme consisted of Departmental officers making short-term consultancies to Antigua, Fiji, India, Indonesia, Kenya, Kampuchea, Malaysia, Papua and New Guinea, Sabah, Thailand, Uruguay, Vanuatu and Zambia; and participation as members of an Australian Mission to China on Seed Production, Animal Quarantine and Plant Quarantine. Arrangements were made to have two officers undertake long-term consultancies in Cyprus and Sri Lanka.

The Unit has also arranged a number of study tours and training programmes for individual officers from a number of South-East Asian, African, European and American countries.



Overseas students inspect experiments with new cheese types at the Otto Madsen Dairy Research Laboratory. This was part of the programme of an Australian Development Assistance Course conducted by the Department's Overseas Development Unit.

Biometry Branch

PROVISION of a biometrical consulting service to the Department's research staff is the major Branch activity. Consulting encompasses: definition of research problems; collaboration in experimental and sampling designs; advice and assistance with statistical analyses; data analysis and interpretation; research participation and co-authorship; refereeing manuscripts for statistical appropriateness.

This major Branch function is carried out by 17 biometricians and three technical support staff. A regional service is provided by units of three or four staff at Toowoomba, Rockhampton and Townsville.

Additional functions of the Branch are the co-ordination of computing in the Department and the provision of electronic data processing services. These services are provided by an EDP group of five and by three data preparation staff.

Biometrical consulting

Consultation before formal approval of research projects continues to be essential to ensure that the most appropriate and efficient experimental designs are used. An inservice training programme and decentralization of the Branch have been key factors contributing to a more effective consulting service.

More than 600 data submissions and statistical analyses are processed annually. The projects varied greatly in complexity and time needed for analysis. A selection of projects showing the diversity follows.

Inferences on the parameters of the Weibull distribution. The Weibull distribution probability density function given by

$$f(x;\ b,\ c) = {}^{c}/_{b}\left(\frac{x}{b}\right)^{c-1} e^{-\left({}^{x}/_{b}\right)^{c}}$$

was fitted to a number of independent data sets on insect survival. The method of maximum likelihood was employed. Requirements were: (1) exact confidence intervals of the parameters, and (2) tests between parameters from different sets of data.

The equations for the maximum likelihood estimates cannot be obtained in closed form, hence an iterative procedure must be used. A program based on the Newton-Raphson iterative procedure was written and estimates obtained. Confidence intervals and tests of significance were calculated.

Parthenium weed survey. Parthenium weed has spread into thousands of hectares of grazing land making these areas non-productive. A survey was carried out in 1977 to try to ascertain what soil, management and botanical factors influence the spread of parthenium. Management factors proved too diverse to come to any conclusion on their effect. Soils were categorized into four types and multiple regression techniques were used to relate parthenium weed foliage area percentage to the other botanical variables.

Efficiency of grain concentrate feeding. The trial investigated the optimum length of time for feeding 610 kg of grain to Friesian cows. The treatments were: a flat rate throughout the whole lactation; a high rate early and a low rate later in lactation; a low rate early and a high rate later; and feeding all the grain early.

Data analysed included milk yield and composition, liveweight changes, diet botanical and chemical measurements, and pasture botanical and chemical measurements. For days 11 to 100 of lactation, regression equations were calculated relating milk yield and fat corrected milk yield to the amount of grain fed.

The analyses showed an advantage in total milk yield to feeding a high rate early and a low rate later in lactation.

Stubble retention study. This long-term (15 years) joint Agronomy-Agricultural Chemistry project begun in mid 1978 seeks to determine the effects of stubble retention and three cultivation methods on soil moisture and nutrient status, crop establishment and crop productivity in grain sorghum.

The experiment is located at Mt Murchison property near Biloela. The 24 large plots (15 m x 25 m) in the experiment are set up in a randomized block layout of four replicates; the six treatments comprise three levels of severity of tillage in combination with stubble retained or removed (the treatment combinations are not factorial because of the way in which certain combinations are achieved).

The analysis of the agronomic data presents no problems; simple 4 x 6 randomized block analyses of variance suffice. The soil moisture and soil nutrient data are of the repeated measurement type, which have been the subject of much discussion within the Branch over several years.

The aim of the statistical analyses of soils data is to test the effects of treatments on the pattern of movement and accumulation of nitrogen, chloride and moisture, all of which are highly mobile. On each plot three cores are taken to a depth of 1.6 m, and the soil profile is sampled by separating each core into nine depth increments and chemically analysing these core segments separately. Plots are sampled twice a year, at post-harvesting and pre-planting.

Multivariate techniques appropriate for repeated measures data, in this case repeated over depth and time, have been avoided by converting to a series of sensible and interpretable univariate analyses of variance. Concentrations (ppm or %) have been converted to yields, such as yield of nitrogen (kg per ha per depth of soil). Integrals over depth or changes over time can then be calculated since 'yields' may be sensibly summed or differenced, whereas 'concentrations' cannot.

Mandarin puffiness container storage trial. A major problem with loose-skinned export Ellendale mandarins is puffiness, which occurs when the fruit segments separate from the inside surface of the skin.

The main trial consisted of an 8 x 8 Graeco-latin square with split plots. Cartons were braced in a stack eight wide by eight high (both dimensions used as blocking), the factors being eight growers each contributing eight size grades. After holding at 4°C for 7 weeks (simulating transport time), the fruit was rated for puffiness by layers, and a number of physical tests was conducted.

Defining layers for the analysis was difficult, as the size range of the fruit resulted in cartons having four, five or six layers. This was solved by some pooling of data into top, upper and lower middle, and bottom layers. A separate analysis of the Graeco-latin square was run for each layer using the statistical program HARVEY.

In no cases were either of the blocking dimensions significant so a split-plot factorial follow-up was run. As expected, size grade showed a linear trend, with the larger fruit being more puffy. Large grower differences were surprising, with the fruit of one grower in particular being rated twice as bad as some of the others. Differences between layers were interesting, with the upper-middle being the most puffy and the bottom by far the least puffy.

A number of smaller associated trials was run in conjunction with this to investigate possible solutions to the problems. A replicated 4 x 4 latin square was used to investigate ethylene absorbent, polyethylene liners, and weight loads; and a number of factorial trials investigated packing arrangements within a carton, carton strength, and packing trays.

The consistent effects from these trials were large grower and size grade differences, while treatment effects were mixed: some appeared to work, most did not, and some significantly increased the incidence of puffiness.

Finally, a multiple regression analysis is being conducted to determine which of the physical factors (% juice, acid, soluble solids, brix acid, bruising energy, deformation rate, specific gravity) are associated with puffiness.

Factors influencing pre-harvest aflatoxin contamination of peanuts. A 3-year project, investigating factors influencing invasion of peanuts by *Aspergillus flavus,* began in 1979. Eleven experiments studied the effect of the factors rainfall, injury by the lucerne web moth grub *Etiella behrii,* the root-lesion nematode *Pratylenchus brachyurus,* duration and intensity of moisture stress, population and spatial arrangement of plants and time of harvest, on aflatoxin contamination of peanuts.

The design of the experiments ranged from surveys to completely randomized and randomized block designs and restricted randomizations enforced by the use of plastic tunnels for control of moisture stress.

Analytical techniques included graphing, calculation of means and standard errors, analyses of variance with and without transformations, and analysis of contingency tables.

Systems research and modelling

Branch staff have been involved in several projects developing computer simulation models of bio-economic systems.

Milk production. At a recent national conference, a general model simulating individual farm milk production was presented. The system considered was the predominantly subtropical Queensland dairy industry.

Two submodels were used. The first simulated dairy pasture production and composition by using an existing water balance/pasture production model. Green, dead, and litter pools were simulated for two pasture types, namely tropical grasses with and without tropical legumes, and forage ryegrass with and without clovers. The second submodel simulated daily milk production.

Because of limited data, pasture intake was not modelled; rather response surfaces were fitted to daily milk production data using independent variables such as pasture yield, stage of lactation, legume content of pasture, dietary history, supplements,

and nitrogen fertilizer usage. Independent validation showed that the response surfaces were adequate for predicting herd milk production.

Descriptions were given of the management options available, and how their effects were modelled. The method for calculating value of milk produced and costs of management options used was given. Profitability analyses for two different management options were presented, with a description of future developments and aims.

Flowering time model. As a submodel of an overall crop growth model for wheat, a model is being developed to predict flowering time for given cultivars. The model is to be a general one for all varieties such that for a given variety, only indices of its response to vernalization and photoperiod need to be input to predict its flowering time.

For a given variety, the data consist of the number of days to flowering (and the intermediate stages) together with daily records of temperature and photoperiod. An iterative regression type procedure using the simplex method for function minimization is being used to estimate the model parameters.

Insect dispersal model. Work is continuing on the model to study the population dynamics and dispersal pattern of insects. Experiments have been carried out to get some base data on dispersion of insects *Tribolium castaneum* in stores of wheat. Data from these experiments are to be used to calculate diffusion rates for the insects. These rates will then be incorporated into the model of birth, death and dispersion and the model validated with further experimentation.

Biometrical research

Biometrical research covers applied research of direct relevance to the Department research programmes as well as the evaluation and development of new statistical methodology. This work has continued to play a very important part in the development of research ability in biometricians. Two projects have come to fruition in papers presented at a recall national conference. Summaries are given below.

Tick counts. Tick count and liveweight change data from growing *Bos indicus* x *Bos taurus* cattle challenged by field infestation of *Boophilus microplus* were studied at four sites in coastal Queensland.

Mean tick counts were low, 3.9 to 5.5 ticks per side, but peak counts reached 58 ticks at one site. Overall repeatabilities of tick counts at the four sites, 0.57, 0.49, 0.42 and 0.25, were significant ($P < 0.01$) but only moderately useful as a basis for a selection programme.

From interclass correlations and correlations with the total count over the experimental period, no time of the year could be identified as superior to any other for ranking animals on the basis of tick resistance. However, the mean of two consecutive tick counts 21 days apart gave a more reliable assessment. Mean tick counts were very poorly related ($P > 0.05$) to liveweight gain over the period at all sites.

Grazing experiment choice of unit. Published results of similar grazing experiments reveal inconsistencies about whether the animal or paddock variation is the appropriate estimate of experimental error. To look at the problem of identifying the experimental unit (EU) in supplementary feeding trials, results from the analysis of 24 experiments with growing beef cattle grazing native pasture and covering a range of environmental and management conditions in Queensland were presented.

The investigation showed that in many cases the individual could be regarded as the EU and animal variation gave a good estimate of random error; but this could not be recommended universally. The difficulties of obtaining uniform replicates resulted in significant interactions in experiments from one site and demonstrated that paddock replication was essential in all experiments.

Log-linear models for contingency tables. This research project is intended to be reported as a Branch research bulletin. It provides a basic mathematical treatment of the analysis of multi-dimensional contingency tables using log-linear models. This is followed by a discussion of aspects of a practical nature which may be encountered by a statistical consultant using the methods described.

Details of computer programs commonly available are also provided. A number of relevant papers is found in journals not commonly consulted by statistical practitioners, and so a comprehensive list of references for additional reading is provided.

Work is continuing on a number of other biometrical research projects: investigation of programs to fit Mitscherlich curves; linear statistical computations with microcomputers—use of Householder/Givens routine; study of the growth of body components over time using data measured on magpie geese; investigation of the effect of liveweight on pregnancy rate in *Bos indicus* cross heifers; calculation of the number of sites and years required for the maize breeding programme; investigation of rounding errors in measurements; investigation of the analysis of a series of variety trials; display/analysis of residuals from linear models; investigation of systematic designs.

Development of statistical programs

Computer programs for the statistical analysis of data are developed and maintained by Biometry Branch for use by both members of the Branch and other Departmental officers. They cover a variety of methods, and are the programs most frequently used for statistical analysis within the Department.

Usage patterns for the main programs were similar to those for the previous year, with the most popular programs (PREP for data summary, preprocessing of data for other programs and graphing; RANB and BALF for analysis of variance for standard designs) each averaging about 40 accesses a week.

The main developments to existing programs included:

improvements in the genetic calculations in programs HARVEY and VCOMP;

new versions of documentation for BALF, RANB, PREP and HARVEY; and

conversion of the GBEI package to run on CSIRONET (this package is for the analysis of genotype by environment interactions).

In addition, a review was undertaken of statistical programs available at the State Government Computer Centre.

Traditionally, virtually all statistical computing in the Department has been undertaken on CSIRONET. As discussed in the following section, planned provision of microcomputers in country research centres will generate demands for adequate statistical programs for simpler analyses. More complex analyses will continue to be handled by CSIRONET although a microcomputer could be used for data entry and preparation of data files. The more complex analyses will also generally require consultation with a biometrician.

The major developments required to allow research staff to efficiently undertake simpler analyses include:

a data entry/verification system, to be suitable also for use on the NOVA 3/12 in Townsville;

modifications to the statistical package MICROSTAT to improve its analysis of variance features;

convenient communications programs for access to CSIRONET and SGCC;

a graphics system;

a register of statistical programs available for the microcomputers; and,

if feasible, transfer of the balanced factorial program, BALF, to the microcomputers and the NOVA.

EDP services

The Branch contains an EDP services group of one systems analyst and four programmers. The central group has responsibilities for development of computer applications that cannot be handled efficiently by individual Branches.

In addition, Biometry Branch has specific Departmental responsibilities for operating CSIRONET computing nodes, providing a punch card data preparation service, and processing accounts for computer services. The Branch has more general responsibilities for co-ordinating computer developments across the Department.

Departmental co-ordination

Two measures were adopted during the year to ensure efficient and co-ordinated growth of computing activity in the Department.

At the operational level, computer user groups were formed at major Departmental centres to ensure adequate co-ordination of proposals from Branches and to ensure appropriate levels of sharing of resources and of standardization.

At the Departmental management level, the EDP Steering Committee was expanded to represent user groups and divisions and to develop Departmental priorities for computer applications.

Software development

The programming group has traditionally concentrated on more commercial applications developed for the State Government Computer Centre. With the expansion in computer activity in the Department and with changes in price/performance ratios for mini and microcomputers, the programming group is broadening its role. Applications are being investigated that may be more efficiently developed on either CSIRONET or on stand alone systems.

Projects currently being either investigated or at various stages of development include—

AGREQS: this system for Standards Branch records the data of registration of agricultural requirements as required by Agricultural Standard Acts and produces registration certificates and management reports.

STATREC: this system records training activity undertaken by Departmental staff.

ADRES: this is a general purpose mailing address system for Departmental publications such as the *Queensland Agricultural Journal.*

BEEKEEPING: a system for recording data for registrations for Queensland beekeepers.

HERBRECS: an existing system for Herbarium records which is to be transferred to a minicomputer at Indooroopilly.

Microcomputer evaluation

Three microcomputers were purchased during 1981 to evaluate their suitability for Departmental applications, particularly at regional research centres. The evaluation and a survey of needs have been completed as a Departmental report.

A survey of 30 regional centres with more than 700 staff showed the major potential applications were for statistical computing, information storage and retrieval, data capture, and computer modelling. Dial-up access to CSIRONET for large or specialized jobs was also a significant need.

The report presents the computer hardware and software specifications to handle the likely volume and diversity of computing needs at larger Departmental centres. The report also develops priorities for provision of computing facilities to regional centres. The need for standardized and co-ordinated provision of computing facilities with strong central support is stressed.

Training and staff development

One of the objectives of the external training programme is to provide Departmental officers with an understanding of biometrical principles and a familiarity with statistical output so that correct inferences can be drawn. This is done on a personal level and by formal courses when the need arises.

Likewise, training in programming and systems analysis is co-ordinated on a formal basis by this Branch. Informal assistance in the form of 'user assistance' consulting is given on both use of hardware and software so that officers can efficiently process their own data.

The objective of the Branch's technical training programme is to facilitate personal development of individual officers. This is achieved by participation in seminars, conferences and courses conducted by external organizations as well as internally organized workshops. In addition, biometricians are encouraged to undertake biometrical research.

External training

Statistical analysis by computer workshops. The initiative for these comes from research staff in the country and from regional biometricians. During the year, workshops were held in Rockhampton, Charleville and Toowoomba.

The courses are designed to provide a general introduction to computing on CSIRONET and to demonstrate the use of the most frequently used Biometry Branch programs. In particular, the general data preparation program, PREP, and the programs for analysing balanced factorials (BALF) and/or randomized blocks (RANB) are demonstrated. Emphasis is given to tutorial sessions with participants gaining experience at using the programs to analyse data sets.

Computer appreciation courses. These 2-day courses are designed to introduce Departmental staff, who are likely to use or be in control of any computerized tasks, to the computer facilities used by the Department. The aim is to give participants an insight into how they can use computers. The various phases of a computer project are described, together with input procedures, what is involved in writing a computer program and the processing of a job.

Participants are given the opportunity to work at a computer terminal and gain 'hands on' experience. Sixty-four clerical and technical staff attended one of the six workshops conducted.

Internal training

Biometry Branch Workshop. The highlight of training for the year was the Branch workshop at Gympie Forestry Training Centre, which was residential for the first time. The major theme of the workshop was analytical methods for nominal and ordinal data. The statistical techniques for many of the sessions are relatively new and these were researched and presented by members of Biometry Branch.

In addition to papers on the theory, and comparisons of methods, papers illustrating the application of the techniques were also presented. The statistical packages available to do the analyses were reviewed and examples of use given. All oral presentations were supported by written papers. It is intended to publish these papers as a Branch bulletin.

Although the major benefit from the workshop was derived by those people who prepared and presented papers, the workshop was very useful to all biometricians as the topic was directly related to their everyday work.

National conferences attended by Branch officers during 1980–81 included: Statistical Computing Symposium, Sydney; CSIRO Division of Mathematics and Statistics, Wagga Wagga; Simulation Society of Australia, Armidale; Australian Society of Animal Production, Brisbane; DECUS Symposium, Brisbane; Nutritional Limits to Animal Production from Pastures, CSIRO, Brisbane. In addition, one officer attended the second GENSTAT Conference at Wageningen in the Netherlands.

Division of Animal Industry

A major reorganization of the Division of Animal Industry was effected during the year. Husbandry Research Branch was disbanded and the staff incorporated into the appropriate field Branches, Beef Cattle Husbandry, Sheep and Wool and Pig and Poultry. Most of these staff continued to be located in their previous accommodation. A third Deputy Director position of the Division was created for the administration of the laboratory Branches and was located at the Animal Research Institute. The Slaughtering and Meat Inspection Branch was renamed the Veterinary Public Health Branch in recognition of its wider areas of responsibility.

A second Assistant Director was appointed to Pathology Branch. The classifications of the Directorates of Pathology and Veterinary Public Health Branches were escalated. Changes were made in some of the executive positions in Veterinary Services Branch.

The Division is now made up of seven Branches. The five field Branches are: Veterinary Services, Veterinary Public Health, Beef Cattle Husbandry, Sheep and Wool, and Pig and Poultry. The other two Branches are Pathology and Biochemistry which constitute the Animal Research Institute and the regional laboratories at Oonoonba (Townsville) and Rockhampton.

The activities and responsibilities of the seven Branches were directed towards the achievement of the following Divisional objectives—

- To promote efficient commercial production of food and fibres from animals, without damage to the environment.
- To provide a service to producers for developing and maintaining healthy herds and flocks.
- To ensure that meat is supplied to the community in an hygienic state and to promote improvement in the quality of animal products.
- To ensure that only disease-free animals are used for human consumption.
- To eradicate or economically control animal diseases.
- To prevent the entry and exit of animal diseases into or from Queensland.
- To ensure adequate technical and management training of staff for performance of functions and duties.
- To provide animal identification services to the livestock industries.

All Branches of the Division responded well to the difficulties imposed by financial stringencies and by judicious management continued to provide efficient advisory, regulatory, diagnostic and research services to the livestock industries. In most areas of the State except the south-west region, relief rains saw the termination of the severe drought, improving conditions for producers and decreasing the demand for advice and assistance from officers of this Division. Unfortunately, the wet season was patchy and not heavy enough to ensure adequate conditions through to the next season. Towards the end of the period under review, drought conditions were again being experienced in many of the areas previously affected. The major incursion of ticks into the previously free area in north west Queensland resulted in the Division committing a considerable amount of resources to the control and eventual eradication of the ticks from the area.

Mr R. J. W. Gartner was appointed to the newly created position of the Deputy Director and Director Animal Laboratories of the Division. Following the retirement of Mr F. N. J. Milne after many years of service, Mr R. V. Byrnes was appointed Director, Pig and Poultry Branch. Dr L. L. Callow was appointed Director, Pathology Branch, and Dr T. McEwan, Director, Biochemistry Branch.

Amendments to legislation

Acts. As a result of the proclamation of the commencement section of the *Exotic Diseases in Animals Act* 1981, Section 26A of the *Stock Act* 1915–1979, which contained provisions relating to the prevention and control of exotic disease, was repealed. At the same time, minor amendments to a number of other sections to remove anomalies existing between the two Acts became effective.

Section 26C of the *Stock Act,* which related to the artificial breeding of stock, was repealed on 15 August 1981, on proclamation of the commencement of the *Artificial Breeding of Stock Act* 1979. This Act is administered by the Division of Dairying and Fisheries.

Minor amendments to the *Meat Industry Act* 1965–1981 principally relating to the constitution and functions of the Queensland Meat Industry Organization and Marketing Authority came into effect during the year.

Regulations, Orders-in-Council, Notifications. The principal amendments to the Stock Regulations of 1935 were the repeal of the provisions relating to the control of exotic disease and the artificial breeding of stock. These matters were provided for in the Exotic Diseases in Animals Regulations 1981 and the Artificial Breeding of Stock Regulations 1981, which came into force during the year.

Other amendments included: removing the restriction on horses entering Queensland during the hours of darkness; providing for compensation to be paid for untested stock disposed of by a destocking order issued under the brucellosis and tuberculosis eradication schemes; changes to the amounts of compensation paid under the schemes in order to maintain parity with fluctuations in the market value of cattle; providing for the payment of fees for the treatment of horses generally and for the treatment of stud sheep, goats and cattle and herd bulls for movement interstate; and clarifying the provisions with respect to the prohibition of feeding animal matter to stock and the storage of animal matter.

The Identification of Cattle Regulations 1976 were amended to exempt from tail tagging provisions calves of a certain weight rather than age, to be in conformity with the exemption provisions of the *Brands Act* with respect to the branding of cattle for sale.

Fees paid under the Pet Shops Regulations of 1966 and the Pullorum Disease Control Regulations of 1970 were increased during the year.

Amendments to the Meat Industry Regulations 1973 included the repeal of provisions relating to the date stamping of prewrapped and packaged frozen meat, in view of amendments to the Food and Drug Regulations 1977 which provide for date marking of packaged foods in general; and meat inspection and registration fees were increased to offset rising costs and inflation.

Orders-in-Council were promulgated under the Stock Act to declare blood to be an animal product; to declare the chemical residue cyhalothrin to be a disease for the purposes of the Act; and to revoke the restriction on the introduction of cattle, sheep, goats, camels and buffaloes from areas of the Northern Territory and Western Australia, previously imposed with respect to bluetongue control.

Under the provisions of the Stock Act, notifications were gazetted to redefine the boundaries of the bovine brucellosis and tuberculosis eradication and provisionally free areas and to clarify the requirements in respect of testing and movement in each of the areas. A new Cattle Tick Infected Area was gazetted in order that the defined area more closely reflects the present position in the field.

By notification under the *Meat Industry Act* alterations were made to the boundaries of the Rockhampton Regional Meat Area.

Animal identification

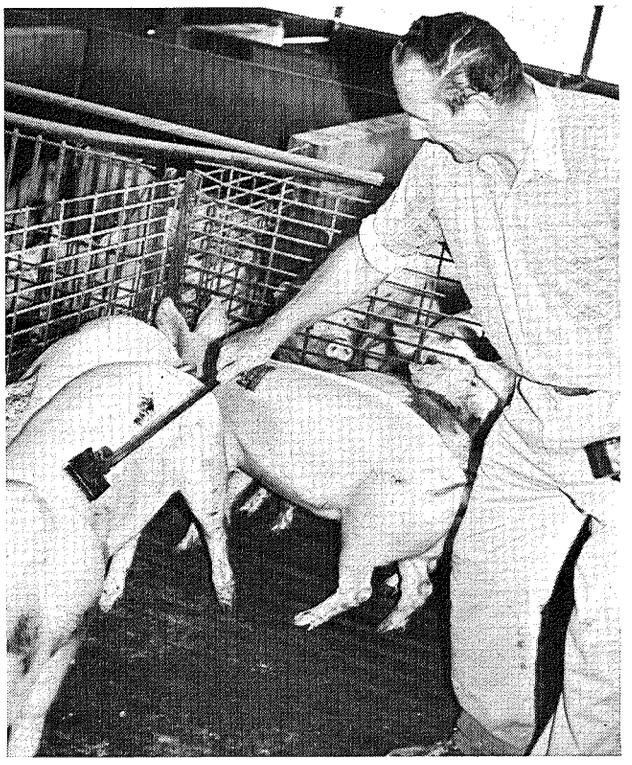
Brands. Over the last 12 months, the Brands Section continued with the development and implementation of the Computer Operated Brands Recording and Acquisition System. Pig tattoo branding, introduced in September 1981, was completely resident on the computer system and all the accounting for the Brands Section was also being handled electronically. The problems associated with capturing the last 110 years of brands information and records were addressed and it is anticipated the information will soon start to be entered into the computer. Apple II microcomputers were used as distributed processing units and were proved very successful in that area.

During the last 12 months, the major transactions were: horse and cattle brands registered 1 817; horse and cattle brands transferred 1 848; cattle earmarks registered 736; sheep brands and earmarks registered 188; sheep brands and earmarks transferred 219; pig tattoo brands registered 828.

Animal traceback. Compulsory tattooing of pigs sent to slaughter improved immensely the identification for traceback purposes. Some owners were still not applying tattoos to pigs sold through saleyards, but follow up action with owners not correctly tattooing their pigs was pursued.

Accurate traceback of cattle to properties of origin reached an all time high with the average recovery being in excess of 95% for the year. This was accomplished by the increased awareness by producers of the need for accuracy of traceback for disease control, coupled with an increase in producer expertise in the application of tail tags. In addition, the introduction of the saleyard tag during 1981 played an important role in the ability for traceback of cattle marketed through Queensland saleyards. The tail tag loss at meatworks was only 4.8%.

During the year, the tail tag manufacturers agreed to reposition the serial numbers on individual tags. Now both of the approved tags have serial numbers printed on either end of each tag. It is now possible for stock owners to readily individually record stock marketed. Meat inspectors may now report individual animal numbers of diseased stock at slaughter as well as the property traceback by registered property numbers. This allows owners to identify either the diseased animal and/or the part of the property from which it originated.



Pig tattooing by a Queensland farmer. Compulsory tattooing of pigs sent to slaughter greatly improved the identification for traceback purposes. This measure was introduced in September 1981.

Animal quarantine

Animal quarantine activities increased significantly during the year under review. The service in Queensland is now more appropriately staffed and trained to meet its responsibilities under the *Quarantine Act* on behalf of the Commonwealth Government.

An undertaking to co-ordinate and develop a national training course was undertaken by Queensland in co-operation with other States. The re-writing of sections of the Animal Quarantine Manual was undertaken by the States. The sections allotted to Queensland were: meat and meat products; ship pets, general policies; and problems and ship stores.

There was an increase of some 69 106 overseas passenger arrivals over the previous year. This represents a 35.6% increase. The new extensions to the Brisbane International Airport are expected to be completed before the commencement of the Commonwealth Games on 30 September. The Townsville International Airport was completed and is working satisfactorily.

One hundred and fourteen overseas yachts made their first port of call in Queensland waters with Bundaberg and Cairns being the most popular landing ports, closely followed by Brisbane.

Importation of dogs and cats was permitted from the Solomon Islands, New Caledonia and Vanuatu in addition to the United Kingdom, Papua New Guinea, Hawaii and New Zealand.

Extension played an important role in quarantine activities during the year. A quarantine awareness seminar was held in Cairns with more than 100 people attending. A screw worm fly pamphlet was also printed but, because it was so popular, a reprint was necessary. Film screenings and discussions dealing with quarantine activities were held with graziers, graziers' organizations, agricultural shows and high school groups.

Staff. An Assistant Inspector was appointed to assist with quarantine duties in the Cape York Peninsula and Torres Strait areas. The four officers appointed to quarantine duties in the 1980–81 year have now completed their training in quarantine procedures. These appointments have eased the workload somewhat and have allowed new initiatives to be commenced. Accommodation for animal quarantine officers at Hamilton was considerably improved.

Prosecutions. Sixteen people were prosecuted under the *Quarantine Act* for illegally importing animal goods including the illegal landing of a cat from a shipwrecked yacht. The master had failed to declare the cat when first entering port. The cat was destroyed.

Two fines of particular note were a fine of $5,000 in default 6 months jail for illegally importing 115 duck eggs from the USA. The person involved was sentenced to 9 months imprisonment for the offence but on appeal the penalty was reduced to the fine stated. The other was a fine of $1,000 imposed on a group tour leader who illegally introduced six salami sausages. Other fines ranged from $50 to $200.

Foreign fishing vessels. Four foreign fishing vessels were taken into custody at Cairns by the Navy. Goods seized and destroyed from these vessels were 236 kg meat, 194 eggs, 2.9 kg egg products, 4 kg milk products plus plant material. One live cat was destroyed.

Overseas passenger arrivals. A total of 263 303 air passengers from 3 248 aircraft arrived at Brisbane, Cairns and Townsville from overseas ports, an increase of 35.6% and 36.5% respectively.

Only 546 sea passengers on eight vessels disembarked at Queensland ports, a decrease of 46.5%.

Of the total air and sea passenger arrivals, 18 291 passengers carried items of quarantine interest compared with 15 933 passengers in the previous year.

The following goods were seized from 1 408 passengers: meat products 535 kg; eggs 475; egg products 95 kg; dairy products 238 kg; Salmonids 9 kg; untanned skins 58.

Parcel post. During the period covered by this report, 1 785 parcels were inspected by Quarantine staff. From these inspections 446 seizures were: meat products 205 kg; eggs 101; egg products 7 kg; dairy products 58 kg; wool 12 kg; feathers 11 kg; skins (untanned) 34; hooves, horns and hair 8 kg.

Live animal imports. A total of 664 dogs and 271 cats was imported from the United Kingdom and the Pacific representing a 3.3% decrease in dogs and a 20.5% decrease in cats over the 1980–81 year.

Country of origin	Dogs	Cats
Papua New Guinea	66	11
United Kingdom	107	. .
New Zealand	486	258
Fiji	3	2
Hawaii	2	. .
Total	664	271

A total of 1 546 920 aquarium fish was imported into Brisbane from Singapore, Hong Kong and Japan. This represents an increase of 11.2% over the 1980–81 figure of 1 391 632.

Country of origin	Tropical fish	Gold fish
Singapore	1 072 880	273 837
Hong Kong	55 118	87413
Japan	11 562	46 110
Total	1 139 560	407 360

Thirty horses were imported into Queensland. All of these horses originated in New Zealand.

Forty-five cattle were imported from the newly opened high security Cocos Island Quarantine Station. These cattle comprised a mixed consignment of 3 Hereford and 42 Brahman and Zebu. All cattle originated from Canada and the United States of America.

In addition, one heifer was imported from New Zealand and one Jersey bull from the United Kingdom. The Jersey bull was required to undertake a period of quarantine at the Torrens Island Quarantine Station in South Australia before entering Queensland.

A total of 40 pigs was imported via the Torrens Island Quarantine Station from Canada and New Zealand. They were 25 Duroc, 4 Landrace and 11 Large White.

Miscellaneous live animal imports included 100 mice from Holland and Japan, 12 guinea pigs from New Zealand and 12 queen bees from New Zealand and Canada.

Animal by-product imports. A total of 278 886 kg of meat products was imported from New Zealand, Romania, Canada and Germany, representing a 378.5% increase over the 1980–81 figure of 58 280 kg. A total of 224 922 kg of chilled beef and 1 777 kg of venison was imported from New Zealand; 50 705 kg of tinned ham from Romania, 1 251 kg of pate de foi from Canada, and 231 kg of tinned beef sausages from Germany.

A total of 34 010 kg of beef rejected by Japan and 138 800 cans of corned beef rejected by Egyptian authorities was returned to Queensland.

Cheese imports totalled 594 742 kg. This represents an increase of 125% over the 1980–81 figure of 272 919 kg. Countries of origin included Norway (294 745 kg), Holland (104 616 kg), Denmark (71 951 kg), Germany (55 782 kg), France (29 206 kg), Italy (13 710 kg), Austria (9 483 kg) and Switzerland (9 287 kg).

A total of 256 938 kg of ice cream mix and 20 466 kg of yoghurt powder was imported from New Zealand.

Bovine semen imported totalled 19 630 straws, 7 010 from New Zealand, 6 320 from Canada and 6 300 from the United Kingdom.

Torres Strait and Cape York Peninsula. Throughout the year, a concerted effort has been made to train staff and co-operators in northern centres in the various aspects of screw worm fly surveillance. Training has centered around such things as identification, life history and epidemiology of the fly in addition to the economic consequences should it enter Australia. To this end, two Veterinary Officers stationed in northern Queensland visited the CSIRO Screw Worm Unit at Port Moresby during the year.

Fly traps have now been set up on many islands in the Torres Strait and also at mainland localities in the Cape York Peninsula. Traps are currently located at the following centres:

Saibai Island 12; Boigu Island 10; Prince of Wales Island 4; Badu Island 2; Yorke Island 2; Bamaga 2; Coen 2; Laura 2; Helenvale 2; Weipa 2; Iron Range 2; Cape Flattery 2.

All trapped flies are submitted to the Quarantine Veterinary Officer at Cairns and suspect flies to the Oonoonba Laboratory in Townsville for identification. In addition, all co-operators are required to submit any maggots found infesting animal wounds to the Department for identification purposes.

Considerable progress has been made in the control of dogs and cats in the Torres Strait areas. This programme involves the spaying and castration of dogs and cats, the vaccination for diseases such as distemper, hepatitis and feline enteritis and the euthanasia of all unwanted pets. In addition, all dogs and cats vaccinated or desexed are tattooed to aid in future traceback procedures.

Progress has been made towards the implementation of the new Torres Strait Quarantine Zone and the Cape York Peninsula Stock Free Zone. Quarantine staff, in conjunction with officers from the Commonwealth Departments of Health and Primary Industry and the Queensland National Parks and Wildlife Service, completed a feasibility survey of the proposed stock free buffer zone in order to define its boundaries, to assess the requirements for the control of feral animals and to maintain the area free from animals. Both initiatives are designed to limit the southward spread of animal and plant diseases exotic to Australia.

Live animal exports

A total of 49 320 cattle was exported during the period. This was a 53.3% increase over the 1980–81 figure of 32 168. Details are outlined in the following table:—

Importing country	Breeder cattle	Feeder cattle	Slaughter cattle
Indonesia	26 402	..	..
Philippines	5 798	..	..
Malaysia	3 082	..	4 075
Korea	2 147	2 507	..
Japan	..	5 065	240
Papua New Guinea	4	..	..
Total	37433	7 572	4 315

Forty-five horses were exported to Japan (28), Papua New Guinea (12) and the Philippines (5). A total of 504 dogs and 74 cats was exported to 26 different countries. A large percentage of these went to New Zealand.

A total of 2 971 straws of bovine semen was exported to Papua New Guinea (40), New Zealand (700), Malaysia (1 500), Vanuatu (331), and Israel (400).

Miscellaneous exports included 1 008 aviary birds to New Zealand and USA; 52 803 day old chickens to PNG, Taiwan, Vanuatu and Solomon Is; 423 510 fertile eggs to PNG and New Caledonia; 21 307 queen bees to 17 different countries; and 577 frogs and toads to the United Kingdom.

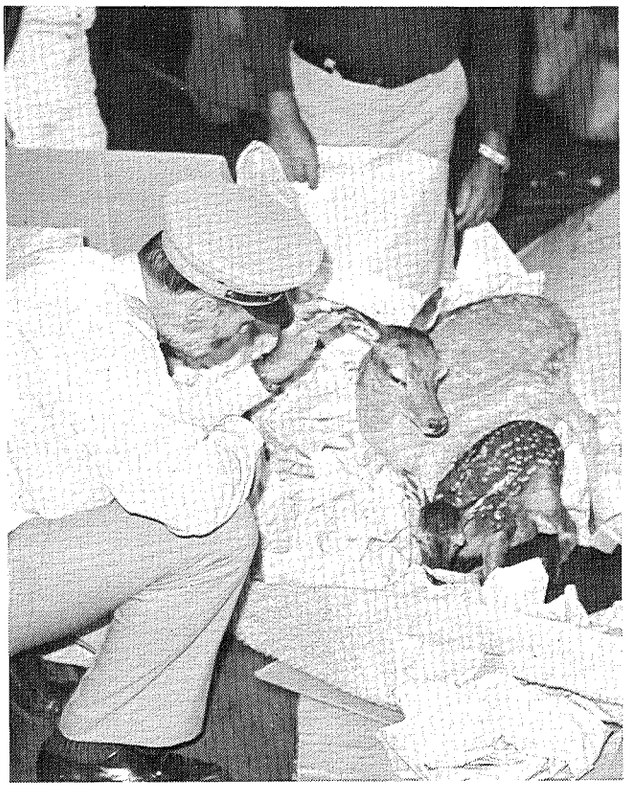
Fauna and feral animals

The limited availability of suitable animals, their relatively high price and the substantial cost of adequate deer-proof fencing currently restricts deer farming in Queensland. The emphasis initially was on a build-up of farm numbers from the feral population and live capture provided the quickest means of achieving this. However, the numbers of deer available for capture and permitted to be captured are strictly limited and eventually stock increases originating from breeding farms will exceed numbers available by live capture. It is estimated that currently more than 2 500 red deer are being farmed on deer farms which are mainly located in the red deer feral area of south east Queensland. Rusa, chital and fallow deer are also farmed with fewer than 300 head of each of these species behind wire.

All deer are 'protected fauna' under the *Fauna Conservation Act* administered by the National Parks and Wildlife Service. Thus the National Parks and Wildlife Service has been responsible for management of both feral and farmed deer. The Department of Primary Industries involvement with deer farming to date has been mainly limited to disease surveys and field involvement with disease problems as they occur. However, agreement has recently been reached with the National Parks and Wildlife Service that the Department of Primary Industries should assume responsibility for farmed deer both legislatively and in the area of management and husbandry advice. The legislative aspects for this Department to control deer farming are currently being formulated in conjunction with the National Parks and Wildlife Service.

Disease. Most interest has been centred on red deer because of their suitability for velvet production and the accessibility of the feral population available for trapping. Experience on deer farms in south east Queensland has shown that farmed red deer can carry heavy infestations of the cattle tick *(Boophilus microplus)*. Deaths have occurred from these heavy infestations. Since strategic treatment with acaricides has proved practical and effective, this problem has decreased. Chital and Rusa deer are more resistant to cattle ticks and have not required dipping on farms in south east Queensland. New born fawns have been found abandoned and paralysed due to scrub tick *(Ixodes holocyclus)* infestation, but some have recovered after anti-serum treatment.

Some newly born red deer fawns have died from heat exhaustion in heatwave conditions. Thus it is suggested that red deer would not be suited to farming in the tropical areas of the State.



Animal quarantine at the Brisbane International Airport. More than 263 000 air passengers from in excess of 3 000 aircraft arrived in Brisbane, Cairns and Townsville from overseas. Of these, 18 000 carried items of quarantine interest.

A serological survey of the red deer farm population in 1981 revealed no evidence of brucellosis infection, while *Leptospira hardjo* was the main leptospirosis serotype detected (13% positive). No tuberculosis has been found in deer in Queensland. Extensive serological testing of red and Rusa deer conducted by CSIRO, for arbovirus antibodies has revealed a significant percentage of red deer sero-positive for ephemeral fever antibodies. However, there has been no clinical evidence of ephemeral fever in farmed deer. Testing of sera has been negative for infectious bovine rhinotracheitis (IBR), with 3% positive for mucosal disease antibodies.

Deer farming has not been restricted to one form of production. Income has been derived from venison, velvet, the by-products from slaughter, such as eye teeth and hides and the sale of livestock. It is expected that, after base herds have been established, the sale of red deer to States with small or no feral red deer populations should become an important source of income for Queensland deer farmers. The attractiveness of retaining stags for velvet production declined because of the depressed velvet prices of up to $80 per kg for A grade velvet. Venison increased in demand at restaurants supported by an industry campaign for greater consumer awareness. Most deer farms began supplying venison on a continuous basis early in 1982.

Environmental studies

Pesticide residues. Statutory limits for pesticide residues are calculated first with a large safety factor from known toxicological data and are set by lowering this value to the level that is consistent with good agricultural practice. Monitoring of organochlorine and organo-phosphate residues in cattle slaughtered in Queensland has continued using a selective sampling programme aimed at detecting actual or potential problem areas. This project was funded from Departmental resources and requires collaboration between Veterinary Public Health, Veterinary Services and Biochemistry Branches.

A total of 5 731 samples of fat was analysed for 23 pesticides. As a result of traceback by Veterinary Services officers, a further 225 samples of either biopsied fat, milk, grass, soil, water, vegetables, or dip sludges were examined. The number of properties requiring traceback were: dieldrin 32; DDT 6; BHC 15; heptachlor-epoxide 5; chlordane 2; ethion 9; bromophosethyl 13. The only new sources of pesticide residues detected during the year were from the spraying of sheds with chlordane and the spraying of *Duboisia* trees with DDT to control pests. The analytical and traceback work indicated a generally responsible use of pesticides with a compliance rate in excess of 99%.

The Pig Section co-operated in a Commonwealth Department of Primary Industry survey of pesticide residues in pig meat. Analyses were done for prescribed pesticides and sulphadimidine. Field officers traced back samples analysed at above half the Minimum Residue Level (MRL). Levels of dieldrin greater than 0.5 MRL were found in one producer's pigs. Six years previously, the feed shed had been sprayed by a pest control firm. Levels of dieldrin were detected in spider webs and dust samples but not in the fat of cull sows. On another property, residues of dieldrin were found in pigs which had consumed waste spaghetti.

Packaging. Pig meats are packaged in a wide range of products. Previous studies had shown that plasticizers can migrate from the wrapping into the pig meat. The Australian Pig Industry Research Committee renewed funding of this work for a study of chemicals migrating from the wrapping. These chemicals may move from the plastic wrapper, from the inks and dyes used in labelling or from other parts of the package. The extent of penetration into the food is also being studied.

Effluent management. At the request of Agriculture Branch officers, Biochemistry Branch participated in a project designed to examine the use of starch effluent for irrigation of pastures. It was suspected that odours produced in short-term storage of the effluent could cause an environmental problem.

Thirty-two samples of the effluent stored either on farm or in the laboratory were monitored for pH and compositional changes over periods of up to 14 days. The pH of the effluent at the time of delivery ranged from 4.4 to 4.9. On storage over several days, the pH decreased to approximately 3.8. Whereas the farm samples stayed at a low pH irrespective of time, most of the duplicate samples stored in sealed glass jars in the laboratory showed an eventual increase in pH to 4.5 and above. This is possibly due to the release of ammonia by anaerobic fermentation.

These samples showed the formation of a curd on the surface and evidence of active carbohydrate fermentation with a distinct sour smell. Several of the effluent samples were analysed for volatile fatty acids, but none was detected. The odours produced by this material, though pungent, would be unlikely to cause a problem to surrounding inhabitants in the on-farm situation provided adequate buffer zones between holding tank and residential or industrial areas were available.

Many poultry farms reported fly and maggot problems in manure during late autumn 1981. Improved chemical control methods and control of spillage from drinkers alleviated these problems.

Development of facilities

A new prefabricated building was erected at the Quarantine and Export Centre, Hamilton, for animal quarantine officers. Finance for leasing was provided by the Commonwealth Department of Health.

A new raised board shearing shed with four stands was completed at 'Toorak' Research Station, Julia Creek. The shed was designed so that, at times other than shearing and crutching, sheep can be housed in and beneath the shed in suitable groups for experimental work. A new sheep shed is nearing completion at the Animal Research Institute, Yeerongpilly. Part of the finance for this building was provided by the Wool Research Trust Fund.

Design work by the Department of Works was well advanced for the Poultry Research Unit to be located at the Redlands Horticultural Research Station. The new unit will replace that at the Animal Husbandry Research Farm, Rocklea.

The additional facilities for pig research at the Biloela Research Station were completed and occupied. All the pigs from Hermitage Research Station were transferred to Biloela. The piggery at Hermitage was closed.

The transfer of officers of National Parks and Wildlife Service from the Animal Research Institute, Yeerongpilly, to Moggill resulted in a relocation of some staff of Pathology Branch into the vacated buildings with an easing of their acute accommodation problems. Modifications to the main Pathology Branch building to accommodate the Animal Research Institute library currently located in unsuitable accommodation were well advanced.

Planning for the major long-term building programme at the Animal Research Institute continued.

Training programmes

In a period when changes and improvements in technology are occurring rapidly, it is important for the Division of Animal Industry to have an active continuing education programme if the Division is to provide the optimum service to the animal industries and the general public. All staff have access to standard texts and journals but staff are scattered throughout the State and it is essential in the continuing education programme that they should be able to attend and participate in workshops, seminars, conferences, field days and be able to visit other scientists both interstate and overseas and be host to scientists from other areas.

As the Division is the largest within the Department, it is important also that its administrative, technical and clerical staff not only have technical training in their specific disciplines, but also management training to continually improve the efficiency of the Division's many operations. In the stringent financial environment, it is becoming increasingly difficult to maintain adequate continuing education programmes. During the past year, however, staff of the Division participated in several aspects of training and were able to assist in training of personnel from overseas countries.

Role specification was gradually being implemented throughout Animal Industry Division and a survey was commenced to assess staff attitudes relating to it.

Staff from various Branches attended courses which provided training in such areas as management, development, personal development, interpersonal communications, research paper writing, communication skills, farm management recording schemes, team building, role specification, extension methods and extension writing.

Staff also attended conferences as part of their training and these included Recent Advances in Animal Nutrition, Nutritional Limits to Animal Production, Biennial Conference of the Australian Society of Animal Production, and the Australian Veterinary Association Conference.

Poultry Section staff were engaged in workshops held in November 1981 and April 1982. At the workshops, objectives of the Section were clearly defined, problems in achieving them were identified, and action plans and recommendations to accomplish them were agreed upon. This action was essential and timely since it followed closely the disbandment of Husbandry Research Branch and the assignment of officers from that Branch to the Section.

A Pig Section staff workshop was held in May 1982 at Toowoomba and included guest speakers from interstate who were in Queensland for the 14th Biennial Conference of the Australian Society of Animal Production. Aspects of nutrition, reproduction, and animal behaviour were reviewed. Discussion also centred around local research and extension with some projects being reviewed and new ones proposed.

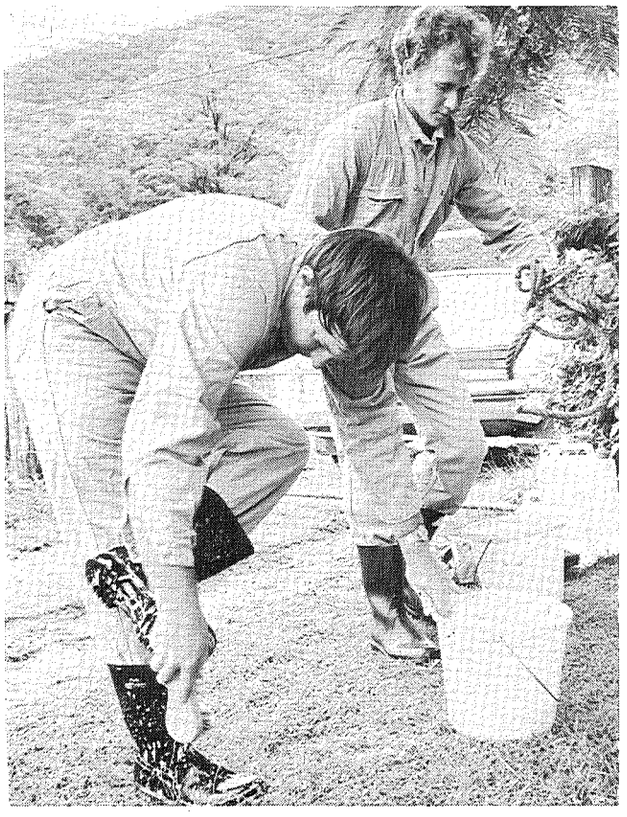
Three officers of the Pig and Poultry Branch together with an officer of Economic Services Branch attended a workshop on recording systems held at Hawkesbury Agricultural College, NSW. A glossary of pig industry terms was produced by a working party from the workshop. This was considered an important outcome, as was the interest shown in the Queensland Piggery Performance Analysis Micro-computer Programme.

A regional workshop for Beef Cattle Husbandry Branch staff was held in central Queensland in April. It was attended by 15 officers including all central Queensland officers, and some

Brisbane staff including the Branch executive. A range of technical topics requested by participants was discussed as well as a number of administrative problems, including the publication of trial work and the requirements for promotion.

Divisional Veterinary Officers attended a conference at Brisbane in November 1981 to discuss administrative, regulatory and disease control matters.

The three veterinary pathology laboratories at Yeerongpilly, Rockhampton and Oonoonba established a programme to obtain better integration between staff in these laboratories.



Disinfection procedure in an exotic disease exercise. An exotic disease exercise was conducted in south east Queensland during the year to familiarize officers with the procedures to be adopted should a real outbreak occur.

An exotic disease exercise was conducted by veterinary officers and staff of the exotic disease field headquarters to acquaint staff with procedures to be used in the event of an outbreak of exotic disease in Queensland and with problems likely to be encountered.

In Veterinary Services Branch, Mr G. Langford successfully completed a QIT Course in Business Administration, while Mr P. Jaques attended a post graduate course in veterinary epidemiology at the James Cook University.

During the year Mr Hodge was granted 6 months study leave following which he took 2 months long service leave to complete his thesis for the Ph.D. degree.

The officer in charge at the Oonoonba Veterinary Laboratory, Mr F. Trueman, was awarded a Diploma in Clinical Pathology from the Ontario Veterinary College, Guelph, Canada, during a period of study leave there.

Dr W. A. Hoey was awarded a Ph.D. degree from the Waite Research Institute, South Australia, following the completiom of a research programme on amino acid metabolism in ruminants.

Field officers were trained in the investigation of residue problems in a series of workshops organized by specialist workers of Veterinary Services and Biochemistry Branches. These workshops were located at Ipswich, Emerald, Townsville, Cairns, Mount Isa, Roma and Brisbane. A similar workshop was conducted for the Northern Territory Department of Primary Production and for Plant Industry Division.

At the Queensland Agricultural College, staff assisted in a course given on ticks and tick-borne diseases for participants from developing countries.

A 6-week study tour in the United Kingdom and West Germany was undertaken by Dr Linda Murphy. The main aims were: to visit scientists conducting research into poultry or pig behaviour and/or welfare; to obtain information on recent European developments regarding farm animal welfare codes, laws and government inquiries; and to attend the 17th International Ethological Conference.

Mr Lapworth toured the USA, with financial assistance from AMRC to further his studies in the transport of beef cattle. This involved the study of stock crate designs as well as loading and unloading facilities for cattle. He accompanied Mr Stewart McIver, a Queensland Stock transport operator and recipient of a Churchill award.

Mr Beasley studied carcass classification and marketing methods for cattle in parts of NSW, SA, and WA.

Dr Lindsay was recalled to duty during a private tour of the UK for 1 week. He visited six major research centres. The main area discussed was feed protein evaluation and the use of silage and hay additives. This has direct relevance to his research programme.

Drought wreaks havoc in south western Queensland. The severe drought continues in this part of the State and, at the end of the year, other areas such as the Capricorn coast and the Mackay hinterland were bordering on drought.

Cattle industry

Widely varying seasonal conditions again were a feature of the year. Last winter started well as a result of unseasonally good rains which blanketed the entire State during the second half of May, giving parts of the inland south the best rain for a number of years. This was followed by further good falls in June and July making three consecutive months of generally above normal winter rainfall. High soil moisture levels and relatively mild conditions combined to promote good winter herbage growth on the softer country, a useful basal shoot on pasture grasses and provided one of the best oat growing seasons in the last decade.

Much of the previously droughted southern inland carried a useful body of winter herbage, but lacked standover roughage due to the failure of the previous summer growing season.

The far north west had one of the best early spring seasons for a number of years, but most other parts of the State experienced a decline in both quantity and quality of feed and a marked deterioration in pastoral conditions. This was particularly severe in the southern inland, which had experienced severe drought conditions during the previous summer-autumn period and was devoid of standover feed. When the winter herbage dried off and disintegrated, this area became desperately short of feed as the spring progressed.

November saw widespread storm activity over much of the State, bringing variable, but mostly effective rains to a wide area resulting in a marked improvement in pastoral conditions. The eastern half of the State experienced an excellent late spring season, but the south west quarter received only light falls. Nevertheless, pastoral conditions were better than normal for this time of the year.

Summer rainfall varied widely throughout Queensland. Much of northern Queensland had only a light summer season and a failure of the normal monsoon. Summer rain came mainly from storms and falls were erratic and variable. As a result, the Capricorn coast and the Mackay hinterland are now bordering on drought. Most other central and northern districts had some grass-producing rain but insufficient soil moisture to sustain growth and will go into the winter with only a light to moderate body of hayed-off feed, with prospects of a very dry spring. The peninsula-gulf regions had more rain and are fairly well off for feed, but there was little runoff and limited replenishment of surface storages and streams. Water shortages could present major problems in the north later in the year.

Much of the south west quarter again missed any worthwhile summer rain making this the fifth consecutive year of a virtually rainless summer. In contrast, the Maranoa generally and southern border districts benefited from good February-March rains which promoted prolific pasture growth and these areas will carry a good body of standover feed into the winter. The south east quarter enjoyed one of the best summer seasons for many years and is similarly well off for feed.

Cattle generally performed well throughout the winter-spring period reflecting the above average seasonal conditions throughout the State. With favourable growing conditions producing some of the best winter oats crops in years, excellent grazing was obtained. Although grazing cut out earlier than usual, a good turnoff of fat cattle resulted.

Despite the light summer season in the north, cattle generally performed well on the shorter, less bulky feed. While lactating breeders are starting to deteriorate, cattle in the main will enter the winter in strong condition. However, if a normal prolonged dry season eventuates, northern cattle, and breeders in particular, could face severe nutritional stress. The current dry conditions in the south west are preventing the normal movement of store cattle from the north west and this will place greater pressure on this region which already is experiencing patchy pastoral conditions. In the south, cattle performed well throughout the year and will enter the winter in good order.

Store prices have been high relative to prices for slaughter cattle. A very good season in southern Queensland and northern New South Wales has induced fatteners to keep buying stores. None of the major store sales has been based on liveweight selling and where this has been attempted the prices paid for stores have been noticeably lower than at 'per head' auctions. This may be part of the explanation for the differential between store and fat prices.

The relative prices for cattle and grain have rendered feedlotting barely economic and naturally many of the smaller opportunity feedlots have closed down. The bigger feedlots have kept going, though some at only minimum capacity. That they have been able to profitably fatten cattle has been due to the high premium paid for lot fed cattle as the result of industry promotion and the 'purple-tag' scheme. The 'Stockyard' promotion was seemingly very successful. The strip branding launched in March is also likely to increase the premium for high quality beef but it is too early yet to judge the results of this.

Cattle finished on oats, while probably of similar quality to cattle finished on grain, have not received the same premium. This, together with the higher returns from grain, is leading to a decline in planting of oats for fattening cattle this winter. This may affect store prices.

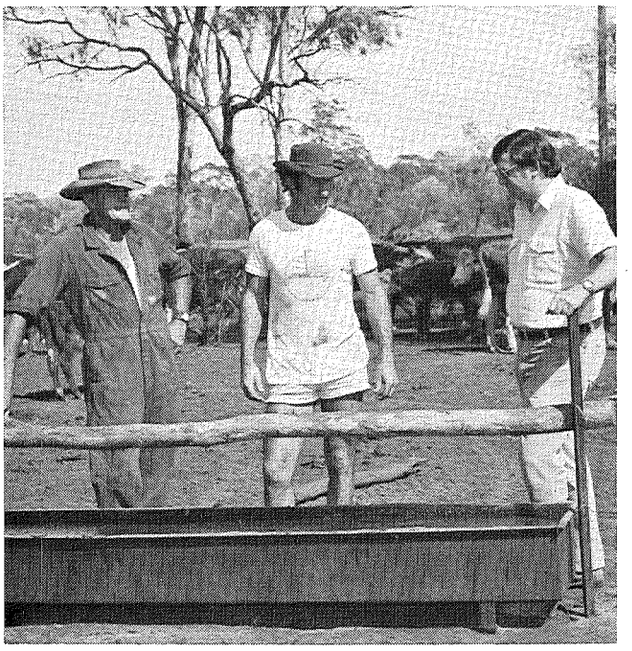
The classification trial at Mackay, which has now led to a price schedule based on classification, has been a major breakthrough in this field.

A large number of formerly beef-only properties in central Queensland are now growing grain. This could well lead to intensification of beef production and consequently more, rather than less, beef produced from the region.

Despite general concern at low prices, development has continued in many areas. In north Queensland, one company commenced a large scale pasture improvement operation involving the sowing of perennial stylos. In the Collinsville area, it is estimated that more than 30 000 ha are being cleared of timber. Much of this development is by new owners.

In southern Queensland, new owners from southern States have been attempting to develop the poor solodic country in the Chinchilla Shire. Although some of the development may be undertaken in ignorance, it is often the newcomers who pioneer and establish new techniques, even though some may fall by the wayside in doing so.

Water has been introduced into selling pens of five major saleyards. This has come about partly as a result of pressure from animal welfare groups but mostly because of work carried out by this Department. This research demonstrated the ineffectiveness of the dry curfew, which meat buyers had insisted upon as an essential adjunct to liveweight selling. Without exception, saleyard superintendents have reported that cattle do, in fact, drink water while in the pens and do not normally foul the troughs. Some have commented that cattle have been quieter and easier to handle as a result.



Beef Cattle Husbandry officer, Mr John Knight, of St. George, discusses drought feeding options with local cattlemen.

Beef industry statistics

Since the peak in cattle numbers in 1977 (11.5m head), numbers declined to 9.9m head over the 4-year period to 1981. Estimates derived from slaughtering figures and interstate movements indicated that the liquidation phase has ended. Preliminary figures for numbers in March 1982 (9.9m head) confirm this.

During the past 12 months with a weakening in the USA import market, some meatworks have run into financial difficulties and closed down. At one stage, a total of 20 meatworks throughout Australia had either closed down or forgone export licences. A total of seven meatworks had closed in Queensland.

Slaughterings during 1981 continued the decline that followed the peak of 3.3m slaughtering set in 1978. Relative to the peak, slaughterings in 1979, 1980 and 1981 were 10, 24 and 33% lower respectively with a total of 2.2m cattle slaughtered in 1981.

Most market analysts agree that little improvement can be expected in the US beef market before the second half of 1982. Despite this, beef shipments to the US during 1982 have been substantially greater than comparable 1981 export levels. Queensland slaughterings during the first quarter of 1982 are 54% greater than for the same period in 1981.

This increase in slaughterings is due to a number of peculiar influences. US beef prices received a boost from unusually bad weather restricting movements to slaughter, low stocks-in-store of all meats and a fall in interest rates. In Australia, a fall in beef

prices, reduced freight rates, and depreciation of the Australian dollar relative to the US, have favoured exports. It is difficult to judge prospects for the coming months from recent events. Any substantial improvement in the US beef market continues to depend on an upturn in the general level of economic activity.

The female slaughter rate continues to decline from a high of 47% of adult slaughterings in the peak year (1978) to a low of 37% in 1981. The female component of adult slaughterings is the most reliable indicator of trends in cattle numbers and can be used to indicate future change in the cattle herd. Analysis of Queensland slaughtering statistics indicates that the tendency is for herd build up to occur once the female component falls below 44% of the adult rate. The female slaughter rate for the first quarter of 1982 continues at 37% indicating that herd rebuilding is continuing.

Prices for all classes of cattle have continued the decline established after the prices peak established in January 1980. Overall prices at the end of the period were down by 41% on the January 1980 peak. With prices of inputs increasing, this represents a serious reduction in beef producers' terms of trade. The BAE forecasts some improvement in saleyard prices during 1982 but the average for the year is likely to be the same as the 1981 average.

During 1981, a total of 261 000 live cattle was moved from Queensland to southern states. This represents a drop of 6% on the 1980 figure. Movements into Queensland at 270 000 were similar to movements in 1980. About 82% of movements into Queensland came from NSW.

When exports of live cattle are taken into account, the overall net movement of live cattle out of Queensland amounted to 54 000 head. This is an increase of 26% on the previous year.

National brucellosis and tuberculosis eradication campaign

The Industries Assistance Commission held an inquiry into the continuation of the national brucellosis and tuberculosis eradication campaign. Apart from placing tuberculosis compensation on a similar basis as pertains for brucellosis (Commonwealth share 75%, State share 25%), the IAC recommended that funding for the operations be continued as at present (industry 70% and State 30%). This produced a spirited reaction from cattle industry organizations, who wanted an operational input from the Commonwealth and the matter is still under debate.

Brucellosis. The progress maintained in the eradication of brucellosis can be gauged by the figures in Table 1 which show that 94.66% of all herds in the State were free of the disease at the latest available quarterly computer printout at 31 March 1982 and that the Herd and Cattle Prevalence figures stood at 1.26% and 0.11% respectively.

Understandably, the progress made in the more extensive western region of the State has not been as spectacular as in the closer settled, more accessible eastern regions. For some properties in the west, the only practical method of eradicating brucellosis appeared to be a complete or partial destock of the property and restocking with disease free stock.

Field activities involved the testing of 1 105 812 cattle in 5 544 herd tests and in the detection of 4 875 (0.44%) positives. Additionally 68 266 cattle were vaccinated with Strain 19 and a further 27 252 cattle with Strain 45/20.

Disease control officers at abattoirs continue to be heavily involved in meatworks sampling for brucellosis. A total of 700 328 blood samples was tested from abattoirs, and 3 342 (0.48%) positives were obtained. This represents a collection rate of 95.3% of blood samples from available breeders. This is an increase of over 1% from a similar period last year. The improvement can be attributed to better tail tagging and the continuing conscientious efforts of officers in the meatworks.

Of the 237 abortion investigations carried out only three were found to be caused by *Brucella abortus*.

Monitoring was also carried out on milk and cream suppliers throughout the State as shown in Table 2.

The use of milk and cream ring testing as a means of monitoring eradication has increased significantly over the past 3 years, from 9 170 herd tests in the 12-month period 1-4-79 to 31-3-80 to 15 092 herd tests in the 12-month period 1-4-81 to 31-3-82, that is, an increase of 64.6%. During the same period the percentage of negative herd tests increased from 94.95% to 98.49%.

On 3 April 1982, the whole State of Queensland was declared Provisionally Free of the disease of bovine brucellosis, with the exception of the shires of Burke, Cloncurry, McKinlay, Boulia, Diamantina, the City of Mt Isa, and the portions of the shires of Barcoo, Bulloo and Quilpie west of the Western Dingo Barrier Fence, which remain an Eradication Area.

In a trial recently concluded, two herds of heifers and cows were vaccinated with reduced dose (1/400) Strain 19 at 9 months (herd A) and 12 months (herd B) prior to test and slaughter. Supramammary lymph nodes were cultured from 82 reactors (herd A) and 72 reactors (herd B). Results are shown in the Table 3.

Table 1. Herd status (brucellosis) at 31-3-82

Divisions	Number of herds							Prevalence %	
	NA	IN	SU	RD	PC	TN MN CF AF	Totals	Herd	Cattle
Toowoomba	11	81	270	52	140	7 998	8 552	0.95	0.12
Brisbane	49	43	48	54	121	5 211	55 266	0.79	0.06
Roma	6	92	21	22	40	2 297	2 478	3.72	0.25
Rockhampton	33	82	46	36	144	5 204	5 545	1.49	0.04
Maryborough	11	8	7	14	29	5 954	6 023	0.13	0.02
Townsville	2	8	4	1	2	1 496	1 513	0.53	0.00
Cairns	6	3	18	8	16	1 511	1 562	0.19	0.03
Mount Isa	61	43	33	12	12	279	440	11.35	0.40
Totals	179	360	447	199	504	29 950	31 639	1.26	0.11
Per cent	0.57	1.14	1.41	0.63	1.59	94.66	100.00		

AF = Accredited Free CF = Confirmed Free MN = Monitored Negative TN = Tested Negative
PC = Provisionally Clear SU = Suspect RD = Restricted IN = Infected NA = Non Assessed

Table 2. Milk and cream ring testing

Divisions	Period 1-1-82 to 31-3-82 Number of herd tests				Period 1-4-81 to 31-3-82 Number of herd tests			
	Positive	Suspect	Negative	Total	Positive	Suspect	Negative	Total
Toowoomba	9	8	1 135	1 152	30	59	4 517	4 606
Brisbane	5	11	1 301	1 317	57	35	4 890	4 982
Rockhampton	..	1	132	133	2	2	743	747
Maryborough	..	8	833	841	3	22	2 937	2 962
Cairns	..	1	254	255	1	12	1 257	1 270
Cream	..	2	75	77	1	4	520	525
Total	14	31	3 730	3775	94	134	14 864	15 092
Per cent	0.37	0.82	98.81		0.62	0.89	98.49	

Table 3. Results of complement fixation tests and bacteriological examination of herds A and B

Herd	*Brucella abortus* isolation	C.F.T. titre*								Total (%)
		0		8	16	32	64	128	256	
A	Strain 19	0	1	2	4	7	3	1	1	19 (23)
	biotype 1	0	0	0	0	0	0	0	1	1 (1)
	negative	8	19	16	8	8	1	2	0	62 (76)
										82
B	Strain 19	0	0	4	4	4	0	0	1	13 (18)
	biotype 1	0	0	0	0	0	0	2	0	2 (3)
	negative	0	5	24	17	5	4	2	0	57 (79)
										72

* Reciprocal of the dilution of serum.

Table 4. Herd status (tuberculosis) at 31-3-82

Divisions	Number of herds						Totals
	NA	IN	SU	RD	PC	TN.MN.CF.AF.	
Toowoomba	0	0	4	2	23	9 867	9 896
Brisbane	0	0	1	2	4	6 466	6 473
Roma	0	56	14	3	10	2 558	2 641
Rockhampton	0	49	2	10	10	6 668	6 729
Maryborough	0	3	0	3	4	7 178	7 188
Townsville	0	31	13	3	8	1 682	1 737
Cairns	1	16	3	0	1	1 817	1 838
Mount Isa	1	65	19	0	2	359	446
Totals	2	220	56	13	62	36 595	36 948
Percent	0.01	0.60	0.15	0.03	0.17	99.04	

AF = Accredited Free CF = Confirmed Free MN = Monitored Negative TN = Tested Negative PC = Provisionally Clear
SU = Suspect RD = Restricted IN = Infected NA = Non Assessed

The following points are of interest—

1. Culture of a large number of supramammary nodes confirmed that both herds were infected with *Br. abortus* biotype 1.
2. The persistence of *Br. abortus* Strain 19 in both herds is greater than expected from recent literature involving low dose Strain 19 in adult animals.
3. *Br. abortus* biotype 1 was only isolated from cattle with C.F.T. equal to or greater than 1/128.
4. *Br. abortus* Strain 19 was isolated from animals with C.F.T. titres from 1/4 to 1/256.

Tuberculosis. Progress in tuberculosis eradication can be gauged by the figures in Table 4 which show that 99.04% of all herds in the State were free of the disease at 31 March 1982.

Here again, progress has been more marked in the closely settled eastern regions of the State. Destockings of extensive properties in the western regions, followed by restocking with confirmed free stock, has proved to be the most efficient method of eradication.

Field activity for the 12-month period is presented in Table 5. Of the 152 herds tested a total of 209 herd tests was carried out involving 799 623 individual animal tests and 2 844 property visits. Of the individual animal tests 0.25% proved to be positive.

Table 5. Tuberculosis testing activity 1-1-81 to 31-12-81

Divisions	Number of cattle tested	Number of reactors
Toowoomba	939	0
Brisbane	1 132	1
Roma	50 134	119
Rockhampton	111 648	141
Maryborough	10 023	17
Townsville	192 139	371
Cairns	61 785	42
Mount Isa	371 823	1 343
Totals	799 623	2 034
Percent		0.25

All but eight of the total of 289 infected, restricted or suspect herds were engaged in an approved eradication programme, involving either testing and/or destocking during the year.

On 3 April 1982, the State was divided as follows—

(a) **Provisionally Free Area**—commencing on the sea coast at the northern boundary of Proserpine Shire thence generally westerly and southerly by the northern boundary of that Shire and the northern boundaries of the Mirani, Nebo, Belyando, Aramac and Longreach Shires to the Western Dingo Fence; thence southerly by that fence to the New South Wales border and easterly by that border to the sea coast, thence generally northerly by the sea coast back to the point of commencement.

(b) **Eradication Area**—the whole of the State of Queensland with the exception of the area defined in the Provisionally Free Area above.

A total of 1 409 carcasses (0.09%) was affected with tuberculosis for the 9-month period to March 1982. This represents a decrease for the number affected from a similar period in 1980–81. Tuberculosis reactors are not included in the above figures. Properties under destocking or partial destocking orders are providing the bulk of tuberculosis affected carcasses. However, there have also been several previously non-affected properties discovered with tuberculosis by meatworks monitoring.

A series of trials to compare the efficacies of different PPD tuberculins (Rotterdam and CSL) was initiated during the year. Initial results indicate that the 4 mg/mL Rotterdam tuberculin gives increased sensitivity and specificity compared with 3 mg/mL CSL PPD. However, further work is required to validate these findings.

To overcome difficulties inherent in such trials, cattle have been collected from infected properties in south west Queensland and held in quarantine for approximately 1 week while each trial was conducted. This has allowed animals to be read at 48, 72, 96 and 120 hours. This trial is continuing.

Laboratory examinations. Laboratories at Yeerongpilly, Oonoonba and Rockhampton carried out the following serological tests—

Brucellosis	ARI	OVL	RVL	Total
Rose Bengal Test	695 941	408 534	539 911	1 644 385
Complement Fixation Test	26 378	18 931	34 761	80 070
Indirect Haemolytic Test	9 983	85	4 528	14 596

A total of 514 specimens from meatworks and 681 from the field was tested for tuberculosis.

Further work was undertaken following trials last year which suggested that many of the mycobacteria other than *M. bovis,* which were isolated from no visible lesion reactors autopsied in the field, were environmental contaminants. The results of these experiments confirmed the initial observations, so efforts were concentrated on developing an aseptic collection technique for use in the field. Such a technique, which it is believed will minimize the contamination problem, has been developed and circulated to field staff.

As part of the above investigation, experiments were undertaken to establish effective methods of sterilizing instruments used in collection of tissues for culture. It was found that alcohol flaming was ineffective while boiling for 5 minutes or flaming for 15 seconds was equally effective.

Destocking operations. Destocking operations have now been approved on 129 properties which will include approximately 195 000 head of cattle.

Of these, about 37 500 head (19%) are being destocked due to brucellosis, about 86 500 head (44%) due to tuberculosis and the remaining 71 000 head (37%) are on properties where both diseases are a problem.

On many properties, particularly those large properties where fencing is inadequate and complete musters are impossible, destocking presents the only practical method of eradicating these diseases.

Over the 9-month period from 1 July 1981 to 31 March 1982, a total of $485,289 was paid out in compensation for destocking.

Ticks

Heavy and widespread rains fell over the cattle tick infested area during the winter and summer months and thus predisposed to increased tick activity throughout the year. However, activity in north west Queensland was light to moderate following a drier than normal summer. In south east Queensland, activity was temporarily depressed during the late winter months.

The following numbers of properties in the area regarded as tick free were quarantined because of cattle tick *(Boophilus microplus)* infestation.

Division	Properties quarantined
Mount Isa	
McKinlay Shire	41
Richmond Shire	19
Townsville	
Flinders Shire	14
Roma	
Taroom Shire	7
Murweh Shire	2
Toowoomba	
Glengallan Shire	19
Allora Shire	7
Crows Nest Shire	5
Cambooya Shire	58
Rosalie Shire	5
Toowoomba City	3
Clifton Shire	22
Maryborough	
Nanango Shire	19
Kingaroy Shire	16
Wondai Shire	2
Chinchilla Shire	1
Total	**240**

The presence of ticks on properties in those parts of the McKinlay, Richmond and Flinders Shires south of the Great Northern Railway continues to give cause for concern.

Additional staff have been transferred to the area with a view to instituting a programme designed to limit the southerly spread of ticks and to mount an extension programme that will seek assistance from property owners through property programmes, in order to assess the feasibility of eradicating ticks from the area. A total of 131 properties and approximately 150 000 cattle is involved.

Epidemiological investigations are also being carried out into tick outbreaks west of the tick line. This work entailed a detailed retrospective study of previous tick outbreaks in the Toowoomba stock district and the establishment of tick plots at Toowoomba, Hermitage, Toorak Research Station and Winton.

Data obtained suggest that the area of the Darling Downs comprising the western slopes of the Great Dividing Range is enzootic for cattle ticks *(Boophilus microplus)* and the extent of tick infestations in the remainder of the area is governed by seasonal conditions. However, other factors are involved because seasonal conditions were unsuitable in 1976 for tick propagation and yet the highest number of tick quarantines were applied in that year.

The upsurge in tick infestations detected in 1974 could have resulted from the occurrence of very favourable seasonal conditions for ticks during the summers of 1973 and 1974 with a very mild winter during the intervening period. The continuing high incidence of quarantines through the remainder of the decade possibly resulted from the focus of infestation provided by the large number of infested properties and the occurrence of further favourable seasons for tick propagation.

The data also indicated that a population of ticks could easily have survived the winter of 1981 on the Darling Downs. Their existence was much more precarious at Warwick although results suggest that they would have survived the winter there also.

Cattle ticks from herds with tick control problems were tested for acaricide resistance. The presence of the Ulam strain of *Boophilus microplus* was confirmed on a property at Gympie. It has also been identified on two Ulam district properties.

The numbers of the various strains of resistance detected during the year are as follows—

——	Detected during year	Progressive total
Ridgelands	0	1 321
Biarra	32	2 567
Mount Alford	34	355
Mackay	0	152
Tully	0	3
Gracemere	0	18
Glastonbury	0	2
Ulam	3	3
Susceptible	8	1 941
Total	77	6 362

In southern Queensland, there is still emphasis in extension programmes on the need to breed tick resistant cattle. In central and northern Queensland this is widely accepted and emphasis has been on reducing dipping and selection, if appropriate, for tick resistance.

At some bull sales, figures on relative tick resistance have been given on each animal, but these do not appear to have influenced price. This is not surprising as many of the buyers have come from tick free or lightly infested areas. Nevertheless, we will continue to devote some effort to having tick resistance data presented at sales.

In north Queensland, Beef Cattle Husbandry and Veterinary Services Branches have continued resistance selection work on five properties. The objectives are to devise meaningful and practical methods of selection for both weight gain and tick resistance under north Queensland conditions. Selection is for both herd replacements and for sale. These projects are likely to continue for a number of years but some conclusions can be drawn from results to date.

In the northern environment growth rates are slow, 0.3 to 0.4 kg per hd per day and even at 2½ years of age animals are still physically immature. This could be contributing to difficulties in detecting the best animals. Some animals selected on performance at this age are subsequently being surpassed by other lower performers. Two-and-a-half years seems a minimum age in north Queensland conditions on pasture.

Where a wide spread of weight occurs at initial weighing or identification, lighter animals are showing significantly higher rates of gain than the heavy ones. Reasonably accurate definition of birth time is important. Where this is difficult, initial weighing must be done when animals are as young as possible.

It now seems that bull selection for tick resistance should be done following the wet season, up to July in the Ingham area, and May–June in the Ayr–Bowen area. Artificial infestation is desirable to ensure adequate challenge at this time and can be done at 18 months.

With breeder selection, animals must not be suffering from any stress factor other than ticks, or selection accuracy will suffer. Lactation will not be a serious factor if evaluation is done at the conclusion of the wet season. Cows should be in store condition or better.

Artificial infestation is not justified but a minimum mean tick population of 30 engorging ticks per side is needed for good results. Different standards need to be set for lactating and dry cows.

According to management requirements, cattle can be readily segregated into resistance classes. This gives immediate benefit in reducing dipping needs, and the dipping frequency for resistant cattle has been reduced to less than once yearly.

At 'Brian Pastures' Pasture Research Station, Sahiwal x Herefords were measured for tick resistance by artificial infestation. Bulls with 75% and 38% Sahiwal content showed a marked difference as indicated in the table below:—

Resistance level	High 98	Moderate 95–98	Low 90–95	Very low 90
3/4 Sahiwal	100%	..	..	..
3/8 Sahiwal	60%	35%	4%	..

Lactating and pregnant 3/8 Sahiwals had more animals in the moderate and low resistance categories suggesting that pregnancy and lactation adversely affect resistance.

Tick fever

Increased tick activity following widespread and heavy rainfalls during the winter and summer months predisposed to a higher than normal incidence of tick fever for the year. Outbreaks confirmed by laboratory examination totalled 115, but many outbreaks were diagnosed where no specimens were forwarded to the laboratories for confirmation.

Ninety-one outbreaks were caused by *B. bovis.* An unusual feature was the occurrence of 24 outbreaks during the winter months. Morbidity and mortality rates were low but notable outbreaks were reported from Calliope (6 dead), Rolleston (10 dead) and Yungaburra (7 dead). Cattle under 3 years of age were chiefly affected. Ten outbreaks of tick fever due to *B. bigemina* were investigated.

Fourteen outbreaks of anaplasmosis were investigated and confirmed. Ten cattle died on a property in the McKinlay Shire and 12 head were affected on a Canungra farm.

Babesia bovis **vaccine developments.** The long running Australian Meat Research Committee project DAQ12 ceased at the end of last financial year with a significant reduction in funding and staff for the Tick Fever Research Centre. Nevertheless an active programme of research continued with perhaps most effort concentrating on the development of *in vitro* methods of culturing *Babesia* with a view to production of vaccine in the laboratory rather than in splenectomized calves as at present.

A series of experiments was carried out using non-living soluble antigen (NLSA) derived from supernatants of *B. bovis in vitro* culture systems. These antigens were partially fractionated and used with saponin adjuvants and compared with living parasites from *in vitro* cultures and with the standard vaccine. Animals receiving NLSA developed good antibody responses, particularly those receiving two vaccinations. They also developed good lymphocyte responses as measured by the *in vitro* lymphocyte transformation test. To date only one group has been challenged with virulent parasites.

The severity of heterologous challenge was assessed by measuring the following parameters: packed cell volume (PCV). rectal temperature, parasitaemia (score method of Callow and Pepper 1974) and the need for treatment. The results are given in Table 6.

Unimmunized control animals experienced very severe reactions to challenge and all five required treatment. Group 1 cattle (one dose NLSA) also experienced severe reactions and 4 of the 5 required treatment. Group 2 cattle (two dose NLSA), which had significantly higher antibody levels, had less severe reactions and their mean maximum parasitaemia score was significantly less than that of the controls. Only one of the five required treatment. All 10 animals immunized with live parasites had mild reactions and none required treatment.

Selected animals were tested for the presence of antibodies to bovine blood group factors. The results showed that one or two doses of NLSA did not stimulate potentially dangerous antibody levels. In summary, two doses of nonliving antigen produced *B. bovis* serum antibodies and provided some protection against heterologous challenge 10 weeks later. The possibility that protection may have been stronger when antibody levels were higher is to be investigated.

Should it prove impossible to develop an effective vaccine based on NLSA, the use of tissue culture derived live parasites remains an attractive alternative.

Some surprising results were obtained in experiments designed to assess the efficacy of serum in promoting the growth of *B. bovis in vitro.* Foetal calf serum was found unsuitable as was serum from some unexposed cattle. Serum from other cattle and horse serum both supported good growth. Immune serum from repeatedly vaccinated cattle did not inhibit *in vitro* growth suggesting that babesial antibodies are functionally dependent on the involvement of immune cells such as macrophages and lymphocytes.

Anaplasmosis vaccine. Laboratory experimentation has suggested for some time that the immunity conferred by vaccination of cattle with *Anaplasma centrale* is less than optimal, particularly if the recipients are only 6 months of age. It was considered that an attenuated strain of *A. marginale* offered the best chance of a more immunogenic vaccine. Attempts to achieve this aim are under way on two fronts. One is based upon the possibility of rapid passage through splenectomized calves attenuating the organism as is the case with *B. bovis,* and the other on the possible modifying effect of temperature and moulting hormone on tick stages of *A. marginale.* No clear cut results are yet available from either method.

Diagnostic tests. The indirect fluorescent antibody test (IFAT) has been shown to have a high degree of accuracy in detecting antibodies to *B. bovis.* However, it has the disadvantages of being read subjectively, being tiring on the operator, and of a very limited daily throughput. In order to overcome some of these deficiencies, an enzyme linked immuno-absorbent assay test (ELAT) has been developed which shows promise of being as specific as the IFAT and possibly more sensitive. In addition, it does not suffer from the first two disadvantages of the IFAT.

The ELAT test is also being looked at for the detection of antibodies to *A. marginale* where the specificity of the IFAT has not been satisfactory. It is also felt that a test with greater sensitivity than the complement fixation test, which is not particularly effective in detecting long-term carrier animals, is desirable.

Buffalo fly

Marked buffalo fly activity was reported from north Queensland, north west Queensland and in the coastal areas extending to the NSW border, during the late winter months of 1981. Frosts in the inland areas of south Queensland curtailed activity during this period. However, good seasonal conditions throughout last summer predisposed to moderate and heavy infestations in the eastern coastal and northern areas of Queensland.

No further detections of Kuttabul pyrethroid resistant strain of buffalo fly strain were made. The pyrethroid insecticides and OP-pyrethroid acaricide dips have effected good control of buffalo fly.

The Executive Officer of AMRC and staff of CSIRO visited various centres in western and northern Queensland to assess producer concern over buffalo fly. Naturally most producers would like to see a cheap, easy and effective means of controlling or eradicating buffalo fly despite evidence that this insect has apparently very little effect on production. The obvious annoyance to cattle and the unsightly appearance of the buffalo fly sores stimulate many producers to take control measures even though they are aware that these may not be justified on economic grounds.

Table 6. Response to heterologous challenge of cattle immunized 10 weeks earlier with either living of nonliving *B. bovis* antigens

GROUP	Mean max % PCV depression	Mean max temp. rise	Mean max parasitaemia	No. needing treatment
1. 1 x NLSA	43.3	2.6	11.0	4/5
2. 2 x NLSA	40.2	2.1	7.2	1/5
3. live culture parasites	6.8	1.0	1.4	0/5
4. live vaccine parasites	11.7	1.3	1.8	0/5
5. unimmunized	38.4	2.5	11.0	5/5

A 4-year trial at 'Swan's Lagoon' Cattle Field Research Station was terminated in June 1981. In 4 successive years, the weight gain of groups of treated and untreated steers and bullocks was measured over a period of a year. The treated animals were sprayed at intervals of 3 weeks and virtually kept free of buffalo fly. This entailed from 16 to 20 sprayings in each year. Over the 4 years, there was no response at all to treatment among steers. In 2 out of the 4 years, the treated steers put on less weight than the untreated ones. In the case of the bullocks, the treated group in every year put on more weight than the untreated bullocks, with a mean response of 8.3 kg per annum. Active skin lesions were seen on 67% to 69% of untreated animals with only 5% of the treated animals showing any lesions. Treatment did not have any effect on the degree of bruising.

Stephanofilariasis

A preliminary survey of the distribution of the filaroid parasite *Stephanofilaria* in north Queensland has now been completed. This parasite is found in conjunction with skin lesions previously thought to be caused by buffalo fly irritation. The presence of significant levels of infection is probably due to the reduction of use of acaricides associated with increasing numbers of tick-resistant breeds of cattle in north Queensland.

More than 3 000 head of cattle have been surveyed and results show infection in all northern shires except Boulia with infection rates up to 17% in Ayr Shire. Infection levels are highest in the coastal and gulf shires and the overall prevalence is 11.4%.

Internal parasites

The trials reported below demonstrated that treatment of internal parasites is often barely warranted. Nevertheless, huge sums of money are spent yearly on anthelmintics, and chemical firms are constantly producing new products and formulations.

At Brigalow Research Station, studies with two drafts of steers, which began in 1978, have shown that dosing of weaners is likely to be of little benefit in that environment, if turnoff is at 3 1/2 years of age. Both Africander cross weaners and Hereford weaners responded to treatment up to 2 years of age, but by 3 1/4 years much of the benefit had been lost.

On Brigalow Research Station, the genetics of helminth resistance is also being studied. This project was undertaken to attempt to verify if differences in helminth resistance particularly in sire progeny groups actually existed in cattle in this region. These differences in sire progeny groups in terms of worm egg counts were assessed by a series of four faecal egg counts taken about 6 weeks apart in female progeny from 9 to 14 months of age. The first year's results indicated no differences between genotypes in faecal egg counts, but sire progeny groups within genotypes had significantly different egg counts, particularly in the Africander cross and Simmental genotypes, but was less marked in the Herefords.

The second year's data have not yet been analysed but again there would appear to be no breed difference and the sire group differences within genotypes appear to be less marked than in the first year's data. Co-operative work with Animal Research Institute (C.F. antibodies) and Australian National University (lymphocyte antigens) is attempting to make identification of these resistant animals simpler by using blood tests instead of a series of faecal samples. No results are yet to hand on this section of the work.

At Wivenhoe, the third and last draft of the helminth study received their last treatment in June 1982. They will be retained until June 1983 to study any compensatory gain. In this trial, treatments at intervals of 3, 6 and 12 weeks have been compared with no treatment. In every year, there has been a response to treatment although the difference between treatments has been variable. In every draft, Brahman crosses have responded less to treatment than Herefords, indicating a higher level of resistance.

From this study, it is apparent that helminths do have an appreciable effect on young cattle in that environment. The most economic strategy still needs to be worked out, and final conclusions will depend on the results of the post treatment phase.

Where sheep and cattle are run together, it is common practice for sheep to be drenched. Many of these graziers in these circumstances believe that cattle should also be treated. A trial at Charleville to compare drenched and undrenched weaners commenced in September 1981. To date there has been no obvious response to treatment.

At Stanthorpe, a trial was started in June 1981 in association with Queensland University's Goondiwindi Pastoral Veterinary Centre. In that environment, weaners appeared to respond to regular treatment, but yearlings in the same trial showed no response. The younger animals are being followed through to an older age to see if the treatment effects are lasting. Worm burdens were fluctuating, but generally low.

At 'Swan's Lagoon' weaners have been observed to receive a setback accompanied by post-weaning diarrhoea. Coccidiosis has been suspected as a primary cause and coccidial oocysts of eight different species of coccidia have been seen regularly in many samples. It is dangerous to presume, however, that these parasites are the main cause of the syndrome observed. Current studies are examining the role of bacteria, viruses, coccidia and other internal parasites as possible causes of post-weaning diarrhoea and reduced growth rate.

Eighty of the 1982 weaners were selected on the basis of genotype and regularly faecal sampled. Half were treated with levamisole at regular intervals. All but one of the four groups have shown a response of 13 kg to 16 kg to anthelmintic treatment.

Diarrhoea in the mob has been widespread but of short duration in individual animals. Although many calves pass oocysts over an extended period, the period where large numbers were shed was shorter than the period of diarrhoea. All three of the postmortemed calves had infection with helminths and coccidia, but the faecal count of oocysts did not give a good indication of the level of infection. One calf had a low count before slaughter but, when postmortemed, was found to be at a stage prior to a massive oocyst release. The second calf suffering from dysentery had a faecal oocyst count of 7 600 per g but had dropped to 250 per g 2 days later. Because the release of oocysts occurred over a short period, the results indicate that most, if not all calves, experienced a period of very high counts.

With the 1982 draft of weaners, one group is being treated for coccidia by giving them a sheep rumen capsule containing monesin which is an effective coccidiostat. Prior to treatment, a random sampling indicated that 17% of calves were passing small numbers of oocysts.

Hydatid disease is a well documented zoonosis: definitive hosts are various carnivora which carry the adult tapeworm *Echinococcus granulosus*; intermediate hosts are various herbivora. Man is infected by ingesting eggs passed by definitive hosts.

In Australia, the predominant cycle posing a risk to man is a sheep/farm dog cycle, while a dingo/wallaby sylvatic cycle also operates in mainland States, but its role in the total epidemiology is not quite clear. In Queensland, it is felt that cattle are accidental hosts in the sylvatic cycle. However, prevalence in cattle may be an indicator of the general activity of the cycle in various geographical regions.

In Queensland, it is known that there are areas of very high prevalence of hydatids in cattle, but these areas are not well defined, and the possibility of infection in rural dogs from these areas has not been investigated. Also, the prevalence of hydatids in sheep in Queensland has not been well documented.

Various world authorities agree that accurate baseline data on prevalence in animals and man is needed to make recommendations on control programmes. It is also noted that such information is usually not available when a decision to mount a programme is made. A comment from meat industry sources in 1980 that cattle liver recovery rates in abattoirs were decreasing over recent years led to a brief investigation by officers of the Meat Inspection Branch of the Commonwealth Bureau of Animal Health.

Results suggested an increase in prevalence of hydatids was to blame. For example, approximately 21% of livers from cattle killed at Willowburn (Toowoomba) between March and June 1981 were condemned for hydatid disease, 16% from Warwick, 21% from Doboy (Brisbane), 33% from Oakey and 37% from Fitzroy (Rockhampton).

If this is correct, are there factors operating whereby rural dogs become infected with *Echinococcus*? Prevalence in domestic dogs is a sensitive indicator of risk to man. If some rural dogs are infected, can any factors be identified which may be causing this infection? This is the type of information which is extremely valuable to the Sub-Committee on Hydatids. Also the Veterinary Public Health Unit of WHO is interested to obtain information on the sylvatic cycle in Queensland. It may well be that a different 'strain' of *Echinococcus granulosus* is involved, and this strain may have a different infectivity to man than does the sheep/farm dog strain.

The following work programme has been instituted to answer these questions—

1. Abattoir traceback survey in cattle to define geographical distribution and prevalence.
2. Abattoir traceback survey in sheep from those areas (notably the Darling Downs) where sheep/farm dog cycle may be operating.
3. Examination of rural dogs for *Echinococcus granulosus* from areas of high prevalence in cattle and sheep. If infected dogs are found, then investigation of husbandry factors which may contribute to infection will be undertaken.
4. Correlation of geographical distribution of dingoes and macropods known to be involved in the sylvatic cycle with the geographical distribution of hydatids in cattle and sheep.

Results of the Abattoir Traceback Survey of Cattle have been collated from examinations of 11 999 cattle from 2 339 properties south of the Tropic of Capricorn. A summary of the results of DVO Divisional Areas is given in the following table—

Division	Cattle		Properties	
	No. examined	% infected	No. examined	% infected
Brisbane	2 568	20.9	593	29.0
Toowoomba	5 353	5.0	1 024	15.8
Maryborough	1 258	19.5	312	39.1
Roma	1 790	8.0	222	18.0
Rockhampton	1 030	13.8	188	30.9

Techniques have been developed for the examination of rural dogs and this stage will proceed during the cooler winter months.

Seven dingoes from the Kilcoy, Inglewood and Theodore areas have been examined. All were infected with *Echinococcus granulosus.*

Material from dingoes and bovine cysts has been sent to the Murdoch University for speciation studies. So far, all material examined has been similar to the domestic (sheep/farm dog) strain occurring in southern mainland Australia. This is an unexpected result as it was thought that the strain from coastal dingoes and bovines in Queensland would be similar to the sylvatic (wallaby/dingo) strain occurring in NSW and Victoria.

Other diseases

Leptospira pomona was diagnosed as a cause of abortions in the dairying districts, but field evidence is increasing that *L. hardjo* is also a major cause of abortion in cattle. Divisional Veterinary Officers at Roma, Cairns and Maryborough ascribe abortions in 150 herds to the presence of these bacteria on the grounds of a high percentage of strong serological positives, infertility and lack of other diagnostic evidence.

It is of interest to note that the incidence of *L. pomona* in cattle, as evidenced by serological results, has decreased in the Cairns division during recent years. A similar picture has been reported in humans. This may be associated with the intensification of the pig industry, with fewer pigs being associated under range and/or semi range conditions with dairy cattle and people.

As histopathological examination of numerous sections of placenta from bovine abortions in dairy cattle in north Queensland indicated that the placental lesions were not unlike those reported from cases of chlamydial abortion in sheep and cattle overseas, attempts were made to isolate this agent.

Following prolonged work on this attempted isolation (techniques needed to be developed and aborted material was often severely autolysed and contaminated), a successful isolation was recently made of an agent believed to belong to the chlamydial group of organisms. Pooled foetal specimens, including lung, spleen, kidney, heart, liver, peritoneal fluid and abdominal contents, were collected from a mid term aborted foetus submitted on ice from the Atherton Tableland. These specimens were inoculated into young guinea pigs which were necropsied after 3 weeks and one was found to have an enlarged spleen.

The spleen was homogenized and inoculated into 7-day-old embryonated hen eggs. Deaths commenced after the second passage. Gimenez stained smears of yolk sacs from affected eggs revealed the presence of organisms characteristic of the *Chlamydia* group.

If the planned inoculation of this isolate into pregnant cattle is successful in producing abortion similar to the overseas organism, this will confirm the isolate as the aetiological agent.

Trichomonas fetus was recovered from the genitalia of a bull at Laura, while *Klebsiella pneumoniae* was diagnosed as a cause of abortion at 8 months' pregnancy in a cow at Helidon.

As was the case in previous years, vibriosis was incriminated as a cause of vaginitis, infertility and abortions in cattle in all dairying areas of the State. An efficacious vaccine is available for both bulls and females. In the more extensive areas of management, vaccination of bulls is the technique used most for controlling vibriosis.

Vibriosis is widespread but its effect on reproductive rates varies. On one Bundaberg property, vaccination failed to lift reproductive levels at all despite evidence that vibriosis was present and might have affected fertility. On a peninsula property, on the other hand, vaccination was reported to have been highly successful. There is no suggestion that the vaccine is ineffective, but the true cause of sub fertility is probably more often poor nutrition.

Botulism caused the deaths of cattle on a property near Croydon. Reports of heavy losses from this disease in the phosphorus deficient areas of the Cape York Peninsula has prompted the larger and better managed stations to re-institute vaccination programmes following 2 to 3-year lapses.

Thirty deaths on a property at Baralaba were ascribed to botulism. A shortage of bivalent vaccine was reported during May.

Histopathological examination of the brains of three bulls that died at Wallumbilla, revealed lesions of polioencephalomalacia. The bulls exhibited ataxia, excitement and diarrhoea. Cattle in the early stages of the syndrome improved following injections of vitamin B.

Salmonellosis caused deaths in calves at Lawes, and *Salmonella typhimurim* (type B) was isolated from the faeces of a bull with diarrhoea at Gatton. Salmonella (Group C) was recovered from a 5-week old calf that died at Kairi.

Mortalities due to blackleg occurred at Bald Hills, Mutdapilly and in three herds in the Burnett area. Vaccinated cattle were not involved.

Queensland is participating in the National Mannosidosis Accreditation Scheme, the objective of which is to eradicate mannosidosis from Aberdeen Angus stud herds. Testing in the Queensland segment was concluded during the year. An estimated 900 cattle in 15 herds were tested and 66 heterozygotes detected. Twenty-five of these reactors involved a Red Angus herd. If this herd is excluded, the heterozygote reactor rate was approximately 5%. All heterozygotes were culled or spayed and transferred to the commercial portion of the herds.

Staphylococcus aureus is the most frequent cause of mastitis which is difficult to treat and isolates are routinely tested for resistance to a range of antibiotics when requested. The results of such testing against the most commonly used antibiotics is given below.

Antibiotic	Percentage of isolates showing resistance (%)
Penicillin	44.4
Neomycin	0
Methicillin	0
Streptomycin	14.7
Tetracycline	4.4
Novobiocin	0
Ampicillin	43.5

The results to date show that more isolates are resistant to penicillin than any other antibiotic, though the limited data on ampicillin suggest that resistance here is also significant.

Cases of ephemeral fever now occur yearly rather than as periodic explosive epidemics and the condition is a difficult one to confirm by routine laboratory procedures. In fact, there is no practical simple routine method for confirmation of this disease. Both the Yeerongpilly and Oonoonba laboratories are developing and evaluating fluorescent procedures aimed at demonstrating virus in circulating neutrophils of early clinical cases.

Sporadic outbreaks of ephemeral fever occurred in south east Queensland during November, but the prevalence rate markedly increased following widespread December rains. Cases were reported from the Peachester, Caboolture, Dayboro, Samford, Lowood, Gympie, Bundaberg and Rosedale areas.

Subsequent to heavy midsummer rains that fell over the eastern areas of Queensland, widespread outbreaks were reported from the Atherton Tableland, Flinders and Dalrymple Shires, districts adjacent to the eastern coastline of Queensland, North and South Burnett areas, Darling Downs and Maranoa areas. Cattle of the 12 to 24 months age group were chiefly affected with a mortality rate of approximately 1% of affected animals. Animals were more severely affected especially in regard to lameness than those involved in outbreaks of previous years.

The virus of Infectious Bovine Rhinotracheitis (IBR) was the cause of encephalitis in calves at Wycarbah (Rockhampton). Fifteen calves were affected, including four that were moved to an adjacent farm. No in-contact animals on the latter farm developed clinical signs. All infected calves were younger than 4 weeks of age. The encephalitis was due to infection with an encephalitic strain of Bovine Herpes Virus I (BHVI = IBR) virus. Symptoms were headpressing, circling, blindness and nasal and ocular discharge. Severe nonplurent encephalitis was confirmed in three calves and BHVI virus was isolated from one of them. One of the other calves was also positive serologically for BHVI infection. This is the first outbreak of the encephalitic form of this disease since 1962. Titres to IBR virus were returned in sera from seven adult females and one bull of 23 animals sampled.

An outbreak of sickness occurred in a batch of Zebu cattle, 10 to 20 months old, imported from USA via the Cocos Island Quarantine Station. These cattle arrived in Townsville on 2 March 1982 where they were vaccinated for *Babesia bovis* and *Anaplasma.* Ten head were transported to a property at Mackay the same day, then five of these went to Biloela the next day. Evidence of sickness in the Mackay cattle was seen in two bulls and a heifer between 8 March and 12 March.

Signs were lethargy, elevated temperature, ocular discharge and seromucoid nasal discharge. On 10 March, one bull was very depressed and in lateral recumbency. However, it recovered over the next 2 days. At Biloela, two bulls had elevated temperatures on 7 and 8 March and one of these also had discharge and salivation. Laboratory results indicated a degenerative neutrophilia in two sick animals; three of the five at Mackay also had microcrytic anaemia, but this was considered to be pre-existing. Paired sera were tested for ephemeral fever—one of seven animals has a positive titre and this did not change significantly. Smears from the sick animals were negative for tick fever.

Virus isolation and homologous antibody seroconversion show that the Mackay cattle were infected with a *Simbu* group virus shortly after arrival. The role of this virus in the clinical disease is unknown.

Leucosis was diagnosed as the cause of sickness in herds at Tiaro, Yungaburra, Atherton, Belli and Maryborough (two) and of mortalities on a property at Gunalda.

The Queensland strain of Enzootic Bovine Leukosis virus (EBLV) was used to produce antigen in co-cultures for the AGID test. The AGID test was then employed to survey a total of 8 560 cattle selected from all statistical divisions in the State for antibodies to EBLV. When results for the Brisbane division were excluded, the prevalence of positive reactors was only 0.2% (13 of 6 440 sera), whereas the prevalence in the Brisbane division was 1.7% (32 out of 1 920 sera).

Twenty sheep were inoculated approximately 2 years ago with tissue culture derived Queensland isolate of EBLV, along with 10 controls which received uninfected tissue culture material. Two of the virus infected sheep died from other causes and four more have died from generalized lymphosarcoma. Control animals have remained normal with mean total lymphocyte counts lower than those of the surviving EBLV infected sheep. These results confirm the oncogenicity of the Queensland isolate of EBLV.

The AGID antigen prepared in Queensland has been evaluated in known EBL infected and known EBL free herds and compared with the imported Pitman Moore Leukassay Kit antigen. No reactions were detected with either antigen in the known free herds and only minor differences between antigens were apparent in the infected herds with the Queensland antigen appearing to be slightly more sensitive. A batch of 60 experimental sera from C.V.L. Weybridge was also tested in the presence of Dr Lucas from Weybridge. It was considered that the test method and reading of both institutions was similar, but that minor variations can occur that may or may not be related to antigen.

Laboratory activity with regard to the bluetongue group viruses has been restricted to an ongoing monitoring of sheep sera from southern, central and northern Queensland and testing of cattle for export.

A total of 2 137 sheep sera has been tested in the monitoring programme to date with seven suspicious reactions in the agar gel immunodiffusion (AGID) test and four positive. None of these AGID reactor sera gave reactions in the serum neutralization tests (SNT) for BT20, CSIRO 154 or CSIRO 156 viruses.

The following table gives the results of bluetongue tests on cattle for export—

Result	Test		
	AGID	Complement fixation (CFT)	SNT (BT 20 only)
Positive	58	138	0
Total tests	224	4 322	2 542

Serious problems were caused by the occurrence of 16.2% of anticomplementary reactions in the Bluetongue CFT. These sera cannot be tested and caused considerable difficulties for the exporter. The cause of the problem has not been fully elucidated but preliminary investigations suggest that both the batch of antigen and of enhancing serum used played a part. It is necessary that the cause be accurately defined otherwise it will not be possible to prevent a recurrence of the problem.

A shipment of bulls from the Dalby area to Fiji was disrupted when 40 out of 58 gave positive reactions to the Bluetongue AGID. None of the sera reacted in the SNT to BT 20 but 11 were positive to CSIRO 154 and 12 to CSIRO 156. It was thought that recent flooding in the area led to an increase in the vector population and increased transmission of the viruses.

Some fine 17-month-old yearlings in the Roma district. They are by a three-quarters Charolais bull out of Brahman x Hereford dams.

Reproduction, herd management and turn-off

In a number of districts, there are reports of greatly reduced calving as a result of the previous dry year or years. From Dalby, for instance, calving rates were estimated to be down to 40 to 50% on many properties as compared with a 'normal' of 80 to 90%. In the Rockhampton area, brandings this year were reported to be 50 to 70% of normal. On the other hand, in the north west, a very good autumn-winter and a large number of dry breeders from the previous poor seasons led to exceptionally high calving rates.

On Brigalow Research Station, the research programme into dystocia has largely been terminated. An assessment of the mineral status of breeders was carried out to determine whether there were any mineral problems associated with dystocia. Blood or serum copper did not appear to be markedly different in normal calving heifers compared to dystocia affected heifers.

Serum zinc was markedly depressed in dystocia affected heifers at the time of calving but quickly returned to near normal levels. This possibly indicates a biochemical upset rather than a deficiency. Serum calcium was slightly depressed at the time of calving and was markedly depressed 24 hours after calving in dystocia affected heifers. Serum calcium took almost a week to return to normal level. Serum magnesium was slightly higher at calving in dystocia heifers and took 2 to 3 days to return to normal.

Of the minerals tested for, there did not appear to be any contributing to dystocia as a straight out deficiency, but perhaps calcium and zinc are involved in some biochemical derangement at the time of calving.

A weaning trial on 'Swan's Lagoon' compared April and July weaning. Calves weaned in July were 45 kg heavier than calves that had been weaned in April. At slaughter 3 years later, the late weaned group still had an 8 kg advantage, but the differences have not yet been tested for statistical significance.

Some of the progeny from a dipping trial that was terminated in 1980 have now been either mated or reached slaughter weight. The progeny of dipped breeders were always heavier at weaning by 13 kg to 24 kg, but 2 years later this advantage had been lost.

Also at 'Swan's Lagoon', some work has continued into bull fertility. In previous years, attempts were made to modify the libido test for use with Brahman cross bulls. These were not highly successful and this work has not continued. Instead, studies on testicular growth patterns and the development of spermatogenesis have been carried out in association with staff of James Cook University. Branch staff have been mainly engaged in testicular growth measurement and the effect of supplementary feeding on testicle size and spermatogenesis.

Changes in scrotal circumference have been measured on one draft of bulls from weaning and on one draft from about yearling age, at periodic intervals to 2 years of age. These results have yet to be collated but will provide an assessment of what is a 'normal' size and what is hypoplastic. Detailed histological studies were done on bulls castrated at 19 months of age with emphasis on a comparison of normal and hypoplastic testes. Standards for seminiferous tubule diameter were defined, and testes with tubule diameters of less than 150 μ m were considered hypoplastic. Also it was found that there was a significant correlation between tubule diameter and sperm production per gram of testicular tissue.

Although there was good agreement between clinical diagnosis and spg (sperm per gram) values, high spg values were found in several small testes which were considered hypoplastic on clinical examination.

At 'Brian Pastures', a project began in 1980 to examine the effect of yearling and 2 year-old joining on subsequent reproductive performance. In both 1980 and 1981, the yearling mated animals have been extremely light, about 200 kg, and pregnancy rates in 1980 were only 20%. Pregnancy rates of the 2 year maiden heifers, weighing just over 300 kg approached 100%. These pregnancy results were not unexpected. What will be of interest is the subsequent performance of the few heifers that did conceive as yearlings.

The breeding herd at 'Brian Pastures' now consists of all Sahiwal-Hereford cross animals produced by mating Hereford heifers with 3/4 Sahiwal bulls resulting in a nominal 3/8 Sahiwal x 5/8 Hereford. Subsequent breeding is by *inter se* mating of these crosses and the 1980 project was started to compare the reproductive rates of the first, second and sequential generations of crossbred females. This is being done because of the decline in fertility that occurs after the first cross in the case of Brahman-British crosses.

A co-operator trial in the Moreton region is also examining the effect of yearling mating. In this trial, however, the practice will be to sell the calves of yearling mated heifers at 6 to 8 weeks of age. The current price for such 'bobby' calves is quite substantial and, by removing the calf from the dam at this early age, the dam should have the opportunity to grow out to a weight comparable to that of heifers not mated until 2 years old. If these yearling-mated heifers conceive satisfactorily then the sale of the bobby calf represents additional net income.

The first draft of the yearling heifers was mated in 1980 at an average liveweight of 229 kg giving a conception rate of 53%. The bobby calves were sold in November 1981 and realized an average of $47 per calf. At the time the calves were weaned, the calved yearling heifers, which were 24 kg heavier than the others at the time of the first mating, were 41 kg lighter than those which had failed to conceive. At the end of the second mating this difference had been reduced to 27 kg. The conception rates of these groups have yet to be determined.

It was in 1971 that a project proposal for evaluation of Africander cross cattle on 'Mt. Eugene' was first presented. Data since collected on this commercial herd must rival in value that on many research stations. To date, a total of 16 scientific papers based on 'Mt. Eugene data' have been accepted for publication. Initially much of the information was on breed comparisons. More recent information relates to factors influencing breeder performance and breeder herd management.

The following paragraphs summarize some of the data that were analysed during the past year.

Liveweight and age data of steers from eight consecutive calvings were analysed to measure the effects of dam age, breed of sire, breed of dam and reproductive efficiency of dams. The sires used were Brahman and Hereford sires on crossbred females, with the Herefords being mated to those females with high Brahman content and the Brahmans being mated to those females with lower Brahman content.

Dam age affected the 23 months' liveweight but had no effect on older liveweight or age at sale. The reproductive efficiency of dams had no effect on progeny performance.

Over the eight calvings, there was no breed-of-sire effect but there was a breed-of-sire by year interaction.

By far the greatest effect on liveweight and age at sale was the year of birth and these data demonstrate that, among tropically adapted genotypes, differences between genotypes, dam and day of birth are insignificant in comparison with the large environmental influences caused by varying seasonal conditions. The results highlight the difficulty in partitioning changes due to genetic and environmental causes.

In another study based on the 'Mt Eugene' herd, the liveweights of 4 066 lactating cows were recorded at the time they weaned their calves, usually in April, in each of 8 years. Liveweight at weaning is a good indication of the probable time that it would take to fatten a cow to reach an acceptable slaughter weight. The sale of cull cows is an important component of beef cattle income and many producers cull on the basis of age irrespective of other considerations. It is therefore important to know the effect on sale weight of culling at different ages.

In this study cow liveweights were significantly affected by age. Liveweight (kg) by age of cow is given below—

2.5 years 373	6.5 years 456	10.5 years 462
3.5 years 414	7.5 years 463	11.5 years 452
4.5 years 438	8.5 years 464	12.5 + years 451
5.5 years 445	9.5 years 464	

There was a cow age-by-year interaction as in some years the older age groups were able to maintain their liveweight relative to the 7.5 to 10.5 age groups. These data indicate that it would be disadvantageous, in that environment, to cull below 7.5 years of age, while there would be some penalty, in most years, in retaining animals beyond 10.5 years.

Nutrition

Nutrition is still one of the most important factors determining the level of performance of cattle in Queensland. Following the change to a genotype adapted to their environment, producers must look to improved management and improved nutrition as the two areas where major improvements in productivity can occur.

Interest in improved pastures continues at a high level especially with regard to perennial stylos in central and north Queensland and irrigated nitrogen-fertilized ryegrass in south Queensland. Indications are that the perennial stylos will establish readily and persist over a wide area of Queensland and the long-awaited legume to lift production significantly on native pastures may be among them. To date there is limited animal performance data to indicate what contribution these plants might make to the diet of the grazing animal. A number of projects has been commenced to obtain animal performance data both on research stations and commercial properties.

While interest in fine stem stylo in southern Queensland is high, limited availability of seed has prevented any application of the technology which has been developed.

Many producers with access to irrigation water have planted areas of ryegrass for grazing but results have not always matched the promise shown in earlier observations. In the Goondiwindi-St George area, animal performance has not been up to expectations. Investigation of the problem has failed to incriminate any specific nutrient deficiency. Indications are that poor pasture growth, possibly associated with below average winter temperatures and irrigation problems, may have been the major contributing factor.

The use of *ad lib* molasses for survival feeding of cattle is becoming an accepted part of the pastoral scene especially in coastal areas of north Queensland. While some producers report no problems, there have been other reports of stock losses, urea poisoning being advanced as the likely reason. There are many unknowns in this area and further research is planned to elucidate the problems.

Alkali treated bagasse. Preliminary investigations into the use of alkali treated bagasse as a stock feed indicated an improvement in *in vitro* digestibility of up to 100% following processing. This increase due to alkali treatment and processing is far greater than for other products such as peanut hulls.

In vitro digestibility studies showed that *in vitro* digestibility for untreated bagasse averaged 32%. When treated with alkali in the range of 2.5% to 7.5%, an improvement in digestibility of 41% to 58% was observed. This corresponds to an increase in metabolizable energy of 1.5 to 4 mg per kg. Dispersal of alkali by milling speeded the response but after standing for 24 hours the digestibility of hand mixed samples was fractionally higher. Drying reduced the effect of the alkali.

A maximum decrease in cell wall content of 10 g per 100 g organic matter was measured.

In vivo trials are planned, but their execution depends on obtaining finance from outside the sugar industry.

Mineral supplements. The acceptance of phosphorus supplementation as a means of improving production of beef cattle in phosphorus deficient areas of north Queensland is increasing. However, there are still many producers who do not feed phosphorus and do not vaccinate for botulism.

There is a history of poor performance and deaths in cattle on a number of properties in the Torrens Creek area, west of Charters Towers. Losses in excess of 600 head have been reported over the last few years. Low phosphorus status was diagnosed and feeding of a calcium-phosphorus supplement on 'Eurunga' resulted in mean intakes of 7 g P and 10 g Ca for steers and 8 to 15 g P and 12 to 23 g Ca for cows. No deaths were recorded in this paddock but deaths occurred on surrounding properties despite supplementation. Nitrogen and phosphorus contents of hand plucked pasture samples were 5.6 g and 0.6 g per kg dry matter, respectively in April, and 3.4 g and 0.2 g per kg dry matter in July. Phosphorus concentration in fat-free bone was 113 g per kg. While these figures indicate that animals would be phosphorus deficient, liveweight change was not related to intake of supplement.

This suggests that protein and energy deficiency may be compounding the phosphorus deficiency, preventing response to the phosphorus supplement. A study has now been commenced on 'Cotonvale' and 'Kalleroi', Prairie, to investigate the effect of vaccinations against botulism and tick fever on the incidence of mortalities in an attempt to clarify the role of these two diseases in the syndrome.

Low blood and liver copper levels have been diagnosed in heifers and steers grazing improved brigalow country on Brigalow Research Station. A study was carried out on the station to measure the effect of copper treatment at 3-monthly intervals on growth and reproductive rates of heifers and on growth rates of steers. Despite liver and serum copper levels in untreated animals as low as 7 ppm and 0.03 mg per 100 mL respectively, no responses in growth rates of heifers, steers and calves or in pregnancy rates were obtained. Copper therapy raised liver copper levels to 90 to 150 ppm. After two joinings, this study has now been terminated.

A series of experiments was performed to test the availability to cattle of calcium in tropical grasses. The work involved feeding hays to steers which contained high and low concentrations of oxalates, and different calcium levels. The absorption of calcium from doses of calcium oxalate, limestone and rock phosphate were also compared. The major findings were—

1. Cattle absorb calcium oxalate, but this is only half as available as limestone and rock phosphate.
2. Adaptation of the rumen microflora to oxalate increased the absorption of calcium oxalate.
3. The maximum availability of calcium in tropical grasses is about 50% due to the presence of calcium oxalate crystals, compared with about 70% in grasses not containing these crystals.
4. The availability of magnesium and phosphorus is unaffected by oxalates.

Selenium deficiency. Work is continuing on defining the selenium (Se) status of dairy cattle in the Moreton Divison. Sixty-six herds have been classified to date, using sera samples taken in the Brucellosis Eradication Scheme. Of these herds, 27 (41%) have been designated marginal/suspect while 10 (15%) are presumed frankly deficient. The distribution by shire of these presumed deficient herds is: Albert (1); Beaudesert (6); Brisbane (1); Caboolture (1); Landsborough (2). It is considered that selenium levels less than 15 ng per mL are deficient, 15 to 35 ng per m L are marginal and levels greater than 35 ng per mL are adequate.

Supplementation trials are being organized and these progammes will seek information on—1. Seasonal variation in apparent Se status; the extent of protection afforded by 1M selenium injections and their required frequency. 2. Any effects of supplementation on cow fertility, calf survival rate and growth rate. 3. The paresis observed in cows grazing winter oats on the Darling Downs.

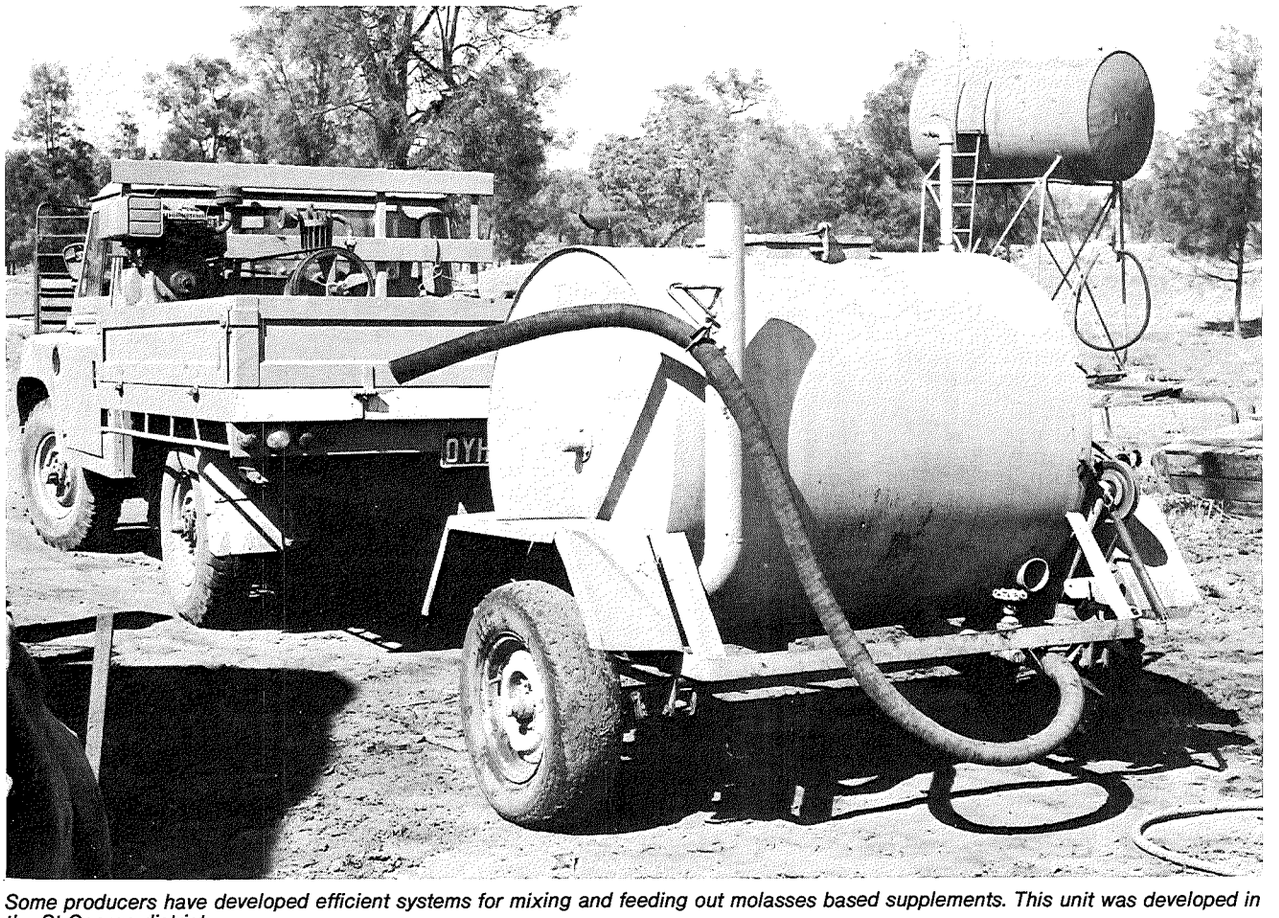
Fluorine. World supplies of rock phosphates containing acceptable low concentrations of fluorine are rapidly becoming depleted. Christmas Island rock phosphate precipitator dust, which contained 1.5% F and has been an important supplement to the dairy and other livestock industries in Australia, is no longer available. Alternatives are other sources of rock phosphate and 'blends' which contain up to 4% fluorine, or defluorinated rock phosphate which is much more expensive and presently not manufactured in Australia.

It is known that the fluorine in rock phosphate is more toxic than calcium fluoride but less toxic than sodium fluoride, based on long term feeding trials, but quantitative data are lacking on the relative toxicity of rock phosphate from different sources. It is now possible to accurately determine the retention of fluorine from rock phosphates under balance conditions. Experiments in progress will compare the retention of fluorine in rock phosphate from Christmas Island, Nauru Island, and Duchess mine. Other questions that may be answered include whether fluorine is absorbed independently of calcium and phosphorus, and the rate of clearance of absorbed fluorine from the body.

Nitrogen supplements. Low nitrogen content of available pasture during the dry season is one of the most important factors limiting animal performance in north Queensland. Supplementation with nitrogen has been accepted widely as a means of minimizing weight losses and mortalities which occur. There is limited information on what type of supplement is most appropriate for particular situations. Producers consider that a high priority area for research is the development of a supplement which will ensure the survival of breeders during the dry season. Research is under way at 'Swan's Lagoon' to investigate combinations of non-protein nitrogen, true protein and energy as supplements to achieve different levels of performance from reduced weight loss to actual weight gain.

In a pen feeding study over 64 days, steers fed native pasture hay (0.46% N) lost 6 kg liveweight while others fed a urea-sulphur supplement with the hay maintained weight. Feeding of soybean meal, formaldehyde cottonseed meal or meat and bone meal with the urea-sulphur resulted in a liveweight gain of 30 kg, while fishmeal plus urea-sulphur produced a gain of 24 kg. When a formaldehyde cottonseed meal-fishmeal-meat and bone meal (8:1:2) mixture was fed with urea-sulphur, animals gained 41 kg. The responses in liveweight performance were due, in part, to the stimulus in roughage intake with nitrogen supplementation. The nutrients contained in the protein supplements would have made a significant contribution as well. The superior performance with the combination of protein sources suggests that the better amino acid balance in this supplement resulted in an improvement in liveweight gain.

When a supplement of 500 g of alkali treated whole sorghum was fed with the base roughage, steers gained 7 kg. This gain was increased to 43 kg when urea-sulphur plus formaldehyde cottonseed meal was fed in addition to the grain. Based on these responses obtained with this range of supplements, it is possible to make decisions more confidently on the type of feeding programme to choose for a particular purpose. Availability and price may be the main influences in choosing a protein supplement. Further studies are planned to develop a response curve in animal performance to graded levels of true protein in the supplement.



Some producers have developed efficient systems for mixing and feeding out molasses based supplements. This unit was developed in the St George district.

A short feeding study carried out during the 1981 dry season demonstrated the benefit of a true protein supplement for grazing animals. After 52 days of feeding with a formaldehyde cottonseed meal supplement, Brahman cross heifers had gained 15 kg liveweight compared with a gain of 3 kg in unsupplemented heifers. Similar responses have been recorded with cottonseed meal in the past under grazing conditions but rapid and uneven intakes of supplement were the main problems. Subsequent field work is planned to develop supplements which are efficient and are eaten at an acceptable rate.

Mating in the dry tropics normally begins soon after the first summer storms. Bulls are required to express high levels of sexual activity shortly after a period of sub maintenance nutrition. To determine the effects of protein supplementation on sperm production, a trial was carried out at 'Swan's Lagoon' over 60 days. During the period, Brahman cross bulls, 42 months of age, lost 40 kg when fed native pasture hay, while others fed a true protein supplement with the hay gained 14 kg liveweight. Scrotal circumference in the unsupplemented group declined by 2 cm during the 60 days but there was no change in the supplemented group. Daily sperm production rate and epididymal reserves were 50% higher in the supplemented group than in the unsupplemented group at the end of the study. While this study has shown that sperm production in bulls declines during periods of poor nutrition, the significance of this finding in terms of libido and fertility has yet to be established. No data are available on the rate of recovery of testicle size and sperm production following the return to a high plane of nutrition. At slaughter, the 54 kg liveweight advantage to the supplemented bulls was reflected in a 28 kg carcass weight advantage.

Since urea is toxic to stock when consumed rapidly, alternative sources of non-protein nitrogen are being investigated. Isobutylidene diurea (IBDU) and urea gave similar liveweight responses when fed with a true protein supplement to Brahman cross steers fed a basal diet of native pasture hay in pens. In this study, the supplement was fed daily and any potential advantage to IBDU as a non-protein nitrogen source of lower toxicity could become apparent with less frequent feeding.

Energy supplements. While total energy intake is the factor which limits performance of beef cattle in most situations, availability of energy is rarely the problem under grazing. The problem often is in getting the animals to consume sufficient of the material which is available, because of nitrogen or mineral deficiency, low digestibility or a combination. However, in drought situations or in feedlots, high energy feeds are often fed as the most economical means of achieving a desired outcome.

For many years, grain has been the energy feed most widely used for drought feeding. Interest in the use of molasses for this purpose is now increasing because of cost, ease of feeding out and absence of digestive upsets. Pen-feeding studies at the Animal Husbandry Research Farm at Rocklea over the past few years have indicated the efficacy of molasses as a drought fodder. In more remote areas where transport costs are high and when true protein supplements have to be added to the molasses, for example, with pregnant and lactating breeders and young calves, combinations of grain and molasses may be the most appropriate.

A pen-feeding study was carried out at Animal Husbandry Research Farm, Rocklea, to evaluate combinations of molasses and grain for this purpose. Combinations of molasses containing 3% urea (M/U) and grain ranging from 100% M/U to 40% M/U:60% grain were fed to Hereford steers. Energy allowances were equivalent to 1.5 kg per day or 3.0 kg per day M/U. Animals fed the higher level lost less weight over the 11 weeks than those fed the lower level (−0.17 *v.* 0.53 kg per day) but the molasses-grain ratio had no effect.

In a short-term follow-up study over 29 days, steers fed mixtures of molasses-urea and grain *ad libitum* consumed much more total feed than those fed molasses-urea only. Consumption of a molasses-urea/cottonseed meal mixture was intermediate. Liveweight change was directly related to feed intake. Inclusion of 1 kg per head per day grass hay in the diet resulted in small increases in total feed intake and in liveweight change. These studies have shown that combinations of grain and molasses-urea are as effective as either supplement on its own. Selection of a supplement for a particular purpose can be based on cost, availability and convenience of feeding.

Earlier studies showed that molasses-based survival rations for pregnant breeders should contain some true protein source which is not degraded in the rumen. Further studies are planned to examine the effects of different combinations of rumen degradable and non-degradable nitrogen on performance of pregnant heifers fed this type of ration.

Growth stimulants. Growth stimulants provide an easy and simple means of improving growth rate of cattle with minimal input. A range of products is available or under test and studies are under way to determine the magnitude of the responses to these products under grazing conditions.

Zeranol. The growth stimulant, zeranol, Ralgro, has been shown to produce responses in liveweight gain in growing steers over a wide range of sites in Queensland. The magnitude of these responses has varied quite markedly ranging from 2% to 40%. Examination of data from 34 studies throughout the State showed that the response to zeranol (y kg per day) was related to the daily gain of the control group (x kg per day) by the regression equation, $y = -0.002 + 0.377 x - 0.212x^2$. The response tended to peak at 0.75 to 1.00 kg per day. The decline in response at higher levels of liveweight gain may be a function of the animals' approaching their physiological limits.

Subsequent studies have been aimed at assessing the value of repeated zeranol implants in growing steers. In most instances, responses to successive implants have occurred, with incremental responses declining with each successive implant. In a trial at 'Mount Brisbane', near Esk, over 16 months, single zeranol treatments near the start produced responses of 15% at 200 days after implantation. In a group receiving five implants at 100-day intervals, the response peaked at 24% after 300 days with no response to subsequent implants. During periods while animals maintained weight, advantages to previous zeranol treatment tended to remain.

In an experiment to compare the conventional position for implanting, 6 to 8 cm from the head, with a site on the annular cartilage at the base of the ear, 2 to 3 cm from the head, performance of both groups was similar. This suggests that each of these sites is satisfactory for implantation. In another study with spayed cows, zeranol treatment produced a 31% response in liveweight gain over the 100 days following implantation.

Oestradiol 17B. Several studies with oestradiol 17B are under way in Queensland. Like zeranol, the compound is contained in a capsule which is implanted under the skin near the base of the ear. The hormone is released at a constant rate and capsules with different release times, for example, 200 and 400 days have been developed. In the observations being carried out responses in liveweight change during the 100 days following implantation have ranged from 1% to 23%. In several studies where zeranol implants have been compared with oestradiol, responses to zeranol have been slightly higher than to oestradiol. This work will continue.

Pastures

Native pasture continues to support most of the beef cattle in Queensland and this situation is unlikely to change in the foreseeable future. Management of native pastures is an area on which there is little documented information.

Many producers use fire as a management tool to remove overburden, control regrowth, provide a green shoot and aid in mustering. A study began at 'Swan's Lagoon' in August 1979 to investigate the effects of various burning treatments and dry season supplementation on the yield, species composition and quality of the pasture and on the liveweight performance of cattle grazing these pastures. Dry matter yields on unburnt pastures were 2 432 and 1 524 kg per ha in May 1981 and October 1981 respectively. These values were comparable with those for 1980.

Burning at the beginning of 1980–81 wet season (December 1980) reduced presentation yields in April 1981 to 80 to 86% of those on unburnt treatments. Unburnt portions of 'burnt' paddocks carried more pasture than totally unburnt treatments suggesting selective grazing of burnt areas. Burning at the end of the 1980–81 wet season (July 1981) reduced presentation yields in October 1981 to 48% of those on unburnt treatments. In general, presentation yields on burnt areas have taken two wet seasons to attain the same levels as unburnt pasture. No changes in botanical composition attributable to burning have been identified to date.

Animals grazing the area during the past year gained an average of 116 kg per head, reflecting the short duration of the 1981 dry season. There was no effect of burning treatment on annual gain, but there are indications that animals may respond to late-wet burns by higher dry season performance and to early-wet burns by better wet season performance. This needs to be confirmed in subsequent years.

In a zeranol study at 'Darracourt', near Blackall, untreated Hereford yearling steers grazing buffel grass pastures at a stocking rate of 2.5 ha per beast gained 137 kg between February and September 1981. Rates of gain were 0.9 kg per day between February and May and 0.5 kg per day between May and September. Other observations on buffel grass pastures in this region produced gains of 0.85 kg per day in 3-year-old Santa Gertrudis bullocks between January and May, 0.62 kg per day in 2-year-old Hereford steers between June and October and 0.32 kg per day in Devon bullocks between June and October. On Mitchell grass pastures near Aramac, 2-year-old Hereford steers gained 0.37 kg per day between March and June while spayed Santa Gertrudis cows gained 0.41 kg per day. These gains can be compared with the gains in yearling Zebu cross steers grazing Mitchell grass pastures at Toorak between February and July of 0.7 kg per day.

The search is continuing for suitable legumes to improve these levels of beef production. Some legumes have been found which show promise in areas of central and northern Queensland. The perennial stylosanthes species, *S. hamata* cv. Verano, *S. scabra* cv. Seca and *S. scabra* cv. Fitzroy, have been shown to grow and persist well in a range of environments. However, to date there is limited information on their effect on animal performance. Emphasis is now being placed on rectifying this situation. Large grazing experiments have been established on 'Swan's Lagoon' and Brigalow Research Station to obtain animal performance data. On 'Swan's Lagoon', Verano and Seca were

sown into native pasture in January 1980 and resowing was carried out during the 1981 wet season. Establishment has been variable, questioning the claims that these stylos will establish readily over a range of soils with minimal land preparation. It is expected that grazing will begin this year.

At Brigalow Research Station, the value of sowing Fitzroy stylo into buffel grass pastures to improve animal performance will be determined. The legume is well established and grazing is scheduled to begin in mid 1982. A range of stocking rates will be compared as well as the interaction of stocking rate with fertilizer level.

Observations are under way on private properties at Springs Road (Mareeba), 'Mistletoe' and 'Forest Home' (Georgetown) and 'Violet Vale' (Cape York) in which animal performance on native pasture and on oversown pasture is being compared. To date, these studies have not yielded any significant animal data and it is likely that their main contribution will be in observing how the legumes persist and spread, and as demonstration areas for producers. Two observations have been established at 'The Springs' near Rockhampton and at Lindsville near Bundaberg to measure the result of oversowing native pasture with Fitzroy stylo in terms of pasture and animal performance.

Townsville stylo *(S. humilis)* continues to play a prominent role in animal production despite the effects of anthracnose *(Colletotrichum gleosporioides).* The 1982 wet season was unsatisfactory for pasture growth in much of central and northern Queensland. Wet season rainfall was well below average and most falls were intermittent storm rains with very few general falls. This was reflected in very low pasture yields.

In the long-term grazing study at 'Swan's Lagoon', presentation yields of pasture in April 1982 were 60% lower than those recorded in 1981. Presentation yields were 1 394 and 1 201 kg per ha for the low and high stocking rate fertilized treatments and 687 and 589 kg per ha for the corresponding unfertilized treatments. The legume represented 14% of the available dry matter on the fertilized pasture and 90% of the material on the unfertilized pasture. These can be compared with the 7% and 38% for fertilized and unfertilized pasture, respectively, in 1981. Anthracnose has been less prominent this year, which probably reflects the dry conditions which would not favour its spread.

Liveweight gains for the period May 1981 to May 1982 have followed the usual pattern with highest gains on fertilized treatments and worst performance on unfertilized areas with native pastures intermediate. The poor performance on unfertilized pasture in this study can be attributed to the legume dominance and the absence of a perennial grass. Mean animal gains between June and April for fertilized Townsville stylo, unfertilized stylo and native pasture at a stocking rate of one steer to 2.4 ha were 140 kg, 75 kg and 97 kg respectively, compared with the mean annual figures over the past 7 years of 169 kg, 88 kg and 99 kg.

The shrub legume, *Leucaena leucocephala,* is used extensively as a grazing plant in many tropical countries. Its value as a supplement to native pasture during the autumn-winter-spring period is being studied in the central Queensland area.

On 'Brian Pastures', Gayndah, growth rates of cattle have been improved when an area of leucaena was grazed on a rationing basis during the autumn-spring period. To assess the benefit when animals were given open access to the legume from March, an observation was set up at 'Baronga', near Gayndah. Performance of steers grazing native pasture was compared with that of steers grazing native pasture but with access to an area of leucaena. Within a month of being given access to the leucaena, steers had preferentially grazed out the legume. The legume area has now been closed up to allow regrowth to occur.

In the breeder study on 'Brian Pastures' where performance of breeders grazing native pasture with a molasses-urea supplement during the autumn-winter-spring period, native pasture plus an area of leucaena and native pasture plus fine stem stylo is being studied, there has been extreme variation in animal performance both within and between treatments. Conception rates in lactating cows in various cells ranged from 25% to 100% in 1981. There is an indication that the legumes may be producing a response in animal performance, but this is yet to be confirmed.

In observations in northern Australia, the presence of the alkaloid, mimosine, in leucaena has resulted in hyperthyroidism with continual grazing. To date no obvious symptoms have been observed at 'Brian Pastures'. In May 1982, thyroid glands were collected from animals with no previous access to leucaena and others which had grazed leucaena for the autumn-spring period during the past 2 years. These will be examined to determine what effect the grazing of leucaena has had.

Studies in the Burnett region and the Texas area have demonstrated high levels of beef production and positive gross margins from irrigated, nitrogen-fertilized ryegrass. This practice is developing rapidly along the Macintyre–Dumaresq river system. During the early winter period of 1981, many producers in the area considered that their stock on these pastures, including sheep and cattle, were not gaining weight as rapidly as expected. Pasture samples were collected and analysed.

In general, nutrient content was high, and poor pasture quality was not considered to be a limiting factor. Some points which did emerge were high nitrate levels and high potassium levels in the ryegrass. While high solubility of protein in the young, vigorous pasture may have resulted in an amino acid deficiency in the lower digestive tract, it was considered that poor pasture growth in the early winter may have been the major limiting factor. Over the 11 sites which were monitored, best animal performance was achieved on heavier soil types with high fertilizer inputs and rapid grazing rotations.

In a grazing observation on a commercial property in the Brisbane Valley, Hereford steers were grazed on ryegrass at a stocking rate of 6.4 beasts per ha. Over 85 days between July and October, yearling steers gained more weight than 2-year-olds (1.0 *v.* 0.86 kg per d). Total liveweight production from the pasture was 535 kg per ha over the 85 days. Unfortunately, irrigation water was exhausted and grazing was terminated prematurely. A ralgro observation was superimposed on this study and responses were 13% in yearlings and 20.6% in 2-year-olds over the 85-day period.

In a trial in the Brisbane Valley, these steers were grazed irrigated perennial ryegrass at a stocking rate of 6.4 beasts per ha. Total liveweight production from the pasture was 535 kg per head in 85 days.

Gambia pea *(Crotalaria goreensis)* is a legume crop easily grown in the lower rainfall areas of the Mareeba district of north Queensland and could have greater potential as a stock feed than the normal 'bush hay' of that region. In co-operation with plant breeders from Mareeba, the digestibility and metabolizable energy of Gambia pea hay have been investigated in feeding trials at ARI.

Hand harvested samples had *in vitro* digestibilities for whole plant, leaf, stem and other species of 62, 82, 40 and 38% respectively. Crude protein values were 12.8, 17.3, 5.4 and 7.9% respectively for the same fractions.

The fed out hay had a crude protein content of 7.9% and the *in vivo* dry matter digestibility was measured at 50%.

The relatively low *in vivo* figures indicate that there was a high proportion of stem and/or other species in the hay, but it should still be superior to normal 'bush hays'. The high protein and *in vitro* digestibility values for leaf show that Gambia pea could be a valuable feed, particularly if harvested with greater than 50% leaf.

Genetic improvement and breed evaluation

The promotion of objective selection continues as a major activity in extension and research programmes. A number of centres is involved in promoting simplified selection techniques for selecting replacement home bred bulls from within commercial herds. Many commercial herds use home bred bulls but the selection technique used is often no better than that generally used when purchasing bulls.

The advocacy of BYO bull has naturally aroused opposition from breed societies, whose members derive their income from sale of bulls. A calculation of the cost/benefits of buying bulls from stud at current prices suggests that the costs greatly exceed the benefits in many cases. Much of the cost is incurred by the unnecessary and possibly harmful feeding that is a traditional part of the preparation of sale bulls.

Some bull breeders are now providing performance figures at sales. At one bull sale, there was an average premium of $28 per point on the performance ratio.

The promotion of environmentally adapted cattle has been a major extension activity for some time. As a result of the downturn in beef, there has been a dramatic swing to tropical breeds. Australian Bureau of Statistics surveys in the past have documented this change when breed data were collected in the 1973 and 1977 Agricultural Census.

With the recent opening of the Cocos Island Animal Quarantine Station, imports of live cattle from north America commenced. A total of 50 head of cattle originating from Canada and the USA arrived in Australia early in 1982. This was the first time cattle had been imported from Canada and the first inputs for 27 years from the USA.

Seven breeds were represented in the first draft, which included 35 Brahmans, 11 Poll Herefords, 2 Galloways, 1 Santa Gertrudis and 1 Holstein-Friesian. The USA and Canada are expected to be the main source of imports for the next few years until the Australian National Animal Health Laboratory is operational.

Some activities and results in the research programme are summarized below—

The basic objective of the Simmental grading up programme based on Brigalow Research Station is to evaluate the potential of the large European breeds, represented by the Simmental, in southern Queensland. High grade Simmentals are being bred for evaluation and, in the process, various grades of Simmental are being assessed.

Steers bred in the Simmental grading up programme are being used to provide information on genetic-environmental interactions in relation to growth rate and carcass quality. Half the steers are grown out at Brigalow Research Station and the other half are grown out under typical fattening programmes on the Downs. Steers will be slaughtered at two liveweights, namely 450 and 550 kg.

To date two drafts of steers are being tested. No. 0 steers are being tested at Brigalow and 'Bindaroo', Wallumbilla. At 27 months of age at both these locations, liveweight increased as the Simmental component increased and the Africander cross was intermediate between the 1/4 and 1/2 Simmental genotypes. Growth rates of all genotypes were greater at Wallumbilla and, in the more favourable environment, the advantage to the crossbred was enhanced. Advantages over the Hereford for the 1/4, 1/2, 3/4 Simmental and 1/2 Africander at Brigalow were 1.8, 4.0, 12.4 and 3.0% respectively. At Wallumbilla they rose to 7.6, 10.8, 17.9 and 7.4%.

The No. 1 steers were tested at Brigalow and 'Bantry', Pittsworth. During this test, seasonal differences increased the performance differences between the two locations to the extent that growth rates at Pittsworth were more than double those at Brigalow. While it is too early to make useful comparisons, the trend is similar to the previous draft with 1/2 and 3/4 Simmentals having the greatest liveweight advantage.

Another co-operative project linked to the Brigalow Research Station is being carried out on 'Highworth' and 'Junedale', at Moura. It is designed to evaluate the Simmental when crossed with adapted genotypes. In this project, Herefords and Simmentals are crossed with high grade Brahmans to assess comparative production and reproductive performance.

Brahman, Hereford and Simmental sires are being mated to Hereford, Brahman and Brahman cross cows respectively. The first draft of calves was born in late 1981 and the first weaning takes place in mid 1982. Calving rates for the Brahman, Hereford and Simmental sire groups were 80, 54, and 68% respectively.

Africander, Belmont Red and Hereford genotype comparison. A two stage project on Brigalow research Station is designed to compare the performance of Africander and Belmont Red genotypes with Herefords. In Stage 1, Africander and Hereford bulls were mated to Hereford cows to produce 1/2 Africander 1/2 Hereford and Hereford progeny. In Stage 2, Belmont Red bulls will be mated to the 1/2 Africander 1/2 Hereford females to produce Belmont Red progeny, that will be compared to contemporary Hereford females joined to Hereford bulls.

In Stage 1, three calvings have occurred. All these calves have been raised on Hereford dams and there have been no breed differences in calf birth weights. At weaning, 1/2 Africander 1/2 Hereford calves were 7% heavier than Hereford calves and at yearling this difference had increased to 14%. Steer progeny were slaughtered at 2 and 3 1/2 years of age. At 2 years, 1/2 Africander 1/2 Herefords had carcasses 14% heavier than the Herefords and this was increased to an advantage of 18% at 3 1/2 years. Degree of finish in crossbreds was as good as in Herefords.

In a tick and worm trial conducted using Stage 1 animals, Africander cross steers were 72 kg heavier than Herefords when both ticks and worms were present and 49 kg heavier when regular and frequent dipping and drenching were carried out.

In Stage 2 of the programme, heifers generated in Stage 1 are mated. Numbers have been small in earlier years but in two more recent calf drops 1/2 Africander 1/2 Hereford cows had similar pregnancy rates (77 *v.* 75%) but higher weaning rates (68.5 *v.* 57.5%) than the Herefords. At weaning the Belmont Red sired calves from crossbred cows were 23% heavier than the Herefords.

Within the framework of the Africander, Belmont Red, Hereford genotype comparison, the opportunity is being taken to demonstrate the effect of selecting bulls on weight for age. In this project high and low ratio bulls are being mated to random groups of cows to assess the differences in the performance of the respective progeny groups.

The most recent results provide data on the performance of progeny sired by bulls with average ratios of 114 (599-day weights of 385.9 kg) versus progeny sired by bulls with average ratios of 92 (599 day weights of 310.5 kg). With a selection differential of 85 kg for bulls and 0 for cows and heritability of 50% for weight for age, the expected difference in the performance of the two progeny groups at 599 days of age should be 21.2 kg.

Progeny from these two sire groups were weighed at 439 days of age and at this age the steer groups had an average weight difference of 22.3 kg (273.3 *v.* 251.0 kg). The respective heifer groups had an average weight difference of 13.2 kg (264.3 *v.* 251.1 kg). The difference in the steer groups is very close to the expected theoretical difference while the difference for heifer groups is lower. These differences are expected to increase at later ages.

Using these results and valuing stock at 50c per kg liveweight, the value added by high ratio bulls increases at $71 for each point difference in the ratio. A bull with a ratio of 110 is worth up to $710 more than an average bull with a ratio of 100.

At 'Inverstanley', Esk, another co-operative project will assess the appropriateness and accuracy of alternative simplified methods for selecting replacement bulls in commercial herds.

Records are being collected on a well managed Brisbane Valley property breeding Droughtmaster type cattle. Birth dates, branding weights, post-branding weights, weaning weights and yearling weights are being recorded together with assessments on tick resistance when seasonal infestations are sufficiently heavy. Records are being used to select home bred replacement bulls and sell surplus high ratio bulls to local breeders.

Three performance recording options are being considered. Performance from birth to weaning and yearling is being compared with performance from branding to weaning and yearling and performance from post–branding to weaning and yearling.

Records are being collected on three calf drops. To date, complete records have been collected on two calf drops and analysis to date indicates that the branding weight option is a satisfactory alternative to the collection of birth date records.

Tropical breeds evaluation co-operative trials. The tremendous amount of data being accumulated from 'Mt Eugene', Jambin, has already been referred to. The programme there is a long-term breeding project which began as a genotype comparison involving Brahman, Hereford, Santa Gertrudis, Droughtmaster and Belmont Red bulls.

Recently data on weight for age and tick resistance of *Bos indicus* (mainly Africander) x *Bos taurus* bulls bred at 'Mt Eugene' were analysed to assess various strategies for selecting bulls on weight for age and tick resistance.

The selection strategies simulated were: (1) liveweight for age selection intensities of 5, 10 and 20% of bulls available when culling for tick resistance was zero; and (2) culling rates for low tick resistance of 10 to 60% in each of the selection intensities.

The base selection intensity had a major effect on potential gain. When the number of bulls increased from 5 to 10 to 20% of the number available, potential genetic gain decreased in relative terms from 100 to 85 to 69% of potential. Within each selection intensity level, the potential genetic gain for liveweight decreased with increasing emphasis for tick resistance because the selection intensity for liveweight for age decreased.

Culling 10, 20, 30, 40, 50 and 60% of bulls for low tick resistance resulted in an estimated improvement for tick resistance of 5, 9, 13, 15, 19 and 22% per generation respectively.

These results demonstrate the tradeoffs involved when selecting for two or more traits.

This herd is now being graded up from base Brahman-Hereford females to Belmont Red. Liveweight data in this programme have been analysed to determine the inaccuracies associated with assessments made on phenotypic appearance within the first year of life.

Analysis showed that dam age had a significant effect ($P < 0.005$) on weaning and yearling liveweights. There was a year by dam age interaction effect ($P < 0.005$) on weaning weight but not on yearling weight. These interactions were mainly between 3 and 4-year-old dams.

Overall least squares correction factors for weaning liveweight were +13.37, +5.00, −1.04, −7.59 and −9.74 and for yearling liveweight were +8.29, +5.70, +2.92, −6.96 and −9.55 kg for 2, 3, 4, 5 to 9 and 10+ year old cows.

Dam age correction factors show that at weaning there could be 23 kg difference across the range of dam ages and at yearling up to 18 kg. Later filial generations have a large proportion of young dams and average weaning and yearling liveweight would be lower than that of earlier generations. Without adequate adjustments, these lower average weights are often thought to be genetic by both producers and technical advisers.

When weaning and yearling weights are adjusted for dam ages, significant year and year-by-generation differences exist. This indicates that results obtained in a particular year may be misleading and genotype evaluations should cover a number of years.

An Africander-Brahman genotype evaluation on 'Cubbaroo', Cloncurry, commenced in 1975. In this project 3/4 Africander and 3/4 Brahman bulls have been mated to 1/2 Brahman cows. To date no differences have been detected in fertility of bulls or in the growth or fertility of the resultant progeny.

During this programme, conception rates have exceeded 90% for replacement heifers and have ranged from 22 to 64% for first-calf heifers and 80 to 85% for mature cows. Conceptions varied greatly with season. Growth rates for males have averaged 0.68 kg per day to weaning and 0.29 kg per day post-weaning to 800 days of age. This trial will terminate late in 1982.

On 'Blue Range' also north of Charters Towers, Belmont Red, Brahman and Santa Gertrudis bull genotypes are being mated to composite groups of breeders made up of equal proportions of high Brahman, low Brahman and Santa Gertrudis females. The first mating commenced in January 1978.

Over four matings, pregnancy rates have varied greatly from year to year and across all genotypes have averaged 72, 42, 73 and 59% for the 1978 to 1981 matings. For the bull genotypes there has been little difference with Belmont Reds averaging 62%, Brahman averaging 61% and Santa Gertrudis averaging 60%. For cow genotypes low Brahman averaged 60%, high Brahman averaged 63% with Santa Gertrudis 60%.

Small numbers have influenced results, but over two calf drops, Belmont Red calves were the heaviest (192 kg) followed by Brahman (176 kg) and Santa Gertrudis (165 kg). High Brahman cows raised the heaviest calves (186 kg) followed by Santa Gertrudis (175 kg) and low Brahman (173 kg).

The No. 9 heifer progeny have been mated and pregnancy rates range from 64% for Belmont Red to 63% for Brahman to 38% for Santa Gertrudis. Heifers from high Brahman had the highest pregnancy rate (68%) followed by low Brahman (50%) and Santa Gertrudis (46%). Pregnancy rates are low and influenced by low heifer liveweights.

With many of these breed evaluation trials on private properties the results must be interpreted with caution because of problems relating to missing animals, broken fences, and other practical difficulties. However, these cautionary remarks do not apply to 'Mt Eugene', where animal control has been exemplary.

Transport and marketing

There has been close involvement with the Queensland Meat Organization and Marketing Authority in a number of areas, including the carcass classification trial at Mackay, an investigation of sale by description, the planning of stock agent 'schools' and investigations on age of carcasses. The latter activity arose out of the rewriting of the export regulations.

A proposal to use ossification instead of dentition as the basis for age was opposed because of its subjectivity. Within 2 weeks it was possible to obtain data on the relationship between known age and ossification to demonstrate that the latter was less accurate than dentition, as well as being a subjective 'measure'.

Beef carcass classification. Joint trials on beef carcass classification by the Queensland Meat Industry Organization and Marketing Authority (QMIOMA) and this Department have continued. The major effort has been in planning and commencing a trial at a large export abattoir, Thomas Borthwick and Sons (Australasia) Pty. Ltd. at Mackay. From March 1982, if they wished, producers were able to sell cattle on weight and class. This is the first time that such a price schedule has operated in Queensland and also at a major exporting abattoir anywhere in Australia. The response has been very encouraging.

A major field day on carcass classification was held at Mackay in early May to brief local producers and others on the trial, as well as to give them the opportunity to discuss the trial. The day was well attended and a most successful one.

Liveweight selling. The sale of cattle at saleyards with liveweight selling facilities continues to receive support. There are now more than 30 saleyards in the State with liveweight scales. New facilities are also either under construction or planned for Clermont, Kingaroy, Nebo and Cloncurry.

Saleyard curfews. As mentioned in last year's report, various sectors of industry agreed to adopt a 'wet' curfew and sale system for selling cattle by liveweight. However, the decision is not mandatory for individual saleyard operators. The decision followed 3 years of research assessing the need for a curfew and examining possible alternative procedures by this Department, as well as by the Queensland Meat Industry Organization and Marketing Authority. The 'wet' curfew system requires all cattle to be offered water from the start of the curfew period until they are weighed after sale.

In the past 12 months, the 'wet' curfew was introduced at most of the major saleyards, namely Cannon Hill, Gracemere, Bohle, Charters Towers and at one of the Toowoomba saleyards. Others also are expected to follow. The reaction from producers, saleyard operators and processors has generally been favourable, indicating that a narrower range of dressing percentages now occurs at these yards. Cattle are also reported to be easier to handle.

Double deck loading races. There are now 14 double deck loading races in use at saleyards throughout Queensland. At least two more are presently under construction. Five meatworks have also installed these unloading races. Others have indicated their intention to construct double deck races in the future.

Double deck races have been designed to suit low profile semitrailers which are part of the trend towards standardization in the livestock transport industry. These races will speed up both loading and unloading procedures and assist in reducing some of the bruising caused during handling and transportation.

Standardization of stock crates. Stock crates in Queensland are not built to any standard other than that they have to fit on to a trailer and that they do not exceed the regulated height limitation.

Standardization of stock crates will help to reduce bruising of cattle in transit and to give those cattle a less stressful ride. An officer of the Department is working with the Live Stock Transporters' Association of Queensland in an effort to achieve standardization of stock crates. Stock crate manufacturers would readily welcome a set of standards that they could work to. They maintain that, because better use could be made of men and materials, they could produce crates more quickly and at a lower cost.

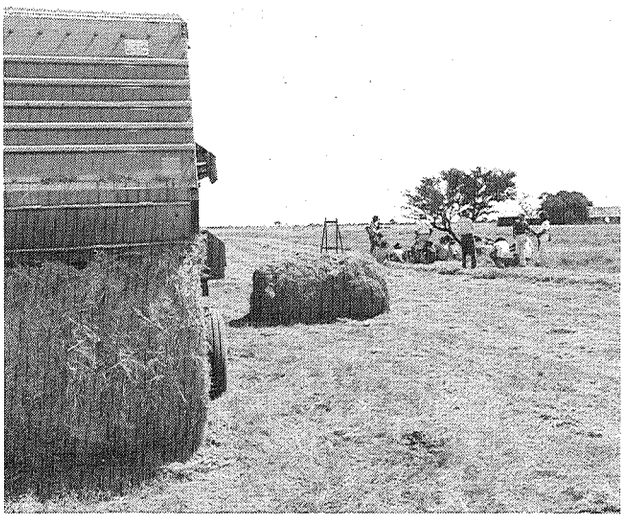
In Queensland, there are two basic crate types, the slatted type and the sheeted type. The standards envisaged would involve a crate to have straight smooth sides on the inside and the placement of doors. The placement and types of some internal ramps would need to be changed.

Research into transportation and marketing. During the past 3 years, research has been undertaken on the effects of transportation and marketing on weight losses and meat quality of cattle. This work is supported by funds from the Australian Meat Research Committee. The studies to date indicate that the time between mustering and slaughter and the availability of water affect greatly carcass weight. Transportation and rest at the abattoir seem to have a greater effect on meat quality than they do on carcass weight, although the confounding effect of time on weight should not be ignored. Further research is essential, and planned, before specific recommendations can be formulated.

Two trials examined further the effects of hydration status on carcass weight. When bullocks were offered water until slaughter, after a long journey, their carcass weights increased substantially through a marked increase in muscle water content. This confirmed a previous result.

The time on water appeared to be important, since water content decreased with the total time cattle were offered water before slaughter. It is possible that, after a period of deprivation, the consumption of water caused an initial over-hydration of muscle tissues, and thereafter muscle water content declines. Offering water to cattle after a short journey in cooler weather did not significantly affect carcass weight, although muscle water content increased. As the cattle denied water had near-normal water contents, these results indicate that there was little dehydration of their muscle tissues. It seems that near-normal muscle water contents may fluctuate without affecting carcass weight, although the techniques used may not have been sufficiently sensitive to detect small but economic increases in carcass weight.

For this reason, more work is planned. At 'Brian Pastures', the effect of the selling method of steers on subsequent liveweight performance in a feedlot was studied. The three selling methods were direct consignment to the feedlot, paddock sale and saleyard auction. The time taken by the latter two groups to regain their initial liveweights depended on the length of their fast during marketing. However, selling method did not affect overall performance, since liveweights were similar at turnoff after 100 days.



Pasture hay field day in north west Queensland. Experiments have demonstrated the benefits of this hay for weaner supplementation.

Sheep and goat industries

Good winter rain was received over much of the southern part of the sheep lands during 1981. The easing of drought conditions and consequent excellent lambings were the reason for an estimated 15% increase in the sheep population to 12.25m. Subsequent summer rains were below normal in many areas, and were received late in the season. Pasture growth was less than normal. Without further rain, particularly in central and northern Queensland, feed and water shortages may be experienced during the spring and early summer.

The far south west area centred on Cunnamulla received no effective summer rain and remains drought stricken.

Markets

Property sales during the year reflected further increases in prices being paid for grazing country. Prices equivalent to $40 per sheep area were realized for central-western Mitchell grass country.

The market for sheep remained buoyant, although only limited numbers were offered for sale.

Wool receivals in Queensland improved in the current season. Approximately 240 000 bales were sold to the end of May 1982 with one further sale to be held at the end of June. The number of bales sold to May included 42 000 bales sold by separation in either Sydney or Newcastle. These sales compare favourably with last season's total of 244 000 bales sold, including 63 000 sold by separation. The issue of selling the entire Queensland clip by separation has been deferred.

The wool market maintained a steady level throughout the season, with the most significant gains being registered during February and March. At all times, the market indicator remained above the Australian Wool Corporation's minimum reserve price of 410c per kg clean. From the July 1981 opening price of 428c per kg clean the market indicator ranged from 418c per kg clean to 447c per kg clean.

For this season's Queensland wool clip two points needing comment were—1. The clip was considerably contaminated with vegetable fault particularly the wools from areas that experienced good winter rain. Buyers reacted to the higher vegetable fault by increasing the discounts which they apply; for example, the discount for wools containing 6 to 7% vegetable fault was increased by up to 35c per kg. 2. During the October and November wool sales, buyers criticized the standard of preparation of the Queensland wool clip. Most of this criticism was levelled at the poor standard of skirting because of the stained and sweat ends left on the fleece lines in many clips. At that time, some clips were rejected from sale and subsequently reclassed. This caused considerable extra expense to the producers involved. As a consequence, efforts have been made by concerned sections of the wool marketing industry to improve the standard of clip preparation.

Extension

Central and north west Queensland. The extension programme which began last year was continued and expanded. Officers in the central and north west have co-ordinated their activities to promote and demonstrate a range of practical techniques which can be implemented at shearing, joining, lambing and weaning. Work at 'Toorak' and on commercial properties showed that these techniques will improve the productivity of sheep raised under semi-arid tropical conditions. An open day was held at 'Toorak' in September 1981. Some 200 producers attended. The theme of the day was the improvement of productivity of Merino sheep in north west Queensland.

South west Queensland. Efforts in this area have continued to concentrate on the promotion of findings derived from research studies undertaken at the Charleville Pastoral Laboratory. The acquisition of 'Croxdale' enabled a number of demonstrations of husbandry techniques to be held.

South east Queensland. During the year, officers in the south east sheep areas commenced a co-ordinated programme for the improvement of sheep productivity in the region. Included in the programme was a series of sheep field days held at 10 centres over a 2-week period. Information obtained as a result of these field days indicated that there is a renewed interest in sheep in the region, and requests for follow-up events have been received in many areas.

Show exhibits. The main theme of exhibits at agricultural shows was the selection of high producing sheep and the improvement of reproductive performance.

Stud field days. In its efforts to assist the Queensland Merino stud industry the Sheep and Wool Branch participated with studmasters in conducting a number of stud sheep field days. Officers prepared and exhibited displays and demonstrations and presented papers on pertinent aspects of technology at these field days.

Clip preparation. The Sheep and Wool Branch undertook a comprehensive programme aimed at improving the standard of clip preparation in Queensland. The programme was conducted in association with the Australian Wool Corporation and the Wool Section of the Ithaca Technical College. One aspect of the programme was training for professional and owner wool classers. The owner-classer courses in particular created widespread interest and all courses conducted to date were well attended. More of these are planned and additional courses have been requested by industry.

In association with the Australian Wool Corporation, producer training programmes were conducted in suitable shearing sheds in all regions of the State. These programmes covered all aspects of clip preparation, with particular emphasis on local environmental problems and their effect on a producer's clip. In addition, various strategies were explained that could be used to lessen the economic loss caused by these environmental factors, thus maximizing returns to the producer.

As a further part of these producer training programmes, district officers of Sheep and Wool Branch organized producer visits to the wool sales. A group of producers was conducted on a specialized tour covering all facets of the wool marketing system including dumping, and a visit to a woollen mill. This enabled them to obtain a better understanding of the need for correct clip preparation to optimize returns.

Sheep blowfly film. The Sheep and Wool Branch in association with Photography Section commenced the production of a film on the ecology and control of the sheep blowfly. Copies of the film will be supplied to the Australian Wool Corporation and the Departments of Agriculture in other states.

Woody weed infestation in south west Queensland. Experiments are being conducted on the control of woody weed infestations in pastures.

Shearer training. Shearer training courses conducted by the Wool Producing Industry Training Committee and the Australian Wool Corporation were held in the Cunnamulla and Tambo districts. Ithaca Technical College held a pre-employment course in shearing shed skills. Recent criticism of skirting standards suggested there may be a need for training of shed hands in addition to the shearer and wool classer training currently being undertaken.

Sheep breeding and wool production

Sheep and Wool Branch has initiated a number of programmes during the past 7 years which were designed to improve the productivity of Queensland sheep, in particular tropical Merinos.

One aspect of this work was the establishment of a Ram Breeding Scheme which involves a nucleus flock of high-producing rams and ewes originally selected from 19 co-operating properties and now maintained by the selection of highest producing progeny. Rams bred from this flock are selected on measured criteria, and the highest producers retained for use in the flock. Surplus rams (approximately 250 per year) are distributed to co-operating properties. Ewe progeny for retention in the flock are selected on fleece weight.

A second programme is a Sire Evaluation Project. Rams from studs with a reputation for having high producing sheep in the more harsh environments of southern Australia are progeny tested at 'Toorak'. The aim of this project is to determine which strains perform better in the harsh semi-arid tropical environment of north west Queensland. Results to date indicate that growth rates and wool production from progeny of some strains are better than from locally-bred progeny.

Studies commenced at 'Croxdale', Charleville; 'Manningham', Longreach and 'Toorak', Julia Creek to quantify the impact of environmental factors on sheep production and, if possible, to determine the most suitable genetic material to use in these differing environments. The performance of ewes, rams and wethers from southern States, southern, central and northern Queensland is being compared with that of locally-bred animals, and appropriate physical and physiological parameters are being monitored.

Results available suggested that high-producing sheep introduced from favourable areas and their progeny bred in north Queensland performed better in the northern environment than locally-bred sheep when seasonal conditions were favourable, but that this superiority was not maintained under adverse seasonal conditions. These investigations are continuing in an endeavour to understand the reasons for the productivity differences, and to determine whether strains can maintain their superior productivity in the long term.

The fleece measurement service operated by the Sheep and Wool Branch was restructured and processing of wool samples was subcontracted to the Australian Wool Testing Authority. The Sheep and Wool Branch still collates the results and provides an extension service to assist producers with their breeding programmes.

The project aimed to develop an easy-care wool producing sheep by crossing Merino with Wiltshire Horn sheep continued during the year.

A comparison of 1/2M 1/2WH, 5/8M 3/8WH and 3/4M 1/4WH showed that the incidence of fly-strike increased as the proportion of Merino in the cross increased. The percentages struck per year averaged 7.2% for the 1/2M, 11.7% for the 5/8M and 38.9% for the 3/4M ewes. This increase in fly-strike was associated with a lower degree of shedding from the belly and breech regions but an improved wool production.

The study is continuing to determine the proportion of WH required in the cross to give the optimum economic returns based on wool production and resistance to blowfly strike. Incorporated in the programme is a comparison of shearing in August and shearing in February as a means of increasing wool yield by minimizing loss of wool from shedding. Preliminary results indicated that August shearing resulted in an increase in greasy fleece weight. It is planned for this project to terminate late in 1983.

Nutrition

Studies at 'Toorak' Research Station and Charleville Pastoral Laboratory had demonstrated the benefit of providing pregnant and lactating ewes with a nitrogen supplement when feed conditions were suboptimal. Work continued with the development of a liquid supplement dispenser to provide a urea (N) solution to these sheep in the drinking water. Two different types of liquid dispenser were tested at 'Croxdale' and 'Toorak'. Experiments were also conducted into the formulation and use of home-made blocks as a means of providing nitrogen to sheep in areas where supplementation in the drinking water is impracticable.

To allow an objective decision on the need for N supplementation, Biochemistry and Sheep and Wool Branches developed an on-the-spot test to determine a sheep's nitrogen status. The test measures rumen ammonia concentrations. All extension advisers of the Sheep and Wool Branch were equipped with a test kit. Its advantage is that it can be used 'on site' to provide immediate information to producers on the necessity or otherwise for nitrogen supplementation.

Interest in producing native pasture hay increased. Several field days were conducted and a number of producers in the central and north west areas of the State conserved hay as a hedge against drought and as a source of medium quality roughage to feed to weaner sheep during late winter. In an effort to improve the hay quality, experiments were carried out to impregnate pasture hay bales with aqua ammonia. Preliminary results showed that digestibility and nitrogen content were improved sufficiently to ensure that nutrient quality was above that required for maintenance. Quality of hay is important in supplementation of weaners and lambing ewes as these two classes of sheep are most vulnerable to adverse seasons.

Further results from the study of the nutritional factors limiting production of sheep grazing a mulga grassland pasture were made available. When seasonal conditions were good, the quality of the diets eaten by the experimental sheep was adequate to support a high level of production. After 4 to 6 months without effective rainfall, however, the nutritional value of the diets consumed deteriorated significantly. The first limiting nutrient appeared to be energy, followed by intestinally digestible protein then a number of minerals including sulphur, magnesium, zinc and sodium. Studies to test this hypothesis are planned.

Reproduction

Further work was initiated into the reasons for recurrent annual lamb losses. Although effects of nutrition, management, teat damage and predators are now more fully understood, the role of plant toxins and viruses needs further investigation. Many lambs of apparently viable birth weight appeared to have a poor teat-seeking drive and subsequently died of starvation. The aetiology of this is unknown and studies on the role of birth type, plant toxins and viruses in the syndrome have commenced.

Monitoring for arboviruses and insect vectors began at Julia Creek and Blackall in collaboration with CSIRO and Melbourne University personnel.

A survey covering three regions of the State indicated 4 to 19% of ewes examined had damaged teats. In a paddock trial conducted at 'Croxdale', Charleville, ewes with intact udders marked 89% lambs, compared with 46% from ewes with only one functional teat. Ewe milk yields were 790 and 568 mL per day respectively.

Prime lamb production

The Sheep and Wool Branch began studies at Hermitage Research Station, Warwick, into the superovulation of ewes, and intensive and semi-intensive finishing of prime lambs using permanent pastures and crops. The studies were designed to mimic prime lamb or prime lamb/grain cropping enterprises. With the use of new technologies, it is intended to turn off more than 150% prime lambs to meet premium market prices. These good prices occur each year in May, June and July before southern lambs reach the market.

In association with the Queensland Meat Industry Organization and Marketing Authority, the Sheep and Wool Branch commenced a series of studies aimed at investigating losses incurred in the marketing of prime lambs. Initial studies concentrated on the losses incurred through transport of sheep to market. Future studies will look at losses incurred with alternative systems of marketing, for example, through saleyards compared with direct selling.

Developing markets for Queensland sheep

Efforts to develop markets for Queensland mutton continued. A delegation of staff of the Divisions of Animal Industry and Marketing and representatives of the Queensland Meat Industry Organization and Marketing Authority visited South-East Asia in April and May 1981. The aim of the visit was to examine export possibilities for Queensland mutton. The delegation reported only guarded interest in the purchase of Queensland mutton. In much of the area, sheep meat is lowly regarded, with ram meat preferred to ewe and wether meat. The report recommended that efforts should be continued, though at this stage the market does not appear large and entry could be difficult.

During the past year, the Sheep and Wool Branch was involved in developing an outlet for mutton through local smallgoods processors. The main aim was to create a viable market for the low producing, aged sheep from the north west of the State. The best time for sale of sheep to this type of outlet is from May to September when the market is poorly supplied from the south. Several trials were conducted at various local meat processing works.

The results from these trials gave guidelines regarding freight costs, weight losses in transit, dressing percentages and meat to bone ratios. They showed that sheep from far northern Queensland gave a meat to bone ratio in the order 64:36 and that an average of 25% of carcasses in the trials were of export quality. These findings were contrary to previously accepted ideas.

The staff at 'Toorak' Research Station conducted a feasibility study into the development of a mutton outlet for sheep from the far north west of Queensland in the Cairns coast and hinterland area. Currently this area obtains approximately 25 000 lambs per year from Victoria, and the average consumption of lamb per head is low. It has been suggested that a market for good quality mutton may be developed. To the present, demand for mutton has been low because of the poor quality being supplied, its high price relative to lamb, and the ready availability of lamb.

The study concluded that, for successful development of this market, it would be necessary to mount a strong promotional campaign complemented by a comprehensive research programme. Areas needing further investigation include: transport costs; slaughtering costs and facilities; disposal of offal and skins; wholesale and retail outlets; availability and cost of developing holding areas for stock prior to slaughter; development of a method of sale by description. It is believed that a viable meat industry drawing supplies from the area embracing Hughenden west to Cloncurry and south to Winton could be established.

Parasites and disease

External parasites. Blowfly activity was generally low for most of the year. Due to favourable seasonal conditions, a fly wave occurred in March and April, particularly in sheep flocks in south eastern districts where strikes of 10 to 40% were reported.

The pastoral industry needs long term effective control of ectoparasites of sheep, in particular the green blowfly *Lucilia cuprina.* To this end, officers experimented with biological control methods.

Current research programmes involved investigation of biological and physiological characteristics which confer natural resistance on some sheep, and possible manipulation of these characteristics. Procedures for immunizing sheep with larval extracts or decreasing their sensitivity to strike continued. The latter procedure involved a close study of the interaction of sheep and larvae at skin level.

The causes of death due to strike continued to be elucidated along with the effects of strike on such production characters as wool growth.

A fly trapping programme was undertaken at 'Toorak', Julia Creek, and 'Croxdale', Charleville. Initial results showed that *Lucilia cuprina* concentrated around watercourses and that only a few flies were found in traps 0.5 to 1 km from water. This could have important ramifications for the control of blowfly strike in Queensland in that it may be possible to reduce fly populations along watercourses to a level where strike would not occur.

Concurrently with the trapping programme, the mechanisms by which *L. cuprina* survive during winter were studied. In northern Queensland, it was demonstrated that soil temperatures at approximately 8 cm did not drop below 15°C and therefore a free-living larval phase may not contribute markedly to the over-winter survival mechanism.

However, it was demonstrated that sheep carcasses may be of greater importance for this mechanism than previously thought. Numbers of *L. cuprina* emerging from sand beds placed under carcasses varied from 20 to 50. In southern Queensland, high levels of covert (small undetected) pizzle strike were detected on wethers during winter. These strikes could play an important part in allowing the blowfly to survive during winter.

Monitoring for resistance to organic phosphorus dips continued. Resistance levels of 20 to 25 times were common, and at these levels producers could expect only approximately 3 weeks' protection against flystrike.

In an investigation of the specific malathion resistance mechanism in *Lucilia cuprina,* the esterase levels of a further two generations of both adult and larval stages of three strains of blowfly have been estimated. The malathion-resistant strain had approximately twice the level of esterase activity when compared with the susceptible strains. It is difficult to interpret whether the increased level is associated with the microsomes or with the soluble fraction of the body cells.

No resistance to Vetrazin has been detected. Trials suggested that Vetrazin when administered orally prevented flystrike. Studies designed to confirm or refute this commenced at 'Croxdale' and in central Queensland. As yet Vetrazin has not been registered for oral administration.

Development of the air mist race continued. The major achievement was the production of a new conveyance mechanism which carries sheep on two narrow belts running along the belly. This mechanism provided better exposure of the sheep's belly and breech regions. In addition, designing of a self-loading mechanism commenced.

Internal parasites. Infestation of sheep with internal parasites was generally low for most of the year. However, severe outbreaks and some deaths were reported from the western Darling Downs in April when seasonal conditions were favourable for the propagation of parasites. All were due to *Haemonchus contortus.*

The survey investigating the resistance of strains of *Haemonchus contortus* to commonly used anthelmintics concluded and results are being collated for final analysis. Preliminary results indicated that multiple resistance occurred on the Queensland coastal belt whereas in the major sheep areas resistance was largely confined to the benzimidazole drenches.

A fly trap near a water point in south west Queensland. A fly trapping programme is being undertaken in many areas of the State for the prediction of blowfly waves. Initial results suggest that blowflies concentrate most heavily around watercourses.

The studies into the effect of low to medium infestations of *Haemonchus contortus* on the productivity of pregnant and lactating sheep continued. Preliminary results indicated that the milk production of ewes infested with moderate burdens of *Haemonchus* was reduced by 15 to 20%. The growth rate of weaners infested with low to moderate levels of *Haemonchus* was reduced by approximately 25%.

Research on the epidemiology of *Haemonchus contortus* in Queensland commenced as a joint project between officers of the Sheep and Wool and Pathology Branches.

In an effort to reduce the time taken to obtain results from faecal egg counts for the diagnosis of internal parasite infestation, the Sheep and Wool and Pathology Branches developed a technique which enabled worm egg counts to be completed on the property. This technique enables the owner to make an immediate decision on the necessity to drench his sheep while they are still in the yard.

A thiamine supplementation trial, instigated following the diagnosis of polio encephalomalacia in lambs grazing ryegrass, improved growth rate slightly but it was still far below that found in the same flock when growing to their full potential on the pasture. Analysis of pasture samples collected over the grazing period on 12 properties is continuing.

Diseases. Forty out of a flock of 580 Merino wethers died due to *Clostridium chauvoei* infection of shearing wounds. Clinical signs of fever, lameness and bluish discoloration under the skin of the hindlimbs were seen. *Cl. chauvoei* was cultured from the muscle of a freshly killed animal. Clostridial infections of sheep are a common occurrence in sheep-producing areas but material is rarely received at the laboratory for confirmation.

A property at Thulimbah has a small percentage of rams with swollen carpal-hock joints due to arthritis. At autopsy of two rams, *Erysipelothrix rhusiopathiae* was cultured from an affected joint of one. Both sheep were negative to the agglutination test for this organism whereas 2 months earlier the culturally positive animal had a titre of 1 600.

Reactors to serological tests for *Brucella ovis* were detected in flocks at Roma and at Warwick in rams with lesions of epididymitis.

Contagious ecthyma was diagnosed in a 4-year-old Merino wether from a mob of 4 000 at Tambo. Direct electronmicroscopy of scab material revealed parapox virus. Lesions were confined to the bare skin under the forelegs. The belly wool of the sheep contained large numbers of burrs. This may have predisposed the sheep to infection. No lesions were seen on the face or muzzle.

Biological defleecing

The biological defleecing programme aims at developing a practical alternative method of harvesting wool in order to contain the cost of shearing sheep.

Studies were made into the effect of the defleecing agent, epidermal growth factor (EGF), on the biology of skin and the morphology of wool fibres. Investigations into the separate and synergistic effects of EGF and betamethasone in mice were completed. Concurrent treatment with 250 µg per kg per day EGF and 5 mg per kg per day betamethasone produced hair growth retardation whereas each compound alone produced little response. Studies with sheep showed that administration of 2.8 mg EGF allowed wool staples to be plucked readily 6 days after treatment.

The defleecing effect of 18 synthetic corticosteroids was evaluated and compared with betamethasone in hair growth studies in mice. Some produced some retardation of hair growth, and were superior to betamethasone.

Studies continued into the natural wool shedding process in sheep which cast their fleece annually, with a view to developing a method of producing controlled fleece shedding in Merino sheep as a means of wool harvesting. An initial experiment using Wiltshire Horn sheep maintained under a range of photoperiodic conditions indicated that adrenalectomy does not prevent brush-end fibre formation and fleece casting. This suggested that a specific adrenal steroid was not directly responsible for follicle bulbs undergoing degenerative changes and regenerative changes after EGF treatment.

Wool growth studies

The aim of the wool growth studies programme is to understand and manipulate the physiological and biochemical processes occurring in the skin of sheep as they affect the growth of wool. Promising technical developments initiated by the Sheep and Wool Branch enabled its officers to detect changes in wool growth in response to nutrient infusions with greater sensitivity than was available with current techniques.

Cannulation of a cutaneous branch of the external deep circumflexiliac artery allowed metabolic isolation of an area of skin so that direct effects of biological compounds on wool growth could be observed. This meant that results were not masked by secondary feed-back effects as a result of influence of the experimental treatment on other body tissues. An essential component of the work was the use of autoradiography to measure wool growth. The precision of this method allowed growth to be measured over periods as short as 2 to 3 days.

The partitioning of nutrients within an animal to satisfy individual tissue requirements or individual metabolic pathway requirements was studied. Natural partitioning could explain the differences in high and low producing sheep, and metabolic changes which occur within an animal when gaining or losing weight. The aim of the research is to understand the basis of these differences so that ultimately the division of nutrients into foetal/muscle/wool tissues may be subjected to a degree of control to suit market requirements.

Monitoring of stock waters

Monitoring stock waters is a labour intensive and time consuming operation. In the pastoral areas, this job often necessitates the employment of one person full time. In an endeavour to obtain a cheaper alternative method, investigations commenced on the use of radiotelemetry. Equipment which will monitor water levels and transmit information to a central receiver was designed and installed at 'Toorak' Research Station. This equipment will be field tested and modified in the ensuing year.

Review of Departmental services in western Queensland

The Department has established a committee with industry representation of Mr J. Heussler (Chairman) and Mr H. Slaney, and Departmental representation of Mr P. Thurbon and Mr A. Wissemann (Secretary) to review the Departmental services to producers in the traditional pastoral sheep areas of Queensland.

The Committee are to submit a report to the Director-General not later than 9 months from the time of the appointment. Three years after the submission of this report, the Committee is to conduct a review and submit a follow-up report on the implementation of the original recommendations.

Goats

The Angora goat industry continued to expand and to utilize much of the Sheep and the Wool Branch's resources. In a continuing attempt to rationalize the use of its limited resources, this Branch placed emphasis on group activities such as field days, seminars and meetings. To meet the continuing demand for published information on Angora goats a booklet *The Angora Goat in Queensland* was produced for sale. This is available from the Information Branch, Brisbane.

During the year, the price of both mohair and Angora goats declined. This is expected to have a consolidating effect on the present industry.

The demand for goat meat (chevon) for both the export and local trade continued to increase. Feral animals remained the main source of chevon, but the current harvesting rates may be exceeding the natural reproductive rate. Limited quantities of chevon were produced under commercial conditions and it is expected that, if the market is to be retained, an expansion in this type of enterprise will be required.

Haemonchosis and trichostrongylosis were serious problems in a number of dairy goat, Angora breeding and meat breeding establishments in south eastern Queensland. Following the use of narrow spectrum anthelmintics effective against *Haemonchus* significant burdens of pure Trichostrongylus were encountered. The mild wet seasons facilitated the year long survival of both parasites. Strains of *H. contortus* showing resistance to a wide range of drenches were widespread in south east coastal Queensland. Management practices for worm control are essential to maintain productive herds.

There was an upsurge in the number of cases of entero-toxaemia in goats confirmed by the demonstration of *Clostridium perfringens* type D toxin in intestinal contents.

Staphylococcus aureus, Streptococcus bovis, Klebsiella oxytoca and *Acinebacter anitratus* caused outbreaks of mastitis in goats.

Pseudomonas pseudomallei was recovered from abscesses in the spleen, lung, bronchial and mediastinal lymph nodes of a goat at Mackay.

Two Angora kids from a triplet birth became blind at approximately 8 months of age. Brain from one of these goats showed oedematous vacuolation of white matter throughout the brain and severe Wallerian degeneration affecting the olfactory and optic tracts. The other affected kid made an apparent recovery. Similar lesions were seen in other submissions from the same area near Gympie, and toxic plants were suspected, though not confirmed, to be the cause.

Three goats were diagnosed as cobalt deficient with serum vitamin B12 levels of 180, 128 and 188 pg per mL. The goats were 8 months of age and clinically showed a slow growth rate, poor condition and no response to anthelmintic treatment. The goats came from the Gayndah area.

Coccidiosis was reported as the cause of death on two properties. In one case *Eimeria arloingi* infection was the organism responsible for the death of 12 of 38 kids in the herds.

Pig industry

At 31 March 1982, preliminary estimates by the Australian Bureau of Statistics place Queensland pig numbers at 492 000 head. This represents a 2% decline on the previous year but is 9% below the population recorded in the peak year, 1973.

Statistics for the 12 months ended March 1982 showed that Queensland pig production had declined on that of the previous year. At 819 000 head, slaughterings were 4.4% fewer while carcass meat produced had fallen 4.3% to 49 700 tonnes. The Australian production decline was only marginal by comparison at 1.7% and 0.9% respectively in terms of slaughterings and meat produced.

On consignment, prices offered for prime baconer pigs escalated rapidly during the year, particularly following the introduction of weekly auction sales by description. From $1.25 per kg hot dressed weight in April 1981, the current price ranges between $1.95 to $2.05, the latter at description sales.

Feed prices, on the other hand, have declined due mainly to two excellent grain harvests. This is reflected in the price of least cost grower diets which have fallen $40 per tonne from $171 in April 1981 to $131 at March 1982. The pig price feed cost ratio expresses the relationship between prime on consignment baconer price and the average cost of ready mixed grower diets. The ratios during 1981–82 were as follows—

Apr 7.04	Jul 7.32	Oct 8.50	Jan 8.84
May 6.34	Aug 7.96	Nov 8.85	Feb 9.67
Jun 6.89	Sep 8.33	Dec 8.84	Mar 10.71

Profitability improvements have naturally captured the attention of new investors and turned existing producers' thoughts towards expansion. Shortage of capital and higher interest rates coupled with inflating building costs have tended to curb any significant expansion.

Unique among Australian pig producers' organizations, the statutory body, Queensland Pork Producers' Organization (QPPO), continued to flourish, successfully representing the interests of Queensland producers in a number of different issues. It negotiated the provision of farm insurance packages for its members at competitive rates. The dial-a-market report on current pig prices and feed prices continued to be an important service to industry.

With Dalgety-Winchcombe as its agent, it introduced Sale by Description Auctions to Queensland in September 1981. Since the initial sale almost 25 000 pigs have been marketed. The number of pigs sold weekly has remained fairly constant. A key factor in the success of this sale method is the accuracy of fat measurement. Some producers have experienced difficulty in estimating fat depth on live pigs. Fat depth on pigs at slaughter is monitored by officers of the Department. An excellent slide-tape presentation on the subject has been produced by staff in Pig and Poultry Branch in collaboration with Veterinary Public Health Branch.

The Pork Producer, a tabloid newspaper, is now the official organ of the QPPO, commencing publication in late 1981.

Officers of the Department maintained close co-operation with the organization at State Council, District and Branch level on such matters as animal welfare, research, promotion, effluent disposal and marketing.

A non-profit producer owned company, Queensland Protein Buyers, continued to provide a valuable service to producer members in procuring feedstuffs.

At the invitation of agricultural societies, Pig Section staff judged 30 pig carcass competitions throughout the State. A special competition at Biloela involving the measurement of growth rate as well as carcass traits drew enthusiastic support from producers. For the first time, the National Carcass Competition has been extended to competitions other than those associated with Royal National exhibitions in the various states.

Breeding

Central boar performance testing. In 1981–82, 206 boars of the 423 tested were approved for future breeding. Of those tested, 280 were Landrace (130 approved), 121 Large White (63 approved) and 22 were Synthetic (13 approved). The latter, a mixture of several breeds, were tested for the first time during the year. Sons of QAR sires comprised 57% of the boars tested and 12% were sons of imported sires.

The average performance of all boars tested and those approved for future breeding was as follows—

—	Daily gain (kg)		Food conversion ratio		P_2 fat depth	
	Tested	Approved	Tested	Approved	Tested	Approved
Landrace	0.92	0.96	2.70	2.53	19.2	18.6
Large White	0.88	0.92	2.63	2.47	19.2	18.0
Synthetic	0.96	0.98	2.51	2.42	20.2	19.4

Reports detailing approved boars' indices were published monthly in the rural media while the 20 herds in the scheme received weekly reports.

As a result of the testing programme at the Central Boar Performance Test Station, it has been possible to make valid comparisons of imported with local breeding stock. Stud herds which test boars in the station have introduced sires from overseas. The earliest introductions were Large White and Landrace boars from New Zealand. Comparative performances of the progeny of

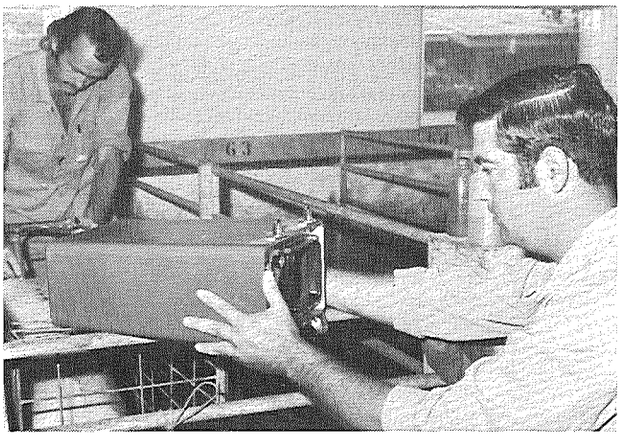
these sires and local sires have accumulated in the station and these results are given in the table. Imported stock comprise 91 sons of 9 Landrace sires and 87 sons of 6 Large White sires. Local stock comprise 781 sons of 127 Landrace sires and 462 sons of 85 Large White sires.

Mean performance of progeny groups of imported and local sires

Trait	Landrace		Large White	
	Local	Imported	Local	Imported
Growth rate (kg)	0.89	0.89	0.87	0.90
Food conv. ratio	2.73	2.75	2.63	2.58
Av. back-fat (mm).....	22.8	23.0	23.2	22.7
Index score (points)	100	95	100	110

Although the progeny tests of several imported sires were significantly better in some traits than those of local sires, the best imported fell short of the best local sires. As a group, the progeny of imported sires were neither significantly better nor worse than those of local sires for any of the traits measured. The halothane test revealed that two of the Landrace sires were carriers of the Malignant Hyperthermia Syndrome (MHS) gene.

There is evidence that imported sires are being used longer and more often than local sires. The average number of sons tested per sire was 12 for imported sires and 6 for local sires. Also, with time, the performance of imported sire progeny has declined relative to that of local sire progeny. The results so far question the benefits to be gained for the local pig industry from importations.



At the Department's Rocklea test station, research workers place an ultrasonic probe on a young boar to measure his backfat depth. This is part of the test to evaluate the genetic worth of both imported and locally bred boars.

On-farm performance testing. All Pig Section officers have access to ultrasonic equipment for measurement of backfat. During the year, they worked closely with more than 40 producers, teaching the skills required in conducting a farm performance test.

Farm visits to demonstrate the techniques required were also gainfully employed in dealing with other subjects of interest.

Ultrasonic backfat measuring instruments used by the Pig Section have proven very reliable and have been used as a bench mark in evaluating the more recently released digital machines. The availability of the latter at comparatively cheap prices has stimulated adoption of independent testing by producers.

Maximizing profits from on-farm performance testing of pigs. A number of major factors which influence the value to a pig herd of a performance testing and selection programme to improve the rate, efficiency and composition of liveweight gain has been identified.

These factors are: 1. the cost of performance testing; 2. the age at which breeding animals are replaced by their offspring; and 3. the degree to which the herd is subdivided into a breeding unit and production unit.

Performance testing and selection are confined within the breeding unit and it supplies all boar and sow replacements for the whole herd. All pigs born in the production unit are sold for slaughter. Computer models were constructed using the gene flow technique. A large number of runs was made varying the cost of testing, the age of culling and the herd structure.

The main findings of these investigations were: 1. the practice of replacing breeding animals at a young age increased genetic gain but reduced the average pig output per sow; 2. the practice of confining testing and selection within a breeding unit reduced the overall cost of the programme but increased the delay in passing genetic improvement to the pigs sold for slaughter from the production unit.

Current costs of performance testing in Australia are estimated to be about $2 per pig measured. At this cost, the maximum returns are obtained when the production unit has: (a) 3 times as many sows as the breeding unit; (b) both boars and sows are worked in the breeding unit for one breeding cycle (6 months); (c) cull-for-age sows are then moved from the breeding unit to the production unit where they are used for a further three breeding cycles. With this optimum structure, the discounted returns from the breeding programme, evaluated over a 10 year period, were estimated to be $200 per sow.

If the cost of testing were to increase above its present value, the size of the breeding unit should be reduced and that of the production unit increased; for example, if the cost of testing each pig were increased to $3, then the optimum ratio of production unit to breeding unit sizes would increase to 5. It would also be necessary for the breeding unit to include some young gilts with the cull-for-age sows being supplied as female replacements from the breeding unit to the production unit.

Litter of origin size of selected gilts. This study is to determine whether physically sound on-farm performance tested gilts selected on index, come from smaller than average, larger than average or average sized litters (numbers born alive) and whether gilts from smaller litters have a growth advantage over those from larger litters. Data were collected during 3 weekly visits to three herds comprising 450 sows which have been performance testing replacement females for the past 2 years. Herds 1 and 2 test 66% and Herd 3 tests 95% of all females born. The following table shows the number of gilts selected and average sizes (number born alive) of litters either supplying or not supplying gilt replacements—

Herd	Gilts selected	Litters supplying gilts		Litters not supplying gilts	
	No.	No.	Av. size	No.	Av. size
1.....	154	117	9.70	597	9.31
2.....	167	135	10.70	353	10.11
3.....	78	66	11.17	343	10.88
Total/Average ..	399	318	10.43	1 293	9.95

The range of size of litter-of-birth of selected gilts was 4 to 15 in Herd 1, 4 to 17 in Herd 2 and 6 to 16 in Herd 3. Contrary to expectations, there was no tendency for gilt replacements to be selected from litters of below average size. In fact, the opposite appeared to be the case, with mild selection in favour of larger litter size.

Selection for efficient lean growth in a pig herd. Selection was continued during the year for maximum lean growth in the research pig herd at Hermitage Research Station. This herd has now undergone 18 batches or 3 years of selection. The average performance of all pigs tested and those selected as breeder replacements are given in the following table—

—	—	Liveweight at end of test (kg)	P_2 fat (mm)	Estim. ham lean (kg)
Males	Tested	88.4	17.5	5.7
	Selected	91.8	14.6	6.2
Females	Tested	86.5	17.1	5.4
	Selected	88.9	16.1	5.8
Average	Tested-Selected	+2.9	−2.0	+0.4

The first comparison between Selected and Control stock has commenced. Results will give an estimate of genetic change to date in the Selected herd.

Performance of mice selected for high growth rate. In these experiments mice are used as models for pigs. Selection for rapid growth on *ad libitum* feeding has been extensively studied in mice. Increases in appetite, fatness and both the rate and efficiency of growth usually result.

A further experiment was undertaken during the year in which three lines of mice were compared. Line A was selected for high 3 to 6-week growth rate on *ad libitum* feeding, line R was selected on a restricted feeding scale which prevented appetite variation being expressed, and line C was maintained as an unselected control. After 6 generations, mice from all three lines were grown from 3 to 9 weeks of age on both levels of feeding.

Comparisons were made of growth rate, food intake, food conversion efficiency (gain/intake) and carcass components. Both 'A' and 'R' mice enjoyed similar improvements in the rate and efficiency of growth, but only the 'A' mice suffered undesirable increases in appetite and fatness. These findings favour restricted over *ad libitum* feeding as a performance testing regime for genetic improvement in the efficiency of lean growth in pigs.

Nutrition

Least cost diet. Least cost diet formulations continued to be supplied on request to pig producers and feed compounders. In the Toowoomba area, the computer formulated diets were calculated and published on a monthly basis using locally available feedstuffs and their current prices. This provided a guide to producers compounding diets on-farm and gave an indication of trends in feed costs.

Changes made to the feed compositional data and diet specifications in the least cost pig diet programme were validated in an experiment comparing 'new' and 'old' diet formulations. Although there were differences in pig performance between diets, these were generally of a minor and, statistically, of a non-significant nature. However, the experiment did highlight the need to control more closely the energy content of the diet. This aspect is now under investigation.

Fibrous diets for weaner pigs. Results obtained from two on-farm trials and presented at producer seminars have encouraged several commercial feed compounders to market high fibre, coarsely ground weaner diets. Such diets, which are normally drug free, have been effective to varying degrees in reducing the incidence of scouring in weaner pigs. Provided conditions were not too severe nor food restriction too harsh, the use of these diets met with success.

Water quality. Concentrations of nitrite as low as 5 mg per L are said to produce symptoms of Vitamin A deficiency and interfere with endocrine function and enzyme systems. Thus in conjunction with 3 000 mg per L of total dissolved salts, further work evaluated the effect of 0, 5, 15 and 50 mg per L nitrite in drinking water for pigs. Liver Vitamin A levels from the trial pigs were in the normal range. A problem with such trials was the instability of nitrite, which rapidly oxidized in storage to the nitrate form.

Provided specific ions are not greater than desirable limits, current practice is to regard 3 600 mg per L Total Dissolved Ions (TDI) as acceptable drinking water for pigs. Up to 5 500 mg per L TDI is safe for limited periods. A recently commenced trial seeks to test the effect on pigs consuming water containing up to 8 000 mg per L TDI. This is expected to assist in framing more specific recommendations on water quality for pigs.

Evaluation of protein concentrates. An appraisal of the feeding value of navy beans *(Phaseolus vulgaris)* continued during the year. Previous work demonstrated that raw navy bean contained a potent growth inhibitor which was difficult to remove by conventional heat processing methods such as oven cooking, dry roasting and steam pelleting. Although the toxic principle in navy bean could be destroyed by autoclaving, such a procedure has limited practical application.

Rat growth assays carried out the previous year indicated that extrusion processing of navy bean was successful in destroying the growth inhibitor. However, because of its low oil content, navy bean could be extruded only when mixed in approximately equal amounts with full fat soybean. Despite the major disadvantage of not being able to extrude navy bean by itself, the success of the method warranted further work to extend the findings to pigs.

The digestibility of two 90°C extruded protein sources—full fat soybean either (a) by itself or (b) as a 45:55 blend with navy bean—and navy bean after autoclaving at 126°C for 15 minutes was determined in a latin square pig experiment. All protein sources were highly digestible (in excess of 84%) although the extrusion process appeared to be not entirely adequate for the navy bean blend whereas it was particularly suitable for the full fat soybean. The digestibility of the autoclaved navy bean was on average, 7 to 8 percentage units higher than for the extruded blended navy bean product.

The influence extrusion temperature has on the nutritive value of the navy bean-soybean blended product was examined in a pig growth assay carried out from 20 to 50 kg liveweight. The nutritive value of the extruded navy bean-soybean product varied according to the processing conditions from being markedly inferior, or equal, to that of autoclaved navy bean. A temperature of approximately 160°C was found to be the most suitable processing condition.

Interest continued in determining the nutritional value of navy bean meals for pigs by using the dye binding technique. It was established conclusively that under standardized conditions, optimally processed navy beans have a dye binding value of 3.8 mg per g. With progressive overcooking, this value remains unchanged until excessive 'charring' occurs, whereupon the dye binding value drops below 2.0 mg per g. Recorded values of 4.0 mg per g for cooked beans have been reconciled with lowered ambient temperatures (20°C) during the 'extraction' phase of the technique. The methodology is presently adapted for use with navy bean-soybean blends.

Energy and lysine requirements of breeding sows. This long-term project, supported by funds from the Australian Pig Industry Research Committee, is examining the effects on reproduction of sows of diets containing either 0.45, 0.58 or 0.7% lysine throughout pregnancy and lactation. Sows are fed either 1.5 or 2.0 kg of feed daily during pregnancy and fed *ad libitum* during lactation. Liveweight and subcutaneous fat changes of the sows and fecundity are being monitored for three successive parities from first mating.

The numbers of sows that have completed their first, second and third parities are 118, 51 and 36 respectively. Although only a small number of sows has completed their second and third parity, responses to dietary lysine content and feeding level during pregnancy appeared to be similar from one parity to the next.

Dietary lysine content appeared to have only a small positive effect on sow liveweight but a profound positive effect on piglet growth rate to weaning (35 days of age). Feeding level during pregnancy, on the other hand, had a profound positive influence on sow liveweight during pregnancy and on piglet birth weight. However, sows on the high feeding level during pregnancy lost more weight during lactation so that liveweight gain for the whole parity was only slightly more than for sows fed at the lower level during pregnancy.

Numbers of piglets born did not appear to be influenced by either dietary lysine content or feeding level in pregnancy. However, there was an indication in the third parity of an association between low birth numbers and sows fed the 0.45 and 0.58% lysine diets at the lower pregnancy feeding level. A clearer picture should emerge as more third parity data become available.

Growth rate of piglets in the 4 weeks after weaning did not appear to be influenced by the prior nutritional history of the sow. There is still an insufficient number of sows that have completed their third parity for any assessment to be made of the effect of nutrition on breeding regularity.

Evaluation of rough rice. Previous work in this field has shown rough rice to be energy limiting in diets for growing pigs. Current experiments were designed to measure the ability of the pig to regulate energy intake by consuming more of a low energy diet and thereby attain growth rates comparable with high energy diets.

Five diets of constant energy to lysine ratio were formulated so that the rough rice content varied from zero to 70%. DE levels were adjusted by the addition of vegetable oil. Lysine levels were adjusted by the addition of synthetic lysine. The results showed that, when fed on an *ad libitum* basis, pigs ate more of the low energy diet and maintained comparable growth rates to those pigs on the more energy dense diets. Feed conversion ratio for the 70% wheat diet was 2.59 compared to 2.79 for the 70% rough rice diet. The best productivity occurred on the 50/50 wheat, rice blended diet (0.98 kg per day gain:FCR 2.65). Growth rates of pigs fed any of the wheat, rice blended diets were superior to those fed the 70% wheat diet.

Feed evaluation. In keeping with the major emphasis on feed evaluation for the pig industry, the amino acid composition of several atypical feedstuffs was determined including a fish silage, a flour mill slurry and a whole poultry meal. Chemical analyses associated with the determination of the nutritive value of *Candida ingens* grown on pig wastes were commenced.

Within the context of this work, it has been possible to show no statistically significant difference between results for dry matter and gross energy of oven-dried faeces as opposed to freeze-dried samples. If oven drying can be applied without detriment to faeces from other experiments it will ease considerably the present problems of sample processing in the area where nitrogen analyses are not required.

Reproduction

Gilt management survey. Ongoing observations from co-operating properties and others suggested that oestrus in gilts and first litter sows commonly remains undetected more often than expected. Confirmation was obtained by post slaughter evidence of ovarian activity. Non-detection of oestrus, despite good boar contact, may have resulted from silent heats, behavioural anoestrus or infantile reproductive tracts. Selection of replacement gilts is now recommended at 160 to 170 days of age following which exposure to sexually mature boars assists in early puberty induction. The gilts are normally mated at second or third oestrus, those failing to cycle by heavy bacon weight being forwarded for slaughter.

Synthetic boar odour. The results of a trial on the effect on recently weaned sows of a synthetic porcine pheromone showed there was no benefit in using such a product. The pheromone or boar odour is available as an aerosol and was sprayed in the nasal area of newly weaned sows already in contact with boars. The aim was to determine whether such a practice shortened weaning to mating interval and increased litter size. Although results did not support the use of the synthetic pheromones under good husbandry conditions there may be some application where artificial insemination is used.

Artificial insemination. The importation of Yorkshire, Landrace, Hampshire and Duroc boars from Ireland, Canada and New Zealand focused interest on A.I. as a means of maximizing the influence of these sires. The importing herds and several others were assisted in establishing within herd A.I. programmes. The results to date are encouraging with non-return rates between 80 and 90%. Further interest has developed following group discussions held at several country centres with a number of

producers electing to start by establishing suitable facilities. The introduction of frozen semen from Canadian sources has also created considerable interest with producer seminars being scheduled for mid 1982.

Pregnancy diagnosis. Vaginal biopsies have been used over the last 4 years to monitor pregnancy status in pigs at the Pig Research Centre. The biopsy results have been cross matched with mating outcomes and slaughter examinations in the case of culls to assess the accuracy of the vaginal biopsy diagnosis. Of the 607 biopsies taken, 92% gave definitive answers and of these 96% were correct as to the diagnosis of pregnancy. The residual 4% was made up equally of false negatives or false positives. Eight percent of biopsies taken did not allow a satisfactory reading which was attributed either to insufficient biopsy sample or technical problems associated with the sample preparation.

Disease

Scouring in piglets due to *Escherichia coli* was reported from all pig raising areas with the greatest incidence occurring on the Darling Downs and in the Beaudesert and Lower Burnett areas.

A trial to determine the benefit of Lactobacillus administration to new born piglets on the incidence of baby piglet scours was undertaken on three properties with a baby piglet scour problem. The basis of the procedure was to administer a culture of Lactobacillus manufactured on the farm in a domestic yoghurt maker as soon as possible after birth.

The culture should assist in the establishment of a healthy gut flora and protect the piglets against enteropathogens. In the most sensitive trial, involving 86 litters, the mortality rate of piglets given the Lactobacillus culture was 5.3% compared with 8.1% in untreated controls and 10.7% in piglets given a dose of an antibacterial agent soon after birth.

Resistance of bacteria to antibiotics is a cause for concern, particularly in those intensively housed and fed animals in which infections spread most easily. Resistance of isolates of *E. coli* was monitored throughout the year.

The results showed a significant level of resistance to the most frequently and longest used antibiotics and the only antibiotic to which no resistance was detected was polymixin. However, only 98 isolates were tested against this antibiotic whereas the others were tested against from 260 to 278 isolates.

A survey was begun to determine the causes of post weaning losses. Financial assistance was provided by the Australian Pig Industry Research Committee. It involved collecting data on the prevalence of various clinical conditions, the prevalence of various lesions at slaughter and the causes of death in pigs on 24 randomly selected piggeries in south east Queensland. Carcass information was also collected from the pigs by CSIRO, Cannon Hill. It is intended that expressions will be derived from this data to indicate the influence of various conditions on growth rate. Approximately 1 200 pigs will be included in the survey but fewer than 100 have been killed to date. Seventeen of 465 pigs (3.7%) died within 1 month of weaning; most deaths were due to pneumonia and enteritis.

The isolation of *Pseudomonas pseudomallei* from abscesses in north Queensland pigs at slaughter, together with the recovery of this organism from clay samples near the water source, was recorded in last year's report. A similar problem, but of much greater magnitude, occurred in a large piggery in south east Queensland. *Ps. pseudomallei* was first isolated from abscesses in these pigs in July 1981 and a total of 10 pigs gave positive cultural results up to 1 September 1981. Between September 1981 and February 1982, 4 000 pigs were sent for slaughter without any evidence of meliodosis being present. From February 1982 to the present, a total of 87 out of 298 specimens has given a positive culture result. This marked increase in infection appeared to be associated with the wet season and suggested that the source of infection was muddy water supplied to the piggery. Extensive efforts to recover the organism from the water, sludge, and mud have been unsuccessful to date but efforts to do this are continuing.

Subsequent to this disease appearing in the one piggery in south east Queensland, it has been diagnosed on a further five properties in the location. All the affected properties have been quarantined.

At present, there is no reliable serological test to detect infected pigs. With the present knowledge of the epidemiology of the disease, chemical treatment of the water supplies has been recommended as the best method to prevent the occurrence of the disease in intensive piggeries.

Infertility is one of the major problems affecting the pig industry, but severe abortion storms are now unusual. A large new intensive piggery on the Darling Downs suffered heavy losses as a result of an *L. pomona* abortion storm. The piggery was populated in May and June 1981 with gilts and a single dose of leptospiral vaccine was administered at the time of introduction. However, of the 1 970 gilts in the piggery, approximately 180 aborted over a 1-month period and abortions continued at the rate of 2 to 3 a week.

Infertility and abortions were investigated in other piggeries on the Darling Downs, and in piggeries in the Burnett and Atherton Tableland areas. Most of these were caused by *Leptospira pomona* and/or parvo virus.

Brucella suis was recovered from samples submitted from a pig at Wowan. The property is destocking through approved outlets. Four reactors to serological testing for brucellosis were detected in 32 samples from breeding pigs on a known infected piggery at Theodore.

A serological survey of feral and domestic pigs to detect the extent and distribution of infection with *Brucella sui* continued as indicated in last year's report. A total of 4 814 sera from cull domestic sows was tested by the Rose Bengal test (RBT) and 47 reactions generally weak in nature, were detected. Only three of these sera gave any reaction in the serum agglutination test (SAT). Only 23 sera from feral pigs were received and five of these gave strong reactions in the RBT and two were also positive to the SAT. These results are in agreement with previous findings that infection is of very low incidence in domestic pigs but that feral pigs are a cause of concern.

Outbreaks of oedema disease in grain fed pigs were reported from the Darling Downs, North Burnett and Maryborough.

Mortalities and sickness due to swine dysentery were investigated at Goomeri, Murgon, Warwick, Chinchilla, Gowrie Junction, Clifton, Nobby, Highfields and Cabarlah. The disease was widespread in piggeries on the Darling Downs and in the Burnett area.

Erysipelothrix insidiosa was recovered from pigs that died on a property near Jandowae.

Lesions of enzootic pneumonia were observed at slaughter in pigs from all pig raising areas.

Streptococcal meningitis was confirmed as the cause of 67 deaths in weaner pigs in a piggery on the Darling Downs.

Piglets exhibiting signs of exudative epidermitis (greasy pig disease) were observed in piggeries at Grantham, Dalveen, Tansey, Biggenden and Malanda.

Hind limb weakness affected piglets in four litters in a piggery near Crows Nest. Histopathological examination revealed a deficiency in the white matter tracts of the spinal cord.

A viral encephalitis, suspected to be due to haemagglutinating encephalitis virus, was diagnosed in six herds at Kulpi, Highfields and Cabarlah, on the Darling Downs. Attempts at virus isolation by passage in porcine kidney cells and suckling mice have not proved successful but the clinical disease was transmitted to 4-day-old baby pigs, using intracerebral inoculation, on one out of these attempts. Clinical signs shown by the piglets were depression, champing and frothing at the mouth, trembling, incoordination, lateral recumbency, cyanosis of extremities and death in 2 to 3 days.

Pigs on a property in the Princess Charlotte Bay area were found to be heavily infested with spargana. Heavy infestations of immature thorny-headed bowel worm *(Macracanthorhynchus hirudinaceus)* were also noted in these feral animals.

In an abattoir survey to determine the incidence of atrophic rhinitis, a total of 1 135 bacon weight pigs' snouts were scored for degree of turbinate atrophy. The results were: no abnormality 894, slight deviation from normal 187, mild turbinate atrophy 51, more severe turbinate atrophy 31, severe or total atrophy of one turbinate 0, absence of both turbinates 0.

Atrophic rhinitis is a complicated disease. The exact aetiology has not been established. Three of the suspected aetiological agents are present in this country and approximately 20 years ago several farms were quarantined for infectious or inclusion body rhinitis. The above results indicate that atrophic rhinitis is not a problem in southern Queensland.

Management

Piggery performance analysis. There are now 62 participants in this programme compared with 30 in the previous year. Results are calculated by the producer, initially with the assistance of the district officer. Initially a manual calculation, participants now have the option of having calculations done by micro computer. A computer program developed by north Queensland officers is now available for result calculation for individual farms, districts and regional groups.

In several districts, groups of participants met to discuss results: management generally improved as a consequence. The scheme also had considerable value in keeping extension officers abreast of current economic factors. This assisted them in their budgetary work particularly with proposals for expansion of existing piggeries or establishment of new enterprises.

The average results for the best five farms and results for all participants during the 12 months to March 1982 were as follows—

—	Best 5 farms	State average
Pigs sold/sow/year.....	19	17
Average dressed weight (kg).....	60	60
Feed cost/kg meat produced (cents).....	79	95
Herd feed conversion ratio.....	4.3:1	4.8:1
Margin over feed cost ($)	20.10	14.71

Pig breeder assessment (PBA). Most of the participants in Piggery Performance Analysis also maintained PBA records as a management aid. In most districts, summaries of results were compiled for 6 and 12 monthly periods. Average results for 20 herds in the Darling Downs and Moreton areas for the 12 months to 31 December were: number of pigs born alive per litter 9.49; number of pigs born dead per litter 0.68; number of pigs weaned per litter 8.39; pre-weaning mortality (%) 11.63; farrowing index 2.13; farrowing interval (days) 171.5.

Electronic management aids. A project in the Darling Downs region sought to evaluate and demonstrate electronic instruments which could assist in piggery management. Field days held at Warwick, Toowoomba and Dalby attracted wide interest. Microcomputers, programmable calculators, backfat graders, pregnancy testers and many other electronic aids were demonstrated. Cost effectiveness evaluations were provided with each instrument.

Piggery business management. Analysis of the pig industry situation in the Burnett region has resulted in the implementation of a survey to assess the business capabilities of pig producers and their attitudes to business management. Following initial interviews with enthusiastic producers, a Pig Business Group has been formed in Bundaberg. The group met every second month and an assessment of the overall project is expected in late 1982. The overall survey and assessment will continue and it is expected that similar groups will be formed at other centres in the district.

Housing. Pig Section staff have provided designs for new piggery construction on request. Due to the economic situation earlier in the year, inquiries had eased but subsequently there was a resurgence of interest as profitability improved. Most construction was confined to established units although a very few new piggeries were established. Capital costs and the interest rate on borrowings appeared to have presented a formidable obstacle. The cost of construction is currently estimated to be in excess of $1,500 per unit of breeding stock.

As a spin-off from gilt performance testing, and investigation of gilt mating problems, producers in a number of areas have been encouraged to establish gilt pool housing as a necessary part of their herd replacement programme. Other requirements are identification, litter records, a culling policy, batch farrowing and performance testing. Before such programmes can be considered, accommodation providing for boar contact and mating facilities was normally required.

Several new piggeries constructed in the past year incorporated slatted floors over Vee-shaped trenches. The Vee trench is hydraulically very efficient and is used extensively interstate.

Extension

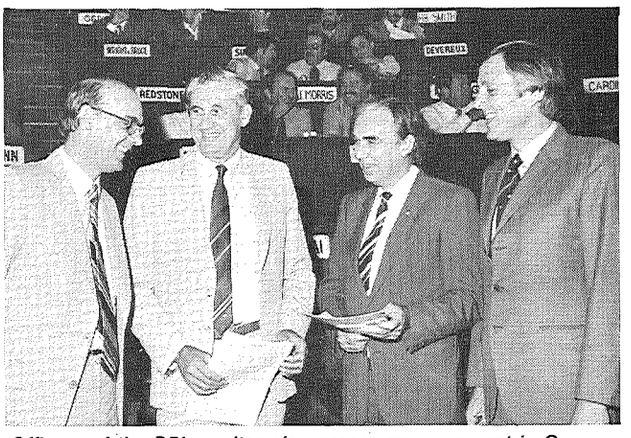
Field officers continued to maintain contact with pig producers through their organization meetings, discussion groups, field days and seminars. Research and extension personnel of the Pig Section were guest speakers at many of these gatherings.

Farm visits and contact by telephone or office interviews were important avenues of communication with producers. Up to 50% of work time was devoted in some areas to demand/response activities. The available media channels were employed as necessary and a wide range of advisory material was supplied.

Industry groups continued to meet and formulate extension and work plans in three major pig producing regions: Darling Downs, Burnett and Moreton.

Carcass measurement. The Queensland Meat Industry Organization and Marketing Authority (QMIOMA) and Pig Section staff familiarized farmers with the details of carcass measurement. Talks were given by QMIOMA and Pig Section officers at meetings and producer seminars. A slide tape package was prepared to explain the objectives and benefits of carcass measurement. Since the implementation of the service, a number of processors and buyers has traded on the basis of classification. Officers were involved in conducting a number of evening meetings to discuss pig carcass measurement. In addition, two seminars were conducted in conjunction with the QPPO to outline all the information including carcass measurement and monitoring service relevant to description sales.

Several projects were undertaken to compare on farm measurement of backfat in live pigs with that taken at the abattoir on the carcasses. In doing so, the accuracy of several ultrasonic machines was evaluated. Preliminary data are being evaluated but further work may be necessary to evaluate the accuracy of on farm P2 measurement as a predictor of factory measured P2. A difficulty was the alteration of the on farm P2 position following slaughter. The site moves caudally and laterally when the carcass is on hooks and backed down. Measurement feedback has assisted producers and district officers in correcting piggery management problems.



Officers of the DPI monitor pig carcass measurement in Queensland abattoirs. This service facilitated the introduction of description pig sales by the Queensland Pork Producers' Organization. The QPPO president Mr Denis Hinton (left) is congratulated at the initial sale by Mr John Ryley, Assistant Director-General of the Department, Dr Llew Edwards, the Deputy Premier (who opened the sale), and Mr Malcolm Capp, State manager of Dalgety-Winchcombe.

Pig seminars, field days, discussion groups. In conjunction with the industry organization and with other bodies, officers of the Pig Section were involved in the organization and presentation of a number of seminars and field days. Discussion groups formed an important part of extension work. Several of these regularly dealt with particular subjects such as piggery performance analysis and piggery business management. A producer buying group has existed at Warwick for many years offering economic, technical and social benefits. A second group has been inaugurated in Boonah along similar lines. Both groups published a newsletter for members with some input by district officers.

Farmfest 1981. At the request of the QPPO Darling Downs District Council, a Pork Chop Shop was conducted at Farmfest 81. This was operated successfully by pig producers representing all branches in south east Queensland. Alongside this catering facility, an information tent was installed housing reresentatives from DPI, QPPO, Pig Promotion Bureau, Protein Buyers and Dactel-Q-Pork. Information on many aspects of the pig industry was keenly sought by visiting pig producers.

Situation analysis. A detailed situation analysis of production in the Crows Nest area of the Darling Downs Region was commenced. The number of producers, the extent and nature of agribusiness activity and major markets were determined.

Effluent and piggery siting. Liaison was maintained with the Water Quality Branch, Shire Authorities, producers and the QPPO in matters of piggery establishment and effluent disposal. Guidelines for the disposal of effluent were published by the Water Quality Branch of the Water Resources Commission. These were supported by the Department. A model by-law was drafted by the Local Government Department. Both the QPPO and officers of Pig Section contributed.

Regulation

Swill feeding. As occurred during 1980–81, inspectors kept piggeries under regular and energetic surveillance during the year to ensure that pigs were housed and fed as required under Regulations 146 to 156 of the Stock Act. This work was deemed necessary to prevent the spread of enzootic diseases and of diseases currently exotic to Australia should they penetrate the quarantine barrier.

There was a high compliance rate by piggery owners with legislative requirements. However, 11 persons were detected illegally feeding swill to swine. Nine of these ceased the practice following receipt of official warnings from inspectors. A dairy farmer at Malanda and a man at Cunnamulla were convicted under Regulation 150 (1) for feeding animal matter to swine.

Poultry industry

Egg industry

The Queensland egg industry achieved further gains in stability, productivity and profitability in 1981–82, continuing the trend which has been evident over the last 7 to 8 years.

Further fine tuning of the hen quota system resulted in a closer match between the demand and supply of eggs on the local market than has been achieved in previous years. The system involved seasonal hen quota cuts over a 28-week period from July-August to January-February of 15% in south Queensland and 14% in central Queensland. In north Queensland, no seasonal cuts were applied and a small increase in quotas occurred as from March 1982.

It became apparent during the year that either the accuracy of sales and production forecasting will need to be improved or the current safety margin for egg production in south Queensland of 5% of estimated local demand may have to be revised upwards to provide greater insurance against unexpected variation in supply and/or demand for eggs.

Better than expected egg sales and lower than expected egg production resulted in shortages of some grades of eggs. However, alternative grades were available to consumers at all times. Significant factors causing the unexpected drop in supply were heat waves in south and central Queensland and an apparent drop in percentage utilization of quotas by producers.

Plentiful supplies of cheap grain resulted in reductions in the cost of feed during the year and these had a significant effect on profitability of egg production. Feed represents about 42% of the total cost of production of eggs. In the major egg producing area, south Queensland, the cost of layer feed decreased by $10 to $11 per tonne during the 10 months to April 1982. The estimated cost of producing eggs rose only marginally during the year. Cost reduction in the most significant input, feed, and improved productivity per bird tended to offset rises in other costs. Net return to producers in south Queensland for the eight months to March 1982 was 103.98c per dozen compared with 89.24c per dozen for the same period in 1980–81.

The structure of the egg industry continued to change in 1981–82 in line with trends which have been evident for many years. Farm numbers continued to decline but the rate of decline has slowed, being only about 4% in 1981–82. Currently there are about 300 quota holders in Queensland producing an estimated 30m dozen eggs worth around $42m annually at wholesale prices. The average size of egg farms has been increasing as farm numbers have declined. At present the average number of leviable hens per farm is approximately 5 000.

Poultry meat industry

Estimated meat chicken production for 1981–82 was 30.5m birds worth around $80m at wholesale prices. This production came from approximately 100 farms, all but six of which produced meat chickens under contract to four processors who operated in the south east corner of the State. More than 96% of meat chickens were grown under contract arrangements with processors. Meat chicken production in 1981–82 decreased by an estimated 7.6% on the 1980–81 level. This was the result of concerted action by some processors to decrease production so that large inventories of frozen stocks built up early in 1981 could be reduced to normal levels.

In the past, decreases have usually not lasted long. This has been the result of the combined effects of the production decreases and rapidly increasing consumer demand for chicken soon clearing surplus stocks. However, the situation changed in 1981–82. Consumer demand slackened and the surplus took much longer to clear than expected. The resulting downturn in chicken meat production was the most prolonged and serious of any that has occurred in the last 20 years.

The effects of the downturn were not spread evenly across all processors. Considerable discussion and negotiation occurred between the Queensland Chicken Growers' Association, processors and the Department on proposals to spread production decreases more evenly among all growers, irrespective of processor supplied, by transferring growers between processors and to control the building of new growing facilities. A limited number of transfers of growers between processors occurred but the matter of control of building of new sheds while excess growing capacity exists was unresolved.

Because of the different levels of productivity between groups of growers supplying the different processors, some difficulty was experienced by the Chicken Meat Industry Committee (CMIC) in obtaining agreement by all sectors on a 'common' growing fee. The matter was resolved late in 1981 and agreement reached to accept the principle of a 'common' fee adjusted on a 6-monthly basis. Growing fees applying during 1981–82 were 25.0c per bird for the July–December period, and 25.6c per bird for the January–June period.

The situation regarding the marketing of spent hens continued to deteriorate in 1981–82. The market for hen meat is declining and most spent hens were rendered into poultry meal or disposed of by means other than human consumption.

Production of other forms of poultry meat, including turkeys, ducks, pheasants and quail, continued to be relatively insignificant in Queensland, with most of the market being supplied from interstate. This situation is unlikely to change.

Disease

Heat wave conditions in early December and January resulted in severe losses on some farms in the Brisbane, near north coast and central Queensland areas. Production drops of up to 25% followed on many affected farms. Some farms experienced a production loss without bird losses whereas others lost both hens and production.

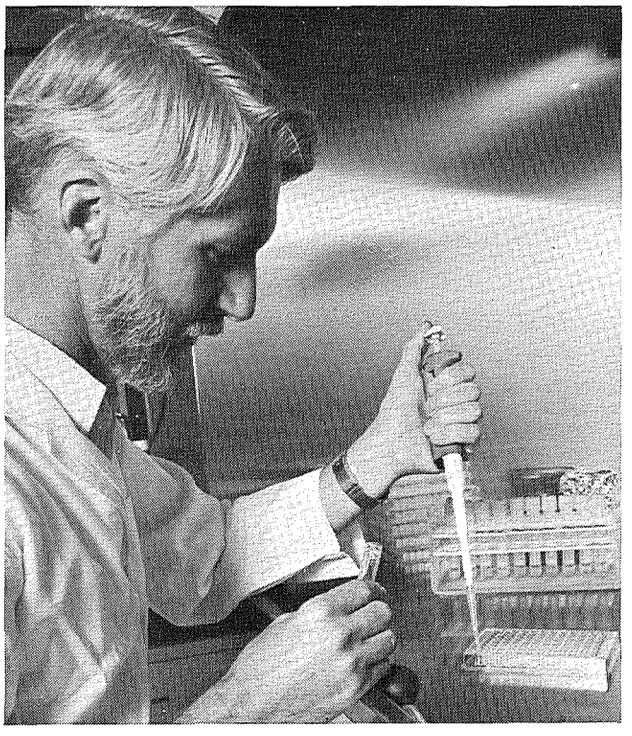
It appeared that farms that lost hens had not taken proper precautions to reduce the effects of excessive heat on the hens. Many had not tested and cleaned misting equipment. Time clocks failing to start foggers, roofs not painted, lack of foggers and fans, and failure to notice the heat had not decreased at 4 to 5 o'clock, all contributed to problems and losses.

A 15% drop in production occurred on a farm due to failure of a water valve which cut off town water and allowed bore water into the drinking lines. The layers would not drink the bore water.

Egg production drops were seen in southern Queensland in spring during October and early November. These drops ranged from 25 to 35%; took 5 to 7 days to develop and 2 to 3 weeks for production to return to normal. Management factors such as lice infestation and poor ventilation appeared to lengthen the period of the production drop. The main investigatory work was aimed at determining the involvement of mycoplasma, avian encephalomyelitis and management factors.

A flock of 5 000 layers suffered production drops following interference with the lighting programme. A check of the ration showed a low calcium level of 2.5%. These two aspects were rectified and production returned to normal.

One of the most significant disease developments was the increased awareness of the importance of infectious bursal disease (IBD) and its immunosuppressive effects. The IBD virus associated problems have been seen more on the broiler industry where there is a quick, constant turnover of chicks which can maintain high levels of IBDV in the environment. The reoviruses and adenoviruses which have caused problems this year were thought to have been secondary to infection with IBD virus.



Serotyping of avian adenoviruses is part of a programme aimed at classifying these viruses and studying their importance as a cause of disease and production loss. The project was supported by the Australian Chicken Meat Research Committee.

An outbreak of haemorrhagic infectious laryngotracheitis (ILT) occurred at the 1981 RNA show among 2 400 show fowls from 150 properties. A total of 87 fowls was destroyed. The fowls were vaccinated and quarantined at the show for 1 month. The flocks from which these fowls originated were vaccinated and quarantined. Cases of mild ILT were seen on two commercial properties. In one case, combination with chronic respiratory disease (CRD) produced severe respiratory signs which resulted in a 15% production drop. In the other case, infectious bronchitis (IB) combined with ILT to produce respiratory signs in point of lay pullets. Several mild outbreaks of ILT also were seen in fancy and backyard flocks. On diagnosis each flock was quarantined and vaccinated.

On a small layer and broiler farm, IB caused problems in broilers after vaccination was stopped because no signs of IB had been seen. Continuation of the vaccination programme has overcome this problem. IB was also seen in a flock of 5 000 replacement stock. Sprinkling dehydrated molasses on the feed successfully treated the disease.

Chronic respiratory disease was reported throughout the year. It was often associated with the introduction of stock and was often accompanied by severe drops in egg production of 30% to 50%. As CRD is known to be stress related, management procedures should be checked to remove stress. One case was due to rain entering the shed and wetting the fowls. Several small broiler flocks had problems with CRD following introduction of stock. At least one case was due to the poultry being stressed by flooding of the shed.

Inclusion body hepatitis was diagnosed in a broiler flock in the Brisbane area on histological liver lesions. There was diffuse swelling and dissociation of hepatocytes, reticuloendothelial cell proliferation in vecrotic areas and intranuclear inclusion bodies scattered in hepatocytes. Spleens exhibited a depletion of small lymphocytes and proliferation of reticular cells. The broiler flock was 4 weeks old and had been experiencing some mortality.

Tenosynovitis-arthritis due to reovirus occurred in 3-week-old broilers on a farm in the Glasshouse Mountains area. Affected chickens were runted and had enlargements above the hock due to swelling of metatarsal extensor tendons. More severely affected chickens in addition had serious arthritis and small erosions on the surface of the articular cartilages of the hock joints. Reovirus was isolated in tissue culture from the hock joint.

Higher than average losses in pullets and layers due to Mareks disease were experienced on several layer farms. Differential diagnosis of the lymphoproliferative avian tumours (Mareks disease, lymphoid leucosis and reticulo endotheliosis) is posing problems as there is accumulating evidence that their classification is no longer clearly defined.

A lymphoproliferative disease resembling Mareks disease occurred in a flock of 11 000, 42-week-old commercial layers. A total of 200 hens died over a 7-week period. No hens exhibited signs of paralysis. Post mortem examination revealed visceral tumours (including liver, kidney and thymus but not bursa). Histologically these tissues were infiltrated with pleomorphic, neoplastic lymphoid cells, as were the sciatic nerves in most cases. The hens had been vaccinated at day-old with herpes virus of turkeys (HVT) vaccine. Tissues and sera from these hens have been forwarded to the University of Sydney for further testing.

During the year, pullorum disease was not diagnosed and no positive reactors to serological tests occurred. Progress has been made towards the introduction of the early chick microbial monitoring programme for eligible breeding flocks.

Infectious coryza due to *Haemophilus paragallinarum* was diagnosed on four occasions. Two cases were seen in one commercial layer flock in the Brisbane area and another occurred on a property receiving stock from this farm. The disease resulted in an egg production drop and a 5 to 15% morbidity with birds exhibiting periocular oedema, nasal discharges and mucopurulent sinusitis. The epidemiology of this case was typical of this disease in that 'carrier' birds involved in movement from farm to farm were the major source of transmission. Treatment only affords temporary remission, that is, once established it is a recurrent disease. *H. paragallinarum* was isolated from swollen infraorbital sinuses of a flock of laying birds on the Downs. Symptoms of mucoid sinusitis persisted despite treatment. There was no particular age prevalence.

The characterization of isolates of avian *Haemophilus* spp. was carried out as part of an industry funded project with the long-term aim of developing an effective vaccine against infectious coryza. On the basis of the characterization tests performed, 43 isolates of the total collection of 69 were identified as *H. paragallinarum.* These organisms, which included four imported strains of *H. paragallinarum,* were characterized by a lack of catalase and glucosidase enzymes, failure to produce acid from galactose and trehalose, inability to grow in air and by an improved growth in the presence of chicken serum.

Another group of 18 isolates was identified as *H. avium.* These organisms, which included an imported strain of *H. avium,* possessed both catalase and glucosidase enzymes, grew in air, produced acid from galactose and did not show an improved growth in the presence of chicken serum.

The remaining eight isolates did not match the properties of any previously described organisms of this genus. Further work is continuing.

Fowl cholera was seen in a small commercial breeding flock where it mainly affected the cockerels, killing 40 out of 200. The hens appeared unaffected.

Persistent haemorrhagic duodenal enteritis was observed in a broiler flock. It was considered that the use of hardwood sawdust combined with warm humid weather provided an ideal environment for the survival of bacteria, particularly *Clostridia* sp. in the litter.

Seven thousand 6-week-old pullets housed in rearing cages suffered an outbreak of staphylococcal infection. Losses were confined to 40 chickens by prompt treatment. Toe nail clipping of subsequent batches was carried out.

Five hundred chickens 18 days of age were affected with bacterial encephalitis. A good response was noted following antibiotic (Furasol) treatment.

Losses of 50% in brooded pheasants and 90% in eggs set occurred due to salmonellosis. Antibiotic (Furasol) treatment proved effective in young pheasants at half the normal dose rate and fumigation of incubator and hatcher and better egg handling were advised.

Coccidiosis was diagnosed in many replacement pullet flocks at 6 weeks of age. Some responded to sulphaquinoxaline and others to amprolium-plus medication. It is suggested that outbreaks at this age are due to the chickens being exposed to stress in the form of heat, cold, draughts or large numbers of oocysts shortly after leaving the brooding area. Improved management and accurate monitoring of shed temperature and humidity should help to prevent outbreaks. One case of recurring coccidiosis which started in 6-week-old stock was due to the non-inclusion of a coccidiostat in the diet. Coccidiosis was also diagnosed in 2-week-old chickens in battery brooders which had not been cleaned satisfactorily between batches.

Several cases of cage layer fatigue were seen. The causes ranged from low dietary calcium to a combination of lower feed intake during hot weather and high egg production. A case of suspected 'Baygon' poisoning with leg weakness and trembling also proved to be cage fatigue.

Fatty haemorrhagic livers were noted in a flock of 14 000 layers which had up to a 10% fluctuation in lay. Biotin and Vitamin E were added to the diet but the response was difficult to determine. Investigations into the problems of fatty liver haemorrhagic syndrome in laying hens continued.

(a) Lysis of the reticulin of the liver has been defined as the primary lesion of fatty liver haemorrhagic syndrome. A total of 774 livers was examined to allow the estimation of the heritability of this condition. The heritability estimates obtained ranged from 0.00 to 0.13 depending on the method of estimation. Thus, in contrast to the level of fat in the liver (which had a heritability of 0.37), it appears that reticulolysis of the liver is not a heritable character.

(b) Liver samples from the fifth generation of genetic selection were examined for their hydroxyproline content. Histological evidence of normality, lysis or burst appearance was used to group 149 livers. Samples were ranked on their fat content which ranged from 6 to 35%. A final total of 38 pooled samples was derived by combining samples of similar fat content within the three histological groups. Total hydroxyproline content (a measure of the collagen type protein in the liver) was determined on the acetone extracted and dried material. Hydroxyproline (1.34 to 1.41 mg per g fat free matter) did not vary significantly between histological groups.

Further investigation into the relationship between liver collagen content and reticulolysis revealed no significant difference in the proportions of immature collagen between the various classes of liver. These negative results mimic those for the total collagen content. However, the spread of results within groups suggested that sampling errors between the histological and chemical studies could have caused a problem.

Future work in this area will be aimed at establishing a collagen deficiency in pathological cases of fatty liver syndrome. Liver lipogenic enzyme activities in pullets from the ninth generation of lines selected for high or low liver fat were studied as they matured. Although there were no line differences from 13 to 25 weeks of age, differing patterns of change for individual lipogenic enzymes were evident with sexual development. At 31 weeks of age, line differences were apparent in acetyl Co. A carboxylase activity but not in the other three lipogenic enzymes studied. A major line difference in plasma T3 was also apparent.

Hypovitaminosis A continued to be a problem in north Queensland with deficient liver Vitamin A levels being detected on a number of occasions. Vitamin A deficiency was also seen in southern Queensland. Several cases of Vitamin B2 deficiency causing curled toe paralysis in fowls and game birds were seen during the year. Good responses were gained by supplementation.

Heavier than normal losses were experienced in a flock of 15 000 pullets up to 2 weeks of age. The crumble being fed was designed for older birds and the younger chickens could not adequately cope with the feed size. Vitamin problems arose due to the low food intake. A soluble multi-vitamin was used for 5 days with good response.

Botulism, coccidiosis, fowl pox, and Mareks disease were diagnosed in non commercial ('backyard' and fancier) flocks. Information was sought by owners of non commercial flocks on a wide variety of conditions.

The establishment of a new specific pathogen free breeder flock at the Animal Reasearch Institute was delayed due to the appearance of antibodies to reoviruses infection in fowls reared in the new medium security shed. Corrective measures are being instituted.

Nutrition

The Department offers two types of poultry feed formulation services: (a) a manual diet check and correct formulation service; (b) a least cost diet feed formulation service. A charge of $25 per diet for the least cost diet formulation service is made to offset computing costs.

The demand for feed formulation services from producers decreased but, in contrast, there was a greater demand for overall feeding management advice. The decrease in demand for feed formulation services was due to producers' opting to buy in commercially prepared feeds. The move away from home mixing of feed can be attributed to a number of reasons including the physical burden to producers of increasing age, sounder income in the egg industry and the availability of satisfactory commercial products at competitive prices.

The emphasis has shifted to a demand from the Department for assistance in relation to feedstuff composition data, feeding practices and diet specification recommendations. In particular, an awareness of the fundamental importance of accurate measurement and prediction of feed consumption has promoted investigations both on commercial farms and at the research station.

Measuring on-farm feed consumption. It is well recognized that one of the major drawbacks to correct feed management for layers is the lack of knowledge of on-farm flock feed consumption. The range in daily intakes in southern Queensland, depending on season, is between 80 and 140 g per day for laying stock. In the commercial situation, particularly in the past, there has been a tendency to overformulate diets for winter and underformulate for summer consumption. Individual flock/age group consumption data are essential if the feed formulation is to have a real chance of providing a diet suitable for any particular flock at a particular time. A current project is studying practical on-farm methods of establishing accurate flock consumption data.

Prediction of voluntary feed consumption. If the feed consumption of laying flocks could be predicted continually over the production cycle, diets could be appropriately manipulated to minimize both excessive and inadequate intakes of essential nutrients. In August 1980, an experiment was begun at Rocklea to provide production data for the generation of models to predict the voluntary feed consumption of laying hens. The experiment will finish in August 1982. Processing has begun of data so far available.

Feed ingredient evaluation. Research continued during the year on the evaluation of our traditional cereal grains and the nutritional value of a potential new summer crop, grain amaranth.

Two varieties of triticale from six locations were analysed. For triticale AT6 (Dua), protein content (N x 6.25, DM basis) ranged from 9.8% (St. George) to 19.4% (Drillham) with a corresponding lysine range of 0.32 to 0.56%. Another variety, AT7 (Satu) followed the same pattern with a protein range of 11.0% to 19.4% and a lysine range of 0.39 to 0.56%. Gross energy content ranged from 18.2 to 18.7 MJ per kg for both varieties.

In conjunction with the Queensland Wheat Research Institute, growth inhibition in chickens fed high dietary levels of triticale was investigated. Two triticale varieties grown at two Darling Downs locations were screened for trypsin inhibitor activity and 5-alkyl resorcinol content. Trypsin inhibitor activity was detected in both triticale varieties but not at levels expected to cause growth inhibition.

Last year data on the apparent metabolizable energy (AME) content of wheat and triticale samples was given. AME was determined using a well established chick bioassay. During this year, a rapid cockerel bioassay was established which, because of a correction for endogenous energy, determines true metabolizable energy (TME). Further wneat and triticale samples are being evaluated by both techniques.

The grain of the amaranths contains essential amino acid levels much higher than those found in our traditional cereal grains and metabolizable energy levels intermediate between those of sorghum and wheat.

Seeds from pot trials at the Hermitage Research Station have been analysed. The seeds examined were from: *A cruentus* (African type), *A. cruentus* (Mexican type), *A. hypochrondriacus, A. hybridus* and *A. caudatus (edulis).* Seeds from these varieties ranged in protein content from 17.4 to 20.1%, in lysine content from 0.86 to 1.16% and in methionine content from 0.21 to 0.32%.

Early feeding experiments demonstrated that the use of amaranth grain in growing chicken diets was limited by toxicity of the grain. In this year, we evaluated the efficacy of a number of treatments in detoxifying the grain. Popping and dry heating were least effective, soaking and toasting were moderately effective, and autoclaving and boiling were most effective.

Potency decline in vitamin premixes. In north Queensland, there is a history of vitamin deficiencies being diagnosed in commercial poultry flocks. Analyses of vitamin premixes implicated in deficiencies have indicated potencies as low as one-tenth of guaranteed levels. The decline in potency is thought to be due to poor storage conditions on farms. A current experiment is examining the decline in potency of vitamin premixes stored at different temperatures and humidities in a tropical environment. Results from the joint project by Biochemistry and Pig and Poultry Branches will be used to develop recommendations for storing vitamins on north Queensland farms.

Breeding

Selection for efficiency of production in layers. A selection programme is being undertaken in which Australorps are being selected on rate of lay and low growth rate after first egg as a means of improving efficiency of production. Fowls selected in this way are being compared with fowls selected on rate of lay alone and with an unselected control line.

After two generations of selection, the lines selected on low growth rate as well as rate of production ate less feed per dozen eggs to 44 weeks of age (2.10 and 2.27 kg) than the line selected on rate of production alone (2.5 kg). The controls ate 2.30 kg per dozen eggs.

Selection for efficiency of production in broiler breeders. A flock of broiler breeders is being selected on a combination of high growth rate to 6 weeks of age and low growth rate after first egg. This selection programme is aimed at improving the efficiency of production of the broiler breeder dams by reducing obesity while not reducing growth to broiler age. Fowls in this line are being compared with a line selected on 6 weeks' weight alone and an unselected control line. After two generations of selection, the line selected for low growth rate during lay as well as high 6 weeks' weight weighed 1.23 kg at 6 weeks, 3.68 kg at 22 weeks and 4.36 kg at 40 weeks of age. The corresponding figures for the line selected on 6 weeks' weight alone were 1.24 kg, 3.69 kg and 4.51 kg and for the control line were 1.22 kg, 3.60 kg and 4.39 kg. Egg production for the three lines to 40 weeks of age were 73, 65 and 72 eggs respectively, while feed per dozen eggs from 22 to 40 weeks was 3.55 kg, 4.04 kg and 3.50 kg respectively.

Selection for high specific gravity of eggs in Australorps. Egg breakage and soft-shelled eggs are two conditions which cause an economic loss to egg producers. Both are related to the proportion of shell in the egg, a trait which is highly correlated with the specific gravity of the egg. An experiment has been concluded which examined the results of five generations of selections for high egg specific gravity measured in 36-week-old Australorp pullets.

The study demonstrated that egg specific gravity, a trait which is easily and accurately measured, responded readily to selection and should be included among the selection criteria of egg-laying stock. Direct economic benefits would result from a reduction in the number of soft-shelled eggs laid and probably in the breakage of normal eggs. An indirect benefit may also be obtained from an improvement in egg production efficiency.

Egg quality

Shell quality investigations. In addition to a significant, but largely unrecognized, loss of eggs before collection, poor shell quality is also responsible for high levels of downgrading of eggs from many commercial flocks. Observations on flocks on the Darling Downs indicated that, in summer months, of the 11% of eggs downgraded because of defective shell quality, about 75% were from cracked shells. In winter, of the 10% of eggs downgraded, about 30% were from cracks. The magnitude of this problem has led to both on-farm and research station investigations.

While the effects of high temperature as such on shell quality are uncertain, it seems likely that much of the increase in the incidence of cracks during summer may be related to an inadequate intake of calcium due to reduced feed consumption. A co-operative experiment between Poultry Section and Biochemistry Branch is evaluating three methods of potentially increasing calcium intake: (1) increasing the ground limestone level in the diet; (2) adding coarse oyster shell grit on top of the feed; and (3) providing coarse oyster shell grit as a free choice option.

Research results showing improvements in shell quality due particularly to dietary changes may not always be practical from a commercial point of view. Also any changes must be considered in the light of cost-benefit analysis comparing the increase in the cost of the diet with the resultant performance. An investigation on a commercial farm is examining the value of changing calcium-phosphorus ratios in least cost formulated diets to improve shell quality. Strain effects are also being assessed and management and analytical difficulties in this on-farm situation are being observed.

Egg breakage in the commercial situation depends not only on the strength of the shell (its ability to withstand abuse) but also on the level of abuse inflicted on the egg in the cage, in packing and in transport and grading. In co-operation with Sunny Queen Egg Farms, an investigation was conducted to determine which classes of egg, defined by several measures of shell strength, were prone to breakage under definable conditions of abuse through the progression from laying to grading. The information obtained will be used in practice to establish whether shell quality as such or management requires attention on farms where egg breakage is a problem.

Egg quality surveys. During the period under review surveys were conducted in north Queensland.

The surveys in north Queensland, conducted in both summer and winter, established local standards for aspects of external and internal quality. These will prove useful guidelines in improving the quality of eggs in the north. As in other areas of the State, the role of the retail store as a site of quality loss was highlighted. Little or no difference was found between summer and winter results for farm eggs. The surveys have shown that, in tropical environments, maintenance of albumen quality needs constant attention throughout the year.

Animal behaviour

Studies on behaviour of meat chickens under commercial conditions. The Poultry Section continued to receive financial support from the Australian Chicken Meat Research Committee for investigation of bird behaviour which is related to performance. An important aspect of these studies has been the co-operation of growers and processors with Departmental officers. This already excellent liaison was strengthened further in 1981–82 by the formation of a Broiler Behaviour Consultative Committee which has become involved directly with the planning, execution and extension of broiler behaviour research.

Two research programmes developed through this committee have begun. One programme involved feeding behaviour and feeding equipment design. As young chicks may have difficulty in accessing automatic feed pans, they are usually also supplied with scratch trays and open feed trays which require a high labour input and have the potential to allow relatively high feed wastage. With industry assistance, data collection on the design and usage of feeding equipment commenced. This data will be used in conjunction with performance data and with behavioural observations on the chicks' use of feeders to determine optimum feeding equipment requirements for meat chickens.

The second, the data collection phase of a project to obtain basic background information on meat chicken behaviour, was completed. Daily video recordings were made of a batch of meat chickens grown for 51 days on a commercial farm near Brisbane. Four cameras were used giving four separate views of the shed and recordings were made for 6 hours in every 24 hours at one-fortieth normal speed.

A great deal of useful and practical information on meat chicken behaviour has been recorded including activity and rest cycles, feeding and drinking and patterns of bird distribution throughout the shed. During its progress, an inspection of this project was made by members of the Australian Chicken Meat Research Committee.

Controlling cage hysteria. Cage hysteria in pullet replacements has been a problem of concern to egg producers in north Queensland. In an attempt to resolve the problem a series of on-farm experiments was commenced to evaluate different methods of toe nail clipping. In the first of these, the toe nail of all three forward toes on each foot was clipped at either day-old or 4 weeks of age. The third group was left with the toe nails intact.

Chickens in the untreated group were more flighty than either of the toe clipped groups. Differences in behaviour between groups clipped at day-old and at 4 weeks were small with the latter group being slightly more flighty. However, birds clipped at day-old had a substantially higher incidence of foot damage than birds from the other groups. Further experiments are being conducted to determine accurately the timing and degree of toe nail trimming for best results.

Animal welfare. In mid 1981, a poultry officer undertook a 6-week study tour of the United Kingdom and West Germany, supported by industry research committee funds, to study recent developments in farm animal welfare.

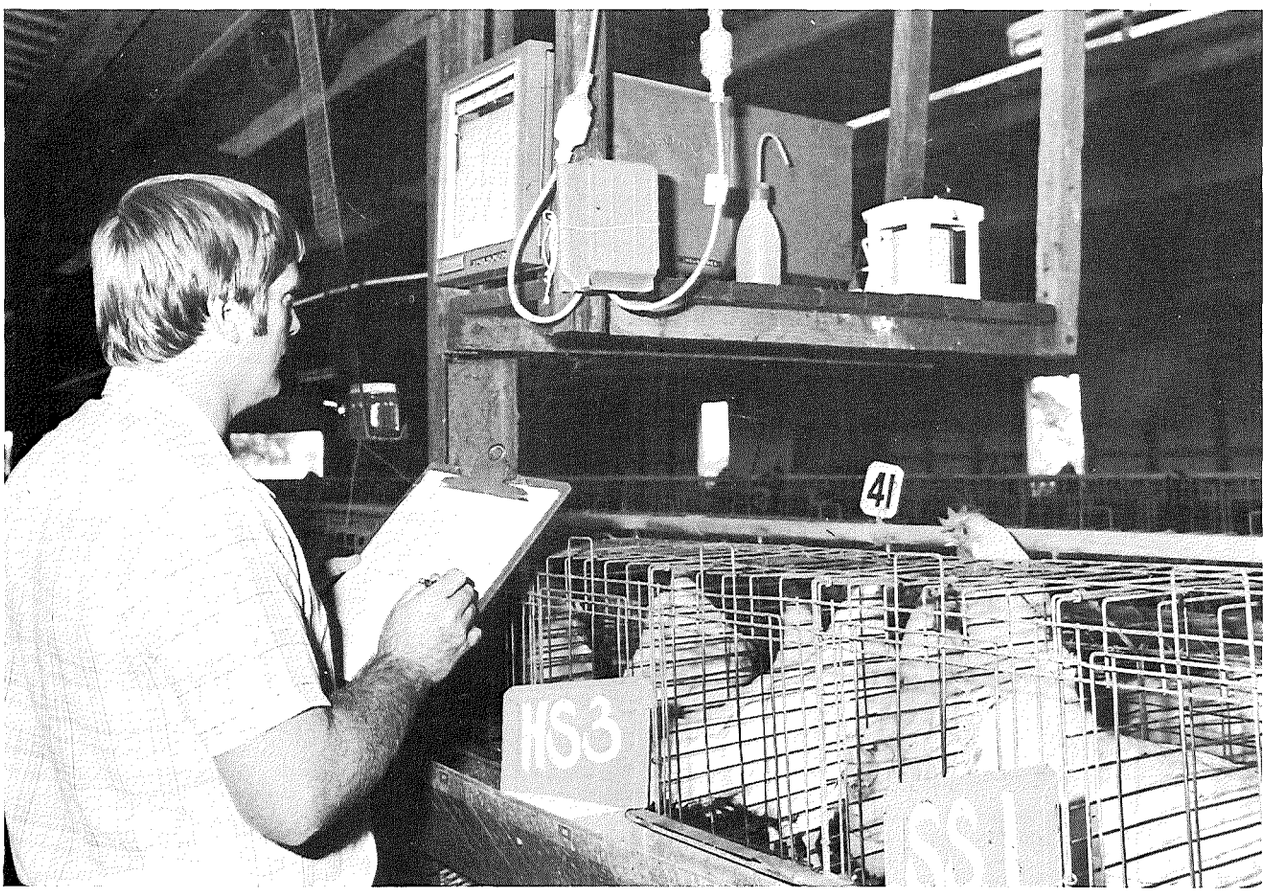
Visits were made to research projects developing alternative housing systems such as aviaries or Get-Away cages for laying hens and family unit pens for pigs. At other centres, more fundamental research was being carried out on pain perception, social stresses and fear behaviour in fowls. Discussions were also held on various national and EEC government inquiry reports and codes of recommendations concerning animal welfare which were being issued at that time. In Australia, the Animal Health Committee of the Standing Committee on Agriculture has prepared draft codes of animal welfare.

Poultry Advisory Board

Three meetings of the Board were held during the year, in July, December and June. Departmental membership on the Board changed during the year. Following the promotion of Mr J. K. Connor, who replaced Mr R. V. Byrnes as Husbandry Officer in charge of the Poultry Section, Mr Connor became an *ex officio* member of the Board.

The major items of business dealt with by the Board during the year included.—

1. The recommendation to the Minister that precepts in respect of 1981–82 should total $116,500. (Egg Marketing Boards, $68,300, licensed poultry slaughterhouses, $40,600, holders of hen quotas in non-board areas, $7,600).



Environmental conditions are monitored both at research stations and on commercial farms to obtain information on changes in the performance of poultry.

2. The completion and wide distribution of 'Guidelines for Poultry Farming in Queensland'. The purpose of the Guidelines is to provide a reference for Local Authorities, producers and others interested in the establishment and nuisance-free operation of poultry farms in Queensland. The Guidelines are to be reviewed in 1983 and updated where necessary.

3. The establishment by the Minister on the recommendation of the Board of a working party to investigate the problems associated with seasonal hen quota adjustments. The working party completed its investigations and reported to the June 1982 meeting of the Board.

4. On the importation of avian genetic material, the Board expressed concern at the apparent lack of communication between the Commonwealth Department of Health and the poultry industry regarding proposed poultry quarantine facilities at Torrens Island in South Australia. While recognizing that importation of poultry genetic material may have adverse economic consequences for some Australian poultry breeders, the Board supported in principle the proposal to establish quarantine facilities as it recognized possible benefits of improved efficiency of production. It was of the strong view that importation should be controlled by Australian commercial poultry breeders.

5. The Board supported the internal review being undertaken on Departmental services to the poultry industries and requested inclusion of a review of methods of financing services.

6. Approved changes to the objectives, membership and operation of the Poultry Liaison Group as recommended by a working party to improve the effectiveness of this group.

7. Problems in the chicken meat industry associated with uneven utilization of shedding, chicken growing contract terms and conditions, and the lack of penalties for enforcing provisions of the Chicken Meat Industry Committee Act.

Other matters dealt with by the Board included: relocation of DPI poultry reasearch facilities; pricing wheat according to protein content; controls on the export of meat and bone meal; recommendations made as a result of a New Zealand Study Tour undertaken by K. S. Orange; microbiological monitoring for pullorum disease; ILT in show poultry; seminars for chicken growers; Poultry Information Exchange; updating nutrient analysis tables; rapid methods for determining protein content of grains; Newcastle disease antibody survey; layer recording systems; egg stamping; classification of live poultry vaccines.

Regulation

Poultry Section field staff who are inspectors under the *Poultry Industry Act* were involved in the following activities during the year.

Inspections were made of 17 hatcheries and the premises of 16 poultry dealers, 13 started pullet suppliers and 5 fertile egg suppliers. Re-registration followed a satisfactory inspection report. One hatchery operator elected to cancel his licence.

Staff bloodtested 16 278 fowls on 22 properties for pullorum disease. There were 74 000 birds in these flocks. Seventeen flocks were subject to sample testing and 16 flocks were completely tested. Eight candidates met the prescribed requirements of examination and practice to be registered as pullorum testers.

Five licensed chick sexers were operating during the year. One sexer renewed his licence but did not operate. Returns of chickens sexed for the year ended 30 November 1981 showed that 2 653 509 chickens were sexed compared with 3 482 165 in the previous year. This downturn in sexing of 24% followed a decrease in the previous year of 13%, and reflected increased sales in Queensland of New South Wales hatched day-old pullets and quota cuts.

Thirty licensed egg pulping premises operated during the year. Only one of these was licensed to pasteurize egg pulp. Inspections showed that most were being satisfactorily maintained. A few owners were required to make minor improvements.

The degree of compliance with the requirements of the Egg Marking and Grading Regulations as indicated by the number of breaches reported was satisfactory.

Extension

The pullet management recording study remained in a developmental stage. Consultations have been held with representatives from other States to develop a uniform approach to recording schemes, and it is expected that a number of States will implement a common basic package in the near future.

The layer farm management recording study which began in New South Wales in 1970 was developed on a national basis. Seven Queensland producers joined the study and were enthusiastic about the information they received. Producers can compare their results with group average results and so determine areas of deficiency. The limit to expansion of the study lies in the ability of producers to keep satisfactory records.

Variable quota management was of major concern to southern and central Queensland producers during the year. Workshops-discussion groups were held in central Queensland, on the Darling Downs and in Brisbane to explain the principles of replacement programming for long term management stability. Many producers still faced management problems in their replacement programming due to their lack of forward planning.

Surveys on production costs of eggs in south east Queensland and central Queensland were reported. Following changes to the south east Queensland model, it is planned to transfer the physical task of updating the quarterly costs of production to the Executive Officer of the South Queensland Commercial Egg Producers' Organization. This will leave the Poultry Section with the role of providing advice and technical knowledge to that organization's Cost of Production Committee.

The Poultry Industry Group, whose objectives are to identify extension and research needs and facilitate co-ordination and communication, met twice during the year. Under its review, major emphasis was given to extension projects and investigations in the following areas: reducing losses due to egg shell damage; improving understanding of the effects of nutrient intake on layer performance; co-ordinated disease prevention and control; development and use of physical and financial recording systems to improve decision making in poultry production; and spent hen disposal.

Newsletters continued to play an important part as communication medium for extension. The monthly newsletter 'Birdwise' was prepared and circulated to producers on the Darling Downs and in the Brisbane region with responsibility for its production being shared by Brisbane and Toowoomba staff. 'Featherfront' was produced quarterly in Townsville for distribution to producers in north Queensland.

Producer discussion groups continued to be active on the Darling Downs, on the near north coast and in central and north Queensland. Staff have also been involved in producer organization monthly meetings in all areas.

The Ninth Poultry Information Exchange (PIX) was held for 2 days in November 1981. The 206 registrations, compared favourably with those in previous years. In general, the topics selected for the programme were appropriate. However, there was some criticism of the number of topics included and the structuring of the programme. Planning for the next Exchange in March 1983 commenced and deficiencies evident in the 1981 Exchange have been brought to the attention of the joint poultry industry-DPI organizing committee.

Horses

While no unusual major disease problems occurred in horses during the year, a range of interesting cases was observed.

Outbreaks of strangles were reported from Caboolture, Rosewood, Amberley, Beaudesert, Warwick, Biloela, Torrens Creek, Longreach and the Noosa Shire. On one property, strangles also occurred in previously vaccinated horses when 80% of a herd of 80 quarter horses were affected.

Equine Infectious Anaemia (EIA) is enzootic in the Mackenzie and western rivers systems, while sera from 21 of 27 horses sampled at Donors Hill (Burketown) returned positive results to serological tests for this disease. EIA was also confirmed in an 8-month-old foal at Warwick. The foal's dam originated in western Queensland and was serologically positive for EIA suggesting congenital transmission since EIA is not endemic in the Warwick area.

Aleukaemic lymphosarcoma was diagnosed in a 10-year-old thoroughbred stallion with a history of sudden weight loss, oedema of the prepuce and scrotum, and generalized enlargement of superficial lymph nodes. A biopsy on a cervical lymph node revealed changes consistent with lymphosarcoma. There was complete obliteration of normal lymph node structure by uniform sheets of small lymphocytes, invasion of the capsule and a high mitotic index. The animal was destroyed and at post mortem examination there was marked enlargement of mediastinal, mesenteric, mandibular, prescapular, inguinal and posterior cervical lymph nodes. The white cell count was 6.9×10^9.

A stallion at Kalbar died after ingesting stable floor shavings containing lead.

Horses on properties in central Queensland developed signs of osteodystrophia fibrosa (ODF) following the grazing of buffel grass. Owners are generally advised to withdraw affected horses from offending pastures or feed a bone meal-molasses mixture. At Maryborough ODF developed in horses that had been grazing kikuyu grass and *Setaria* sp.

Investigations into the cause of equine nutritional secondary hyperparathyroidism (NSH) have concluded. A large proportion of the calcium in high oxalate grasses is present as intra cellular calcium oxalate crystals which are not absorbed by horses. The soluble oxalate in the grasses has a smaller and variable effect in depressing absorption of the remaining calcium in the grasses, probably because calcium and oxalate ions do not crystallize extensively in intestinal fluids as they do in plant sap. The bulk of experimental findings has been published.

The disease is cured by feeding calcium plus phosphorus supplements. The best indicator of hazard to horses is a calcium to oxalate ratio of less than 0.5. A technique recently developed by the Victorian Department of Agriculture suggests that urinary calcium and phosphorus concentrations can be used to diagnose NSH in thoroughbreds when related to creatinine clearance or osmolality of the urine (in order to allow for differing urinary volumes). This shows promise for use in detecting NSH caused by oxalates.

Combined immunodeficiency complicated by crytosporidiosis was diagnosed in an Arab foal at Oakey. The 23-day-old foal died during an exploratory laparotomy performed because of severe abdominal distension following a short period of scouring. Histologically there was lymphoid hypoplasia and a severe mucopurulent enteritis involving the small intestine. Large numbers of *Cryptosporidial* organisms were adherent to the epithelium of the small intestine.

An ataxia syndrome was observed in three horses aged 3 to 14 years from neighbouring properties at Carseldine. One animal showed marked hindlimb inco-ordination with an uneventful recovery in 72 hours. The other two animals were more severely affected for longer periods of time (4 weeks in one case). These animals eventually collapsed and were unable to rise and were destroyed. Histological examination of the spinal cord showed marked Wallerian degeneration, particularly of the lateral and ventral white matter tracts.

Bacterial septicaemias in foals due to Salmonella and *Actinobacillus equuli* were seen on a number of occasions.

Streptococcus zooepidemicus, Pseudomonas sp., *E. coli, Pseudomonas aeruginosa, Alcaligenes* sp. were each incriminated as the cause of metritis cases in thoroughbred mares on the Darling Downs.

Actinobacillus suis, haemolytic *E. coli, Klebsiella pneumoniae, Streptococcus bovis, E. coli,* and *Pseudomonas aeruginosa* caused abortions in thoroughbred mares.

Veterinary public health

The name of the Slaughtering and Meat Inspection Branch was altered during the year to Veterinary Public Health Branch, in recognition of the wide ramifications of its responsibilities.

Slaughtering

Seasonal and marketing conditions and shortages of stock resulting from de-population practices of graziers led to a limited export cattle killing season. In most seasonal works, particularly in north Queensland, the killing season closed relatively early in 1981, and opened later than usual in 1982. Some did not commence killing until after Easter. Borthwick's Brisbane abattoir and the Roma meatworks, previously closed, did not reopen. There is little prospect of the former ever operating again, and the future of the latter remains uncertain.

All other export abattoirs continue to function though industry is very concerned about abattoir profitability and over capacity of killing facilities. A need for positive action to reduce killing capacity is becoming more and more evident.

Satisfactory throughput at non-export abattoirs was maintained. There has been a trend towards greater usage of these at the expense of domestic throughput at export abattoirs, due to the higher costs of production, accentuated more and more by export demands for higher security.

Feed lot cattle for the domestic market continued to be in demand, with use of the feed lot identification and carcass marking system continuing to be a success story, for trade and consumer benefit. Generally good trade cattle suitable for the domestic market were readily available at reasonable prices to the meat trade and consumer.

Meat inspection

Proposals for unification of Commonwealth and State meat inspection services were again discussed by the Australian Agricultural Council in August 1981, without resolution. There is no clear indication of progress of the investigations being undertaken by the Commonwealth and Victoria into integration of the two services within that State.

A week long strike by Commonwealth Inspectors, over a pay claim, took place in November 1981, causing considerable dislocation to industry. With co-operation of management, State inspection continued at those export abattoirs where State inspectors are part of the inspection complement. This allowed a percentage of normal throughput to be devoted to domestic slaughterings, under the same standards that ordinarily operate. However, efforts at Industrial Commission level failed to achieve the use of State inspectors for processing of additional domestic throughput or for manning of Cannon Hill abattoir where Commonwealth inspectors have sole responsibility.

This strike led to further consideration being given to State inspectors being made part of the inspection complement at Cannon Hill, commensurate with domestic-export throughput. As well, further consideration was given to the State assuming the role of export meat inspection, with an exercise being conducted in regard to numbers of inspectors that would be required. A theoretical saving of some 10% at least seems quite feasible, but difficulty would be expected in obtaining industrial acceptance by the present Commonwealth Meat Inspectors' Association.

These matters are held in abeyance, pending the outcome of the Royal Commission into the Meat Industry. The Commission was set up following the export meat substitution scandal in Victoria, involving horse and kangaroo flesh. The Royal Commission was agreed to by both the Commonwealth and Victoria, with Queensland participating only if allegations of malpractices within this State could be proven.

The Director of the Veterinary Public Health Branch gave evidence before the Commission regarding general matters pertaining to meat inspection and of two incidents regarding alleged malpractices. A District Inspector also gave evidence regarding one allegation. Relationships between Commonwealth and State officials have become somewhat strained because of these circumstances.

A sequel to the 'scandal' is increased security measures now being adopted by the Commonwealth, at great cost to industry and the taxpayer and involving appreciable increase in Commonwealth inspectorial staffing. Many of these security measures, which include species testing, carton sealing, obliteration of Australia Approved stamps, prohibition on use of State inspection legends, security sealing of cold rooms, cold stores and meat transports, and entry of meat into public meat markets, together with varying interpretations on their application in practice, have caused considerable difficulties and added expense associated with domestic meat movements.

Measures were introduced by the Commonwealth without consultation with the State, seemingly with concern only for export with little appreciation of the domestic meat marketing situation. Challenge has been made to the application of some measures.

Further, such measures have given rise to initiatives by the Commonwealth Meat Inspectors' Association to endeavour to ban State inspectors from certain tasks they were previously performing. This has resulted in industrial disputes at a number of meatworks, leading to duplication of services by the Commonwealth, at further extra cost to the taxpayer. This has caused more friction between the two services.

Industry liaison

Although being nominally inspectorially orientated in administering the provisions of the Meat Industry Act and Regulations, the State Inspection Service takes pride in its extension and advisory approach. It adopts the policy and practice of involving industry in its decisions and actions and has close working liaisons with producer, processor, butchering and consumer groups.

There has, to date, been no cause to call together a 'complaints tribunal' that was set up by Cabinet several years ago. There is a close working relationship with the Queensland Meat Industry Organization and Marketing Authority, particularly in the fields of carcass classification and consumer identification.

Slaughtering facilities

The Sunshine Coast Regional Meat Area became fully operational during the year. Slaughterhouses at Caboolture, Landsborough, Eumundi and Cooroy and abattoirs at Maleny and Gympie were upgraded. Full time inspection was provided at all establishments with one inspector being shared between two slaughterhouses. This has not been without problems, due to slaughterings beyond prescribed limits. It has also been a costly exercise, with necessity to cater for overtime and to include provision for costly relief.

Large scale renovations and additions took place at the Ipswich Regional Abattoir during the year. A modern small stock slaughter floor was provided, together with a large boning room and chiller complex for a large retail chain operator. Some sections of a Kingaroy plant still require attention, including the provision of additional chiller capacity.

Additions were completed at Capricorn Meats, Rockhampton, involving a butcher's shop and chiller. Inspection of introduced meats can now be done satisfactorily at the abattoir. The Calliope River abattoir at Gladstone will not reopen. Deficiencies at the Townsville Public Abattoir were raised with the Board and Queensland Meat Industry Organization and Marketing Authority, and it is understood plans are in hand for necessary corrections.

Routine inspection of slaughterhouses continues. Every effort is being made to increase the amount of meat inspected. Generally standards are satisfactory. At Cloncurry, upgrading to Class 1 standard continues. Consideration is being given to the establishment of a Regional Meat Area in the Mount Isa region. Pigs for the Maryborough region continue to be killed at a slaughterhouse, under inspection. The Rosewood slaughterhouse has been re-licensed as a knacker's yard.

Water testing for potability standards is carried out routinely. A number of unsatisfactory findings have been made, with prompt action taken to correct by way of chlorination or prohibition of use of that supply.

Increased throughput at some abattoirs has seen need for increase in inspectorial staffing, mainly at Ipswich now requiring 9 inspectors (previously 5), Kingaroy 4 (previously 2), Killarney 4 (previously 3), Capricorn Meats 3 (previously 2). Those have come from re-deployments rather than from staff increases.

Numbers of deer being presented for slaughter remain small. Apparently local demand is limited and competition is evident from New Zealand venison.

Poultry slaughterhouses. An oversupply of frozen poultry occurred during the year due to large consignments arriving from interstate. The industry used the market place to eliminate their stocks by offering 'specials'. Influenced by the large numbers involved, the sale of chilled birds dropped accordingly. Such was the impact on the market that two major processors for a short period reduced their kills from 5 to 4 days a week. The latter part of the year saw the firming of prices and the return of consumer demand for chilled birds.

A new high standard Class 1 premises at Glasshouse commenced operations. Several premises in the metropolitan area have effected improvements during the year. Plans are in hand for a new Class 2 slaughtering establishment for turkeys at Beenleigh.

Country slaughterings remain depressed due to cheap frozen poultry. In the north, production is very low although premises are being maintained. One Class 3 slaughterhouse at Bowen opened. Despite the depression a new poultry slaughterhouse commenced operations at Bundaberg. In the Toowoomba area, the Authority has given approval for construction of a Class 3 slaughterhouse for game birds only.

During the year, one establishment exceeded the maximum allowable water uptake with an unsatisfactory result of 9.21% on one occasion. Subsequent tests were satisfactory.

Butchers' shops and smallgoods establishments

All Class 2 premises are of a satisfactory standard. All those in the Brisbane region now have satisfactory maintenance programmes. The retail meat market concept at Mount Gravatt appears to have been a complete failure. Only three section shops opened and all closed after a short period. The premises are to be demolished or used for other purposes.

The trend in butchers' shops has been towards new shops opening in holiday and mining areas and some established shops closing apparently due to competition from supermarkets. Prewrapped meats continue to be popular, particularly in holiday areas and supermarkets. Few butchers yet take the opportunity to sell products other than meat.

Species testing was adopted as a routine procedure during the year. This is seen as an aid to good meat inspection practice rather than a substitute for it. It will be used with discretion. Officers collected samples of meat introduced from interstate, from the products being used for smallgoods manufacture and from minced products sold in butchers' shops. No cases of meat substitution were detected during the year.

A serious outbreak of salmonellosis in humans in Victoria caused by contaminated salami resulted in a marked drop in consumption of both the local and interstate product. Samples from both taken in Queensland were negative. The episode produced an awareness in industry in Queensland of the need for strict practices to prevent similar happenings.

Little change was noted in market trends. Toowoomba retailers specializing in feed lot beef, extended operations into Brisbane where they opened a large shop selling pre-wrap meats, counter sales and products other than meat permitted under the regulations. Bulk meat sales appear to be increasing again, possibly due to the availability of good cattle following the drought last year. Electrical stimulation of carcasses at the Metropolitan Regional Abattoir may have helped.

Pet food. Pet food trading continues to be of great importance although numbers of kangaroos reaching depots declined following the loss of southern markets partly associated with New South Wales regulation changes, the Commonwealth sales tax levy and the export substitution scandal. The numbers of outlets increased during the year particularly in country areas.

Pet food sales may be of greater importance in butchers' shops than previously realized as butchers' representatives claim that pet food represents up to 30% of sales. Negotiations between interested parties to allow sales of frozen raw pet food wrapped and sealed in flexible film in the grocery section of chain stores continued.

Liquidation problems forced the closure of the export field shot game meat processing works at Hamilton. The premises reopened quickly under new management.

Proposed amendments to regulations under consideration in accordance with uniform Australia wide standards, requiring the dyeing of pet food with brilliant blue, should enable tighter control in regard to identification of pet food.

Meat market activities. Some interesting features of trading were noted during the year. There has been a further trend towards increased trading in locally produced and interstate carton meats, particularly the chilled vacuum packaged product. Early in the year, the importation of rumps from New Zealand was a feature of the trade but good supplies of local cattle and cartons of primal cuts and quarters from southern States caused this trade to cease towards the end of the year. Large amounts of mutton trimmings were imported from New Zealand during the year, along with some venison.

Small amounts of lot fed and electrically stimulated carcasses were introduced from New South Wales and Victoria and branded after satisfactory identification procedures were established.

Difficulties have been experienced with introduced meats where meat markets are on export premises, particularly at Mackay. The establishment of the new complex at Capricorn Meats has eased the reinspection problems which previously occurred at Rockhampton.

Further evidence was accumulated during the year to indicate that reinspection of meat after long distance transport continues to be essential. Cases were revealed of fibre glass contamination due to vehicle accidents and contamination due to collapsed rails, broken ropes, metal fall out and wooden partitions. Putrefaction due to poor refrigeration was occasionally found. A few cases of poor dressing and faecal contamination were taken up with the appropriate authorities. Faults in trucks were taken up with the transporters.

Reinspection of smallgoods revealed serious problems in the wholesomeness of the product from one major interstate source. Temperatures of 12°C were detected on arrival in Brisbane with putrefaction, gas production and 'off' odour being evident. Over 600 cartons were condemned. Immediate action on the first occasion resulted in improvement but problems recurred. Close surveillance is continuing.

The abolition of reinspection fees for interstate meat from New South Wales and Victoria on which a State fee has already been paid has been applauded by industry.

Disease control

Disease control activities were carried out at 40 meatworks throughout the State. Partly due to pressure from meat industry representation, a hydatid liver survey has been commenced in selected State controlled works. Six slaughterhouses now under full time meat inspection have been included in the disease control programme. Disease control officers' duties include collection and preparation of tuberculosis-like lesions and general pathological conditions, collection of blood samples for brucellosis testing, recording of slaughterings and condemnations plus participation in various trials relating to specific diseases and conditions.

A 3-day trial was conducted at Mackay Freezing Works to determine whether two additional categories, that is, extra deep and extra heavy deep, could be added to the existing categories in the Australian Carcass Bruise Scoring System. A request for a more accurate coverage of severe bruising had come from the work's management and a State officer conducting classification and bruising assessment trials at Mackay. The analysis of results of the trial is not yet available but it does appear that, in the light of the severe bruising seen at Mackay, the existing categories are not sufficient to assess this type of bruising accurately.

Meat quality

Grading and classification. Staff continue to supervise and conduct grading and branding of carcasses. To ensure that grading procedures are of a consistent standard and to familiarize supervisors with the new colour branding system, a meeting of inspectors from south east Queensland was held in March 1982. Basic standards and discussion were circulated to all staff.

Pig carcass classification is now conducted at 12 works, which are accredited by the Queensland Meat Industry Organization and Marketing Authority. Only abattoirs on this list are approved for slaughter of pigs sold through the sale by description auction. Most pigs killed in Queensland have their back fat measured with the introscope. Monitoring and supervision of this measurement service are carried out by meat inspectors. Accuracy of measurement is generally satisfactory.

Consumer meat identification. Funds were made available during the year from the Australian Meat and Livestock Corporation, the Queensland Meat Industry Organization and Marketing Authority and this Department to promote the new colour system of branding meat. The aim of the system is to increase the sales of red meat by improving public confidence in the product. A condition imposed by the Australian Meat and Livestock Corporation on their allocation of funds to this project was that it be concentrated in the Brisbane, Ipswich and near North Coast areas, and be conducted as a pilot study of the system with a view to national adoption.

The major changes to the previous strip branding systems were to discontinue the use of blue, which was replaced by red to brand young beef and lamb, and to use orange to brand meat which is electrically stimulated or tenderstretched. This change to 'meat compatible colours' was made in response to trade complaints about difficulties due to finding specks of blue dye in mince and to blue being used to replace methyl violet for pet food identification. Purple is still used for lot fed beef, and green has been allocated to hoggets.

Future newspaper, radio and other advertising will publicize the tenderness benefits of electrically stimulated and tenderstretched meat.

Interest in the new colour brands has spread to country centres. Rockhampton, Mackay and Gympie have indicated that they intend to launch meat branding. The promotion is increasing interest in electrical stimulation. When branding is commenced in any new works, it is policy to insist that ageing by dentition be done to determine eligibility for a brand.

Lot fed beef. This type of beef is still in demand by consumers, but, in some country areas, the price asked seems to discourage sales somewhat. The 'Stockyard' media promotion seemed to successfully increase the demand for lot fed beef.

During this year, a few reports were received concerning 'unfinished' animals in drafts from feed lots, which were identified with purple tail tags. The Queensland Meat Industry Organization and Marketing Authority circularized all feed lot operators about the undesirability of this, and the problem seems to have been resolved.

From July 1982, all wording will be eliminated from the lot fed brand, and the purple colour only will identify lot fed beef. Coinciding with the new meat branding system, the minimum fat level for branding as lot fed was increased from 3 mm to 4 mm at the twelth to thirteenth rib level.

Electrical stimulation. Three Queensland abattoirs now have 'on line' high voltage stimulators for use on beef carcasses—Kilcoy; MRA Cannon Hill; and Tancreds, Beaudesert. The first two stimulate whole carcasses before splitting, while the Beaudesert works stimulates sides of beef.

The use of extra low voltage (ELV) equipment is spreading. This is of three kinds—rectal probe, nasal probe to rectal probe, and nasal probe to shackle. All use 45 volts, which is quite safe. Currently, the only nose to shackle equipment is imported, and costs $8,000. An Australian device is being developed in collaboration with CSIRO. When available, this will be much less expensive. ELV equipment is especially suited to small establishments.

Because of the current meat identification publicity, officers are keenly aware that meat which has not been properly stimulated or tenderstretched should not be branded orange. Incorrect stimulation can occur if there is a malfunction of the equipment or too great a time interval between slaughter and stimulation. When this occurs the red colour is used indicating simply young beef.

Interest is being fostered in stimulating sheep and some steps have been taken towards the practical implementation of this.

Lamb classification and branding. Lambs are now defined in the Commonwealth Exports (Meat) Regulations as not having erupted any permanent teeth, and where possible lambs submitted for branding are aged by dentition. The Commonwealth Department of Primary Industry has accepted responsibility for identification and has so instructed its inspectors. In the interests of national uniformity the Queensland lamb brand has been altered to resemble the New South Wales brand by adding a line to each side.

Carcass classification

During the year, the carcass classification trials at Kilcoy and Bundaberg were terminated, as it was considered that they had achieved their purpose. Two new trials were commenced at Thomas Borthwicks, Mackay, and at Teys Brothers, Beenleigh. These trials, which are being conducted by the Authority in conjunction with Veterinary Public Health and Beef Cattle Husbandry Branches, are placing more emphasis on usage of carcass classification information for the purposes of trading in beef, and for estimating yield.

An officer conducted a trial on the correlation between dentition and spinal ossification as methods of ageing beef carcasses for branding. One thousand animals were examined. The results were startling. An appreciable number of milk tooth heifers would, if ossification were used as the criterion, be ineligible for any brand, that is, they would be classed as over 3½ years old. As well, a significant number of 8-tooth steers would receive a 'yearling' brand when aged by ossification.

This project is being written up in detail, and more extensive trials, including chronological age as well, are being conducted throughout Queensland in co-operation with the Beef Cattle Husbandry Branch. This information has resulted in ageing by dentition being favoured in export trading. Also, officers successfully supported the cutting and measuring of fat thickness rather than assessment, to include as much objectivity as possible in the grading system.

A proposal by the Pig Working Party of the National Carcass Classification Supervisory Committee that Commonwealth Department of Primary Industry inspectors and some 30 specially trained 'checkers' from the Australian Meat and Livestock Corporation take control of training, supervision and monitoring of pig carcass measurements (introscope) in export and other abattoirs is strenuously opposed, mainly on three grounds—

1. The cost of the service would increase.
2. The fragmentation of the service would make it less efficient and less acceptable to industry.
3. At present the system is controlled by the State Veterinary Public Health Branch and is running well in all areas. No change is necessary.

Queensland is now represented on the National Carcass Classification Supervisory Committee by only one representative, Mr J. Hall, of the Queensland Meat Industry Organization and Marketing Authority. Departmental officers are kept informed of developments and maintain a close watch on the national scene.

Extension and liaison activities

Officers have been active in addressing interested groups on various activities.

The Meat Quality Officer, Mr J. Beames, addressed the Meat Industry Committee of the National Party on the new consumer meat identification system, and they expressed their support. He also spoke to the Food Science Class at the Queensland Institute of Technology on the same subject. Other interested groups have also been addressed. Several radio tapes which have been broadcast throughout the State were made.

Some international visitors were shown through various meat establishments. Three meat inspection and public health officials from Thailand and Vanuatu exchange students were catered for.

District Inspector L. J. Brown judged the Department of Primary Industries–Woolworths beef bone-out carcass competition for the RNA, and also judged the super-pork bone-out event. Other officers acted as stewards. Mr J. Beames judged the Porker Carcass section for the Toowoomba show, and country officers have been nominated as judges for various country shows in carcass events. District Inspector K. Crotty has been appointed assistant council steward in the beef carcass sections of the RNA. The Meat Information booth at the RNA was well patronized.

Problems and investigations

Post mortem detection of arthritis in pigs is being investigated in collaboration with meat inspection services in other States. It is expected that more rational inspection judgements of affected carcasses will result.

The outcome of investigations into meat inspection procedures has been the introduction of new procedures for carcasses inspected solely by State inspectors. The new procedures are more efficient and less inclined to spread contamination from one carcass or its parts to another. Under the auspices of the Sub Committee of Veterinary Public Health, similar procedures have been, or will be, adopted in other States. The Queensland meat inspection service has led the rest of Australia in this matter.

Problems reported last year with mechanically deboned meat appear to have been ameliorated following greater industry awareness of the need for proper handling, particularly temperature control.

Poisonings and mycotoxicoses

As in previous years, poisonous plants, chemicals and mycotoxins were significant causes of sickness and deaths in livestock. In the poisonous plant field, a considerable amount of work remains to be done in identification of toxic species, clarification of gross and microscopic pathology to aid in diagnosis and pathogenesis, and identification of toxic components to aid in treatment and prevention.

To achieve these ends, two Divisional teams of laboratory and field staff were established to escalate investigations of two long standing problems, namely, sawfly larvae (*Lophyrotoma interrupta*) intoxication in the Roma-Injune area and gidyea (*Acacia georginae*) poisoning in the north west of the State.

The Poisonous Plants Committee continued to review stock losses from poisonous plants and research programmes investigating plant toxicoses. The death of Dr S. L. Everist (the former Government Botanist) a member of the Committee is deeply regretted.

Poisonous plants

Losses in stock. A herd consisting of 140 Hereford x steers grazed for 12 h on a grass pasture contaminated with *Bryophyllum* spp. Four were found dead after this period and the rumen was found to contain large amounts of *Bryophyllum tubiflorum* and *Bryophyllum tubiflorum* v. *daigremontianum*. A further two cases

of *B. tubiflorum* v. *diagremontianum* poisoning were confirmed: one at Tambo where four Santa Gertrudis cows died and one at Pittsworth in which 10 Hereford yearling steers died after being turned out of a grassed paddock into a dry and poorly grassed enclosure in which Bryophyllum was growing.

Bracken fern (*Pteridium esculentum*) toxicity occurred on a number of farms in the coastal areas around Burrum Heads, Pomona, Dayboro and Numinbah Valley. It was generally diagnosed on clinical signs and depressed leucocyte and platelet counts.

Lantana (*Lantana camara*) poisoning was investigated at Gatton, Beaudesert, Canungra, Bohle, Helidon, Toowoomba and Crows Nest.

Outbreaks of St. George disease were reported from the Bollon-Surat area where seasonal conditions were dry and also in a herd at Thargomindah. A more unusual occurrence of St. George disease occurred at Longreach. Typical clinical signs and pathology were present in six cattle of 150 grazing Mitchell grass downs and gidyea scrub. *Pimelea trichostachya* was identified on the property.

On a property near Gympie, three animals from a total of 300 died suddenly after being driven. On post mortem the rumen was found to be grossly distended with the fruit of *Castanospermum australe*. There was a severe enteritis involving the small and large intestine but especially the colon. Clinically the animals showed a severe diarrhoea. The kidney had a mild nephrosis. *Passiflora subpeltata* toxicity was suspected during August on two properties at Rathdowney. Eight cattle were affected on one property and six on the other with most affected animals dying. Clinical signs were inco-ordination and blindness. Significant Wallerian degeneration was found in the brain and cord from an animal off one property but not from the other.

At Richmond four cattle died after having been mustered into yards containing native leek (*Bulbine bulbosa*).

Six of a mob of 200 cattle at Roma died following the ingestion of marshmallow (*Malva parviflora*). Samples of the plant contained 8.3% potassium nitrate on a dry matter basis.

Yellow-wood (*Terminalia oblongata*) poisoning was incriminated as the cause of renal damage in slaughter cattle from a property at Clermont. Reports of losses in young cattle from yellow-wood poisoning were received from adjoining properties.

Clinical signs of grass tree (*Xanthorrhoea media*) poisoning were observed in cattle at Beaudesert. Six mortalities and sickness in six other animals occurred at Goomeri after cattle grazed a heavily infested paddock.

One cow died at Beaudesert and another at Thornton after having ingested poison peach (*Trema aspera*). Noogoora burr (*Xanthium pungens*) poisoning caused the death of a heifer at Booval. A cow died at Warril View following access to ryegrass.

During 1981, sawfly larvae (*Lophyrotoma interrupta*) were again the cause of extensive mortalities of cattle in the Maranoa and St. George districts.

Nine of 140 dairy cows died at Samford. Typical symptoms were mild salivation and ataxia followed quickly by recumbency and death within 24 hours. Lesions in one cow were very severe oedema, necrosis and haemorrhage affecting the posterior half of the small intestine. Two other cows autopsied had only mild congestion or oedema of the small intestinal mucosa.

At the time of the problem, this property was feeding brewer's grains and processed vegetable waste (beetroot, peas and carrots). Effluent from these feeds which accumulated in a drain running through the paddock was collected and drenched daily to a steer. On the third day of drenching this steer appeared ataxic then lost control of all four limbs and fell in lateral recumbency with signs of very severe dyspnoea; it died within 10 minutes of first showing symptoms. Very severe pulmonary oedema was seen at autopsy. The above syndrome was suspected to be caused by a toxin in the effluent possibly produced by bacterial or yeast activity.

Thirty-five sheep were condemned out of a group of 1 035 slaughtered at Toowoomba abattoir. Gross changes seen were jaundice and swollen livers and gall bladders. Microscopically there was biliary retention in hepatocytes and nephrosis. The sheep had been held at Toowoomba abattoir for 7 days before slaughter where they had been eating lantana.

Outbreaks of humpy back were recorded on four properties at Winton, Thallon and Cunnamulla. Diagnosis was based on consistent clinical signs and histological changes of Wallerian degeneration in the spinal cord. This condition is thought to be due to ingestion of the berries of *Solanum* spp. though this has never been conclusively proved by feeding trials.

Horses on properties in central Queensland developed signs of osteodystrophia fibrosa (ODF) following the grazing of buffel grass. Owners are generally advised to withdraw affected horses from offending pastures or feed a bone meal-molasses mixture. At Maryborough, ODF developed in horses that had been grazing kikuyu grass and *Setaria* spp.

Fifteen of 40 horses developed selenium poisoning on a property near Hughenden after ingesting *Neptunia amplexicaulus*. Dry seasonal conditions predisposed to the outbreak.

Birdsville disease was diagnosed in two horses near Charters Towers that had access to *Indigofera linneai*.

White cedar (*Melia azedarach*) poisoning was diagnosed as the cause of death of a 5-month old foal at Warwick.

Crotalaria medicaginea poisoning was diagnosed in stock-horses on Marble Island off the central Queensland coast. Four horses from a herd of 30 died over a period of 1 month after showing clinical signs of chronic wasting, dysphagia, depression and dehydration. Post mortem examination revealed severe necrosis and ulceration of the oesophageal and gastric mucosa. The horses were grazing pasture heavily contaminated with *C. medicaginea*. The condition has been known locally as 'coastal' disease for some 50 years in the Keppel Sands, Emu Park, Tungamull and Stanage Bay areas. It is clinically indistinguishable from the condition known as Chillagoe horse disease produced by the ingestion of *C. aridicola*.

Poisoning due to ingestion of *Crotalaria novae-hollandiae* was diagnosed in horses at Forsayth.

Poison peach (*Trema aspera*) toxicity caused the death of two goats on a property in south east Queensland. Both animals had very severe centrilobular liver necrosis and vacuolation of the renal tubular epithelium. The animals had access to the plant and there was evidence of the plant having been eaten.

Yellow-wood (*Terminalia oblongata*) poisoning was suspected in a 9-month-old Angora cross doe. Suggestive histological changes in the kidney included tubular necrosis, neutrophils in tubules and large deposits of a yellow-brown pigment in tubular epithelium.

Haemoglobinuria and anaemia were observed in a Saanen doe which was fed almost exclusively on cabbage and cauliflower leaves. Histological changes included severe nephrosis with haemoglobin casts in the tubules. There was active phagocytosis of haemoglobin by the renal epithelial cells of the proximal tubules.

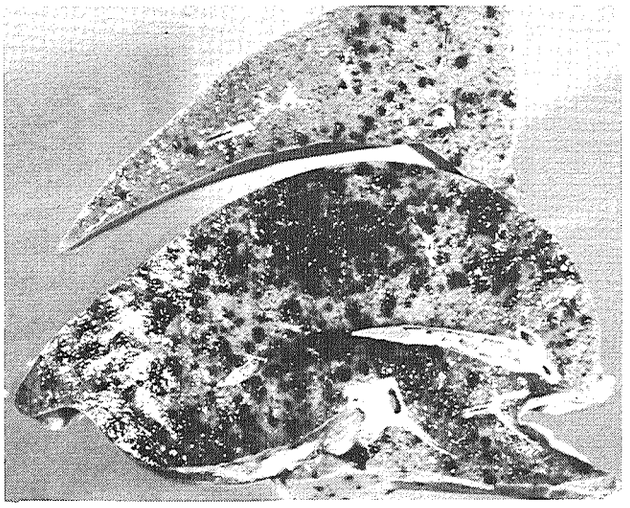
Wild cotton bush (*Asclepias fruiticosa*) caused the deaths of four goats in a herd of 64 at Biggenden.

A mass of sawfly larvae (Lophrotoma interrupta) *collected in the Injune area in September 1981. The larvae feed mainly on the silver-leaf ironbark* (Eucalyptus melanophloia) *and in some years reach plague proportions. Cattle avidly eat the masses of dead and decaying larvae which accumulate at the bases of trees in plague years. The larvae contain a potent hepatotoxin and individual losses up to 800 head have been recorded in recent years.*

Research. Larvae of the sawfly (*Lophyrotoma interrupta*) were collected from the Injune area in September 1981 to accurately define the LD50 of the material for cattle and to thoroughly describe the pathology of the experimental disease. This is necessary to quantify the toxicity of the material for further experimental requirements, particularly the evaluation of a protective toxoid if one can be developed.

Four calves were dosed at 10 g wet weight per kg liveweight. All calves died between 32 and 56 hours after dosing. They became depressed, anorexic, developed abdominal pain and diuresis, and nervous derangement in three out of four. Principal clinical biochemical findings were marked elevations of blood ammonia, total, conjugated and unconjugated bilirubin, GT, GOT and Alkaline phosphatase, and a moderate elevation of serum creatinine. Blood urea increased initially, then steadily declined. Urine osmolarities remained low and pH decreased to 5. Prothrombin and activated partial thromboplastin times increased, as did neutrophil counts and haematocrit and figrinogen concentrations decreased. No fibrin degradation products appeared. Autopsy samples of CSF had elevated ammonia and glutamine concentrations.

Autopsy findings were jaundice, dehydration, petechial haemorrhage of the heart and extensive mottling of the liver. Histologically, severe panlobular necrosis of hepatocytes was the principal finding. Two calves were dosed at 2.5 g wet weight per kg liveweight and these did not become clinically affected suggesting that the LD50 will be between 2.5 to 10 g per kg.



Cross section of a severely damaged liver of a calf which was dosed with sawfly larvae at 10 g per kg bodyweight.

Structural studies on the toxic compound, lophyrotomin, carried out in Cambridge University (UK) indicated that the physiological effects characteristic of sawfly larvae poisonings arise from the unusual D-configuration of the amino acids present. This is thought to be the first reported occurrence of this type of structure in higher animals.

Passiflora subpeltata collected on a property where deaths were occurring was administered to three cattle. Two calves were drenched at 18 g per kg and 10 g per kg per day respectively and they showed clinical signs at 4 and 7 days respectively. These signs were blindness and ataxia with an occasional convulsion. The third animal was a lactating cow with a calf. She was fed the plant mixed in lucerne chaff at 6 g per kg per day. The cow showed questionable ataxia after 17 days but died that night from bloat. The calf remained clinically normal. The brains and spinal cords from the above three animals did not have significant lesions.

The toxic principle of *Bryophyllum tubiflorum* (mother of millions) was isolated and its structure partially identified.

Feeding trials with Crofton weed *Eupatorium adenophorum* continued. A horse, fed the plant for two periods to coincide with the non-flowering stage of the plant (March–July), was killed and found to have marked lesions of the disease. This was a considerable disappointment as it was hoped that the non-flowering plant was non-toxic and could be grazed with safety.

Feeding trials of the closely related mist-flower *(Eupatorium riparium)* commenced to assess the toxicity of this species.

White cedar *(Melia azedarach)* occurs all around the world and has been responsible for numerous poisonings in animals. Four new tetranortriterpenes (named meliatoxins A1, A2, B1 and B2) were isolated from the *Melia* fruits. The meliatoxins were demonstrated as causing the acute nervous symptoms and rapid death in pigs. They did not, however, account for the scouring often observed.

Fruits from four areas of south east Queensland were analysed for the presence of meliatoxins. Low concentrations of meliatoxins found in only one of the four samples support the contention that not all white cedar trees are toxic.

In recent years, sesbania pea *(Sesbania cannabina)* has become a troublesome weed of sorghum crops grown in the Burnett and Dawson-Callide districts. The resultant contamination of the sorghum grain with sesbania seed can be severe with levels as high as 8% (w/w) having been reported. There is currently no restriction on the sale of sesbania contaminated grain sorghum. Field reports have linked the feeding of pigs with sorghum grain contaminated with sesbania seed with poor growth and ill health.

An experiment was carried out to ascertain the tolerance of pigs to feed contaminated with sesbania seed. In this experiment, graded amounts of sesbania seed were incorporated into a sorghum-based diet at 0.5% increments from 0 to 3.5%. Unpalatability of the feed was observed with all levels of sesbania seed inclusion although this did improve during the course of the 6-week experiment, particularly in those diets containing less than 1.5% sesbania seed. Growth rate and economy of feed conversion declined when sesbania seed was included at levels above 1%. Although scouring was observed in pigs fed the higher sesbania levels, no deaths or neurological signs occurred. A second experiment examining graded amounts of sesbania seed at 0.25% increments over the range of 0 to 1.75% commenced.

Chemical poisonings and drug overdosing

Lead was the most frequent agent responsible for animal poisonings as indicated by laboratory analysis. Samples were submitted from 200 properties of which 21 supported a diagnosis of lead intoxication. Access of cattle to inadequately disposed car batteries remained a problem. At Moogerah, a stallion housed in a stable the walls of which had been painted with sump oil (shavings of the surface contained 2 800 ppm lead) developed hyperexcitability and muscle tremors of the forelimbs progressing over 48 hours to ataxia, lateral recumbency, violent struggling, nystagmus and finally coma. A blood lead level of 0.4 ppm was considered suggestive of lead poisoning.

A declining use of arsenic as an agricultural pesticide has resulted in a significant reduction in the number of arsenical poisonings supported by laboratory analysis. Samples were submitted from 187 cases of which 14 confirmed arsenic as the cause of death. However, four of the outbreaks involved cattle that had been recently treated in arsenic dips or with sprays: at Thangool following dipping of a mob in an arsenic dip that had been reinforced following flooding 30 cattle died; two animals died at Rathdowney and another three at Reesville following dipping in arsenical solutions; at Kennedy 27 cattle in a mob of 50 died after having been sprayed accidentally with a 1.2% solution of sodium arsenate. Access of cattle to ground contaminated with arsenic continued to be a problem in a limited number of cases.

Organophosphorus and organochlorine pesticides presented another major source of animal poisonings. From 75 cases investigated, 16 were confirmed by analysis. Dieldrin, diazinon, fenitrothion and fenthion ethyl were the most common pesticides found. Several of these cases occurred in poultry. Dieldrin toxicity was diagnosed as the cause of death on a commercial duck and meat chicken farm. A crop in the area had been treated with dieldrin 3 weeks before deaths occurred. Non commercial fowls at Roma died following treatment with dieldrin for external parasites. Dieldrin levels in the liver were 98 ppm. Seven adult geese died and three others became sick at Taabinga following exposure to a pesticide containing dieldrin.

Diazinon poisoning was diagnosed at the cause of death of 30 broilers. Affected broilers exhibited paralysis which terminated in collapse and death. Three weeks previously, the shed had been treated with Nucidol 20. A 90% mortality in a duck flock in which the ducks had severe generalized hepotocyte degeneration was diagnosed as diazinon toxicity. Diazinon is not recommended for use around poultry sheds. This is specifically stated on labels. Paralysis followed by death in two turkeys and a drake was considered to be due to dichlorochlorpyrifos (the breakdown product of Dursban) toxicity.

Exposure to the disinfectant, phenol, and an insecticide, endrin, was elucidated as a cause of a syndrome characterized by skin ulcerations and nervous signs in a small herd of pigs at Nanango. Pigs exhibited hyperaesthesia, clonic and tonic convulsions and ulcerations on one or more of the following areas—snout, gums, tongue, interdigital cleft and coronary band.

Retrospective inquiry into husbandry procedures on the property revealed that incorrectly diluted 'Phenyle' (2.9% phenol) had recently been used to disinfect the pen. Analysis of pen 'sludge' revealed 15 mg per L of endrin present. Both phenol and endrin have been incriminated as a cause of nervous signs in pigs. Phenol acts as a direct corrosive when applied to the skin and was considered responsible for the skin and mucous membrane lesions seen in this case.

Two cows died at Monto after breaking into a shed and ingesting urea. Another mortality occurred at Redland Bay.

Clinical presentation of a nervous syndrome together with an eosinophilic meningoencephalitis seen histologically led to a diagnosis of salt poisoning/water deprivation in all ages of pigs from a piggery near Chinchilla.

A case of 'Sulpha' poisoning occurred in a flock of 2 400, 5-week-old pullets. Typical lesions of haemorrhages in the muscles were noted. Before the diagnosis, 10% of the flock had died.

Mycotoxins

A survey of barley samples from the 1979 harvest, supported by the Queensland Barley Growers' Co-operative Association, for the presence of mycotoxins was completed. Tests for aflatoxins B1, B2, G1 and G2, zearalenone, T-2 toxin, ochratoxin A and sterigmatocystin were negative for all samples.

The potential synergism of action between aflatoxins and ochratoxins in the mycotoxicosis of pigs was studied. As a preliminary part of this work, isolation of feed quantities (800 to 1 000 mg) of toxins from laboratory cultures of *Aspergillus flavus* and *A. ochraceus* was completed.

Four outbreaks of mycotoxicosis occurred in pigs during the year. In the first, 80 pigs of differing ages died between 2 hours and 3 days following one early morning feed. The piggery was a licensed swill feeding farm feeding stale bread, vegetable scraps and rendered hospital scraps. No feed was available for analysis, but high levels of aflatoxin B1 and B2 were identified in stomach contents and aflotoxins B1, B2 and M1 in livers.

At post mortem, a large volume of blood stained fluid was found in the thoracic and abdominal cavities, the liver was congested and the gall bladder wall was markedly oedematous. Copious blood was present in the posterior small intestine, caecum and proximal colon. Haemorrhages were present in the pharyngeal-submandibular area and in the diaphragm. The lungs were oedematous. Massive acute liver necrosis with haemorrhage was seen histologically.

In the second, 12 pigs showed inappetence, depression, weight loss and vomiting after the introduction of a new batch of sorghum into the home mixed ration. Two pigs died after consuming the toxic ration for 3 weeks. Post mortem findings included swollen yellow liver and very pale kidneys. Subacute toxic hepatitis with bile stasis and bile ductule hyperplasia was seen histologically. A sample of the mouldy sorghum was analysed and contained high levels of aflatoxin B1, B2, G1 and G2.

In the third case, inappetence, depression and loss of condition in growers was reported in a 200-sow piggery after introduction of a new batch of mouldy sorghum into the ration. Significant levels of aflatoxin B1 and B2 were detected on analysis of the grain.

The fourth outbreak occurred on a 200-pig farm on which the pigs were fed bread returns and grower pellets. Four deaths occurred and several pigs 4 to 6 weeks of age showed depression and staggering gait, after access to an upturned drum of badly moulded bread. Centrilobular liver necrosis, elevated serum bilirubin and demonstration of traces of aflatoxin in the liver of two pigs confirmed the diagnosis.

Laboratory services

Specimens examined

The Division's laboratories in Brisbane and Townsville continued to examine a large number of specimens to support the diagnostic, regulatory, extension and research work not only for Departmental officers but also for private veterinarians and others who service the livestock industries and the consumer public. The Animal Research Institute, Yeerongpilly, Oonoonba Veterinary Laboratory, Rockhampton Veterinary Laboratories and the Charleville Pastoral Laboratory continued to examine a large number of specimens from the brucellosis and tuberculosis eradication programmes.

A total of 11 396 batches of specimens, excluding those connected with the brucellosis eradication campaign, was processed. Of these, 9 202 were handled at the Animal Research Institute and 2 194 at the Oonoonba Veterinary Laboratory. This represented an increase of 21% over the quantity of material handled in the previous year. Of the total batches of specimens processed, 56% involved actual investigations into sickness, abnormalities and deaths of livestock with the remainder being done largely to satisfy regulatory requirements.

Examination of these batches involved 168 235 serological tests, 11 215 microbiological tests, 3 675 haematological tests, 13 665 parasitological tests, 424 toxicological tests, 2 769 biochemical tests, 662 protozoological tests, 3 545 histopathological tests and 94 botanical examinations. These procedures totalled 204 286 individual laboratory examinations.

Testing of livestock for sale either interstate or overseas continued to increase with testing being carried out both at the Oonoonba Veterinary Laboratory and the Animal Research Institute. The Export Serology Section at the Animal Research Institute coped efficiently with the heavy demand as the following statistics indicate. A total of 66 735 animals was exported after 114 744 serological tests were done for which charges of $71 001 were levied.

As an integral part of the diagnostic services of the Animal Research Institute, the Toxicology Section of the Biochemistry Branch examined 1 171 samples representing 569 cases of suspected poisoning. Toxicologically significant results leading to positive diagnostic findings were obtained in 75 cases (13.2%). Analyses determined included arsenic, lead, strychnine, pesticides, nitrates and mycotoxins. The incidence of arsenical poisoning is reducing, but arsenic and lead were again the predominant sources of animal poisoning. Five samples of stock feeds were analysed for aflatoxins and ochratoxins as part of the regulatory programme of Standards Branch. Two of these contained hazardous levels of aflatoxins (greater than 0.2 mg per kg).

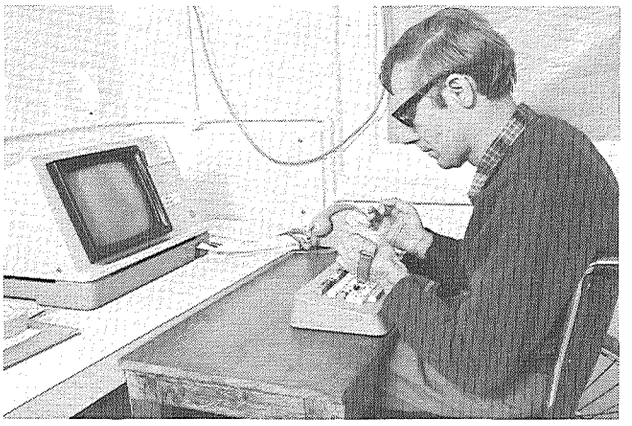
In the pesticide monitoring programme, Toxicology Section performed more than 11 000 analyses on 5 731 fat samples. In addition, 225 samples were screened for pesticides as part of a traceback programme and 86 samples representing 51 cases of suspected pesticide poisoning were analysed. Samples included biopsied fat, milk, grass, soil, water, vegetables, spider webs, spaghetti and dip sludges.

Clinical Biochemistry Section of Biochemistry Branch performed more than 11 000 analyses for a wide range of blood and tissue components. Of these 6 253 were for diagnostic service work. Nutritional Biochemistry Section received 3 141 samples on which 9 380 analyses were done. The bulk of the samples were from research programmes within the Department.

The dip analyses service analysed 3 418 samples of dipping fluids. Ethion (289 samples) continued to be the chemical used consistently above the recommended strength of 0.075%. Approximately 60% of ethion analyses were above 0.09%. Tixafly was released in October 1981 and 30 samples were analysed. Promicide was being broken down in the dipping vats, apparently by bacterial action. The addition of triple superphosphate to the vats to adjust the pH below 5.5 reduced and in some cases eliminated this breakdown.

The radioisotope facility at the Animal Research Institute undertook counting and advisory services for Agricultural Chemistry, Plant Pathology, Dairy Cattle Husbandry, Beef Cattle Husbandry, Sheep and Wool, Biochemistry and Pathology Branches. Isotopes counted were iodine—125, phosphorus—32, phosphorus—33, carbon—14, cobalt—57, sulphur—35, chromium—51 and tritium in a total of 7 150 samples.

There was an increasing emphasis on methods involving radioimunoassay procedures. Automatic beta and gamma counting instrumentation which is potentially capable of 24 hour per day operation approached 60 to 70% on-line operation. When the compulsory down time was included, the equipment was near maximum output. This led to the need to impose advance booking requirements on the user Branches.



A computer programmer is operating the terminal located at the Animal Research Institute, Yeerongpilly, for the Univac computer in the State Government Computer Centre. All Queensland's diagnostic disease data are stored in this computer.

Method development

Work continued during the year in developing or adapting methods to improve the efficiency and accuracy of diagnostic and biological analytical tests.

Clinical Biochemistry Section developed the isoelectric focusing electrophoresis technique for monitoring fresh meat samples for the species of origin. Samples were collected by Veterinary Public Health officers from retail outlets, from meats received at small goods manufacturers and from miscellaneous sources. Of 494 samples analysed, none contained meat from species which were not acceptable.

The method developed for estimating rumen ammonia in the field was adequate for sheep on dry pastures where the colour of the rumen fluid does not affect the comparison. As the quantity of green forage increases, the test becomes less reliable. Also, a significant error occurred in samples from sheep receiving urea supplementation. Work aimed at eliminating both the failings continued. Adaptation of this method for use on the Gilford 3500 autoanalyser, to rapidly analyse large numbers of samples commenced.

A spectrophotometric method was developed for determination of free lysine in plasma by decarboxylation of free lysine to cadaverine using lysine decarboxylase. This is capable of measuring levels to 10 micromoles per 100 mL of plasma.

Work continued in an attempt to find a suitable, rapid laboratory technique for the determination of the fraction of protein in feeds and supplements which escapes ruminal degradation.

In collaboration with officers of the Lands Department Alan Fletcher Research Station a method for the determination of sodium fluoracetate (1080) in meat baits and in baiting stock solutions was developed. This will be used to assess the effects of weathering on the stability of 1080-treated baits in the field.

There is presently no known reliable serological test to detect melioidosis in pigs and infection can be confirmed only at slaughter. A test which could accurately identify infected animals pre-slaughter would considerably assist any control programme. Available techniques are being evaluated to more clearly define their limitations.

Vaccine production

A total of 702 224 doses of tick fever vaccines was supplied by the Tick Fever Research Centre at Wacol of which 458 866 doses contained both *Babesia bovis* and *Anaplasma centrale.* The demand for anaplasmosis vaccine has remained at this high level of 65% which is somewhat surprising in view of the fact that fewer than 20% of all tick fever outbreaks have been due to this infection since 1974.

The coolite eskies introduced as vaccine containers last year have improved protection of the vaccine from temperature stress during transport but are not the complete answer. Experiments have shown that in vaccine packs held at 18 to 25°C, vaccine initially at 4°C was 10°C cooler after 24 hours than in packs held at 26 to 31°C. There is therefore still a need to minimize temperature stress of vaccine during transport to ensure viability on receipt.

Miscellaneous

The main thrust of activity in the Animal Research Institute library was directed towards acquiring more suitable accommodation for the collection, staff, and users. Water damage to books caused by inadequate weatherproofing of the library building precipitated a crisis which resulted in the relocation of the library to another building. A shortage of shelf space remained a problem, despite continued weeding of the collection. The collection comprised 2 625 catalogued books, 1 964 indexed pamphlets and 523 journal titles of which 359 were current subscriptions.

An historical collection was established. It included books which belonged to Mr C. J. Pound who was appointed in 1893 as Director of the newly established Stock Institute for Queensland, a forerunner of the Animal Research Institute. The binding programme was well maintained with 609 volumes being bound.

There was a further increase in the demand for computer-based literature searches. Forty-six searches were conducted for institute officers using the DIALOG service. Funds were provided for the librarian to attend two DIALOG training seminars. Publications lent to Institute staff increased substantially to total 3 266, while 1 074 items were lent to other departmental officers. There were 694 requests for material not held in the library, and 298 items were lent to other libraries.

Division of Plant Industry

QUEENSLAND'S rural industries encompass wide environmental diversity for plant production, ranging from tropical to temperate and from humid to arid conditions. This diversity is reflected in the plant species utilized commercially. For many of these, particularly in the tropical regions, production problems are unique and related research has its major affinities with that in the developing countries of the world.

The objectives of the Division of Plant Industry are to improve and stabilize the productivity of the agricultural, pastoral and horticultural industries of Queensland and to conserve its soil and plant resources for the benefit of the entire community. This requires broad ranging programmes of research and extension which extend from improving the native pastures of the arid regions to ensuring superior quality of wholesome fruit and vegetables on the consumer's table.

The Division's functions are developed by two major production Branches: Agriculture Branch, which is responsible for research and extension for native and sown pastures, field crops and heavy vegetables; and Horticulture Branch, which undertakes research and extension in the fruit, vegetable and ornamental plants industries. Specialist services are provided by Agricultural Chemistry, Botany, Entomology and Plant Pathology Branches.

The Director of Horticulture administers Plant Quarantine in Queensland as an agent for the Commonwealth. Divisional officers are also involved in the administration of regulations concerned with crop production and beekeeping.

Research units

Four special research units established within the Division carry out research for particular industries.

At 'Brian Pastures' Pasture Research Station, Gayndah, research is aimed at improving beef production through the development of improved nutrition and husbandry practices. The Australian Meat and Livestock Corporation contributes an agreed sum each year with staff salaries and running costs being met by the Queensland Government.

Toowoomba is the site of the Queensland Wheat Research Institute where an integrated programme of research into the many production problems of the wheat industry is conducted. The Australian Wheat Research Council and the Queensland Wheat Industry Research Committee are responsible for financing most of the activities with the State Government making a major contribution to staff salaries and operating expenses.

Staff at the Charleville Pastoral Laboratory are involved in studies on the management, productivity and maintenance of the semi-arid rangelands of the south west. Evaluation of new pasture species forms part of the programme. Grants from the Wool Research Trust Funds meet most maintenance costs, while the State Government is responsible for most staff salaries.

Tobacco experimental work is centred at the Southedge Tobacco Research Station, Mareeba, with a small field station at Beerwah. The emphasis in research is on plant breeding, crop protection and management. These centres are financed very largely by the Tobacco Industry Trust Account with some salaries again being met from State funds.

New varieties

Genetic improvement of plants by breeding and selection for yield, product quality and resistance to pests and diseases continues to be a most effective avenue for productivity advance. Two new wheat varieties, Flinders and Hartog, were released to meet the need for mid season and quick maturing varieties with full rust resistance and high grain quality. Grimmett, a high yielding barley variety has been released as a replacement for Clipper. The new soybean variety, Nessen, combines high yield capability with major gene resistance to *Phytophthora*. Other field crop releases were the sweet corn variety, Aztec, the non-shattering sesame variety, Palmetto; and a male sterile, midge resistant sorghum breeding line QL23.

In the horticultural field, the new stringless French bean varieties Redlands Wintercrop and Redlands Wintergreen have made a large advance in yield for winter production.

Plant diseases

A bacterial wilt resistant hybrid tomato with excellent fruit quality will soon be released for warm season production. Virus-indexed avocados are supplying high quality propagating material to industry.

The plant disease spectrum is continually changing with the emergence of new diseases and new disease races with increased virulence. An important disease of bananas, black sigatoka, was detected near Cape York and an eradication campaign appears to have been successful. Replanting of plantations in the Cape will commence in late 1982. Boil smut (*Ustilago maydis*) in maize occurred for the first time in the State and actions taken on seed

Large, round bales are suited to paddock storage of hay for on-farm use as they reduce weathering losses. This specialized machine is baling Rhodes grass after the seed had been harvested. It is working at Bauple, near Maryborough.

production and seed treatment supported by quarantine declarations for central and northern Queensland are directed at containing the disease in south east Queensland.

An oil quality analyser has been developed to give automatic readout of iodine values, linoleic acid and oleic acid contents of vegetable oils within 2 min of sample injection. The instrument is expected to find a useful role in oil quality determinations for both research and marketing purposes. Negotiations are proceeding for manufacture and sale under licence.

A major programme aimed at using computers to design forage systems for beef production at the property level has advanced to the point where this objective is clearly possible. It is already feasible to simulate production of various forages from long-term weather data, and to use these to predict monthly liveweight changes for a range of native and sown pastures at varying stocking rates. This appears to offer a valuable tool for extension officers and property managers when eventually combined with a capacity for economic interpretation.

Agriculture Branch

AGRICULTURE Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in the State through its research and extension programmes.

Plant breeding programmes are seeking superior local adaptation and disease resistance in wheat, barley, rice, sorghum, maize, sunflower, soybeans, peanuts, navy beans, tobacco and cotton.

Plant selection programmes are also seeking varietal improvement in forage oats, linseed, safflower, mung beans, potatoes, sweet potatoes and onions. Exploratory studies are assessing the potential for new crops such as chickpea, lupins, cassava, guar and pigeon peas.

Soil fertility and weed problems are also diverse, and Branch research and extension encompass tillage practice, plant nutrition, fertilizer technology, crop and pasture rotation systems, and weed control. Irrigation developments require specialized servicing.

The pasture research programme seeks principles to guide the balanced use of the natural grazing lands with emphasis on the mulga, Mitchell grass, blue grass and bunch spear grass communities.

Improvement of animal production from natural grassland is pursued through legume selection and introduction to extensive grazing lands in the better watered eastern section of the State. For intensively developed areas, forage crops and sown pastures are researched for superior species, grazing management, optimum fertilizer strategies, seed production and establishment methods.

Branch research relies heavily on support and collaboration from other Branches of the Department and particular effort is directed at linking the Branch's practically oriented research with the more basic studies undertaken by CSIRO and the Universities.

The Branch maintains a widely deployed extension staff skilled in promoting the application of crop and pasture technology to commercial enterprises. This demanding activity has to blend productivity and farm profitability with conservation of natural resources. The extension service maintains effective liaison with all agricultural industries and, in this way, identifies problems to ensure a proper orientation for research activities.

Branch programmes are reviewed regularly to ensure their relevance and that Branch resources are used wisely. In 1981–82, the Branch conducted major reviews of the wheat variety improvement programme and extension activities in Far North Queensland. The recommendations of these reviews are being implemented.

There was also a Departmental review of the structure and functions of the Branch in 1981–82, and many of these recommendations have been and are being implemented.

In addition, Branch activities in western Queensland are being reviewed as part of a wider review of Departmental services in that region.

Agronomy research

Wheat

In the 1981 season, the proportion of the Queensland wheat crop sown to varieties released from the Department of Primary Industries' breeding programme increased to 67%. This was a result of the rapid rise of Banks to 17%, as Cook maintained its level at 40% and Oxley continued its slow decline falling to 10%. As well as being popular with growers, the release of Cook and Banks is having an important beneficial effect on the quality of the Queensland crop.

Two new varieties, Flinders and Hartog, have recently been released from the Department's wheat breeding programme.

Flinders is a bearded, mid season wheat with resistance to all strains of stem rust and complete resistance to leaf rust. In yield, it was equal to the high-yielding Oxley in 1980 but 8% lower in 1981, possibly due to its later maturity in a season with a dry finish. Quality of Flinders is superior to that of Oxley. The release of Flinders meets an urgent need in Queensland as the only other mid season wheats grown have serious deficiencies. Oxley is rust susceptible and Shortim has proved unacceptable for agronomic reasons.

Weeds, particularly annual summer weeds, have become a problem in the Emerald Irrigation Area. Weed-free head ditches, such as the one in the picture, allow water to flow freely and permit easy use of siphons.

Hartog is a bearded, strong-strawed, quick-maturing variety which yields at a similar level to Cook, Banks and Kite. An important feature of the variety is that its culture will add much needed diversity to the stem rust resistances used in Queensland. Apart from its good stem rust resistance, Hartog is also resistant to all contemporary Australian field races of leaf and stripe rust. The quality of Hartog is adequate.

Prospects are good for meeting most of the more urgent wheat industry needs for varieties to fill particular gaps in the near future; namely a tall, awnless wheat and a slow maturing (winter) wheat. There is also good 'back-up' conventional, quick and mid season material which could be available from 1983 onwards.

Following a review of the Department's wheat breeding programme, close attention is to be given to additional breeding aspects including resistance to yellow spot, stripe rust and root lesion nematode diseases, additional straw strength, grain weathering resistance and frost tolerance.

Plant physiology studies have shown that variation in grain yield of wheat in Queensland is well explained by a yield index incorporating plant water use, pan evaporation and mean daily temperature, where these factors are measured 10 days before and after flowering.

The yield index, supported by trial results, suggests that, for any given level of available soil moisture, grain yield will increase as pan evaporation and/or mean daily temperatures decline. Thus, in the absence of frost damage or other factors, maximum grain yields will be obtained by flowering in midwinter (July).

This finding has important implications for the Central Highlands where early planting is desirable to capitalize on diminishing levels of soil moisture following summer rains and where the frost risk, while still present, is less than in south Queensland. In 1981, approximately 60% of the Central Highlands wheat crop was planted in March–April following publicity of previous trial results. These early plantings which flowered in June–July gave farm yields in the vicinity of 3 t per ha compared with 1.8 t per ha for 'normal' May planted crops flowering in August–September.

Barley

Grimmett, a high yielding, two-rowed barley variety tested as Bus x Zep 166, has been released from the Department of Primary Industries' breeding programme. It had a yield advantage of 16% over Clipper, the current malting variety, in 63 trials over the 6-year period to 1981 and a 4% advantage over Corvette in 44 trials over 4 years.

Grimmett flowers slightly earlier than Clipper and slightly later than Corvette. It is of similar height to Clipper but has much improved resistance to lodging. It also has resistance to races of powdery mildew prevalent in Queensland.

In malting tests at the Queensland Wheat Research Institute over 4 years, the quality of Grimmett compared favourably with that of Clipper. However, its behaviour differed in commercial malthouse tests where increased modification is required to achieve the same quality characteristics as Clipper. It is hoped to finalize its position as a malting barley later in 1982.

Galleon (2.62 t per ha), a South Australian feed variety, was on average the highest yielding entry in the 10 trials comprising the 1981 Regional testing programme. Other high yielding entries were Corvette (2.53 t), Bandulla, a recently released New South Wales feed variety (2.53 t), Con x Clip 102, a Departmental crossbred (2.51 t), and Grimmett (2.40 t).

Oats

The objective of the oat evaluation programme is to provide improved grazing oat varieties for Queensland. New material introduced from interstate and overseas is evaluated for forage yield and resistance to crown and stem rust. In 1981, short rows of 180 new introductions from Wisconsin, USA, were grown for preliminary assessment and seed increase. The remaining 200 lines will be grown in 1982.

Since 1980, Queensland has participated in the Interstate Oat Testing Programme by growing trials at Hermitage Research Station. The main aim of this programme is to select for grain yield but observations are also made on forage production and disease resistance.

In the three trials which have been conducted over two seasons to date, the variety Stout, which is recommended for Queensland, has produced slightly above average yields. Lines from Western Australia, Victoria and South Australia have performed very well in seasons which were climatically unsuited to crown and stem rust. Interstate material is normally susceptible to crown and stem rust.

Sorghum

Breeding for midge resistance is now the most important objective of the sorghum breeding programmes centred at Hermitage and Biloela Research Stations. The leaders of the programmes believe midge resistance is an attainable objective in the relatively near future.

The first release from the midge resistance breeding programme was made in 1981 in the form of a female line QL23. It possesses a moderate level of resistance but, because of the many shrivelled seeds produced on the A (cytoplasmic male sterile) line, QL23 was released as a breeding line only and not as a female parent. QL23 is making a very significant contribution to the B line (female) midge resistance breeding as half of the 466 female breeding lines selected in south Queensland for male sterilization to help in the programme are based on QL23.

Thirty-seven midge resistant hybrids are among 229 hybrids being tested in the Department's 1981–82 screening programme. Based on previous results, however, there is no commercially viable midge resistant hybrid at an advanced stage of testing at this stage.

The development of the five midge resistant populations designed to produce B (male sterile producing) and R (male fertile restoring) lines for both central and south Queensland is progressing satisfactorily. At least two random matings have occurred in each population at the end of 1981–82. Selection in each of these populations could begin in 1982–83.

Considerable progress is being made in terms of midge resistance and agronomic type particularly in the early generation female lines. Some 70 of the 2 398 early generation female lines have been selected for rapid male-sterilization at Biloela. It is planned to produce hybrids on these for testing at Biloela in January 1983 and in southern Queensland in the 1983–84 summer.

Lodging is another major problem of the sorghum industry, particularly in central Queensland. Charcoal rot (*Macrophomina phaseolina*) is associated with the problem. A project has commenced at Biloela Research Station to identify new sources of charcoal rot resistance to introduce them into the breeding programme. Lines with resistance to charcoal rot will then be crossed with midge resistant lines to combine both resistances in the same lines.

Maize

Boil smut of maize, caused by *Ustilago maydis*, was recorded for the first time in Queensland in the 1981–82 summer.

A large part of the maize area in southern Queensland is sown to seed company hybrids. These hybrids are based on American inbreds which carry a fair degree of resistance to the disease. This probably accounts for the low levels of infection found in most infected fields. The few exceptions occurred in crops of older open-pollinated varieties such as the one grown on the two infected farms in the Gatton Shire. This variety is much more susceptible than the commercial hybrids.

The maize industry in north Queensland is based on hybrids bred locally. The resistance status of these hybrids is not known and they are being screened. If adequate resistance does not exist in these hybrids, the breeding programme will be amended to incorporate resistance as an insurance against the possible appearance of the disease in the north Queensland region.

A new sweetcorn hybrid, Aztec, was released early in 1982. Aztec was bred at Kairi Research Station as a replacement for QK 467S which, though a good variety, had problems in seed production. Seed production of Aztec is a straightforward operation and, as its quality characteristics are similar to or better than those of QK 467S, it should be very acceptable to commercial growers.

In the regional variety testing programme, the line F138 gave a very good performance and produced high yields at all sites except Kingaroy where it flowered during a period of intense moisture stress. This line has been released by the DeKalb Shand Seed Company, as XL94, for commercial production in the 1981–82 season.

It is noteworthy that in the mid maturing trial at Kairi Research Station seven of the eight highest yields were given by experimental lines. Three of these experimentals, including the highest yield, came from the Departmental breeding programme.

Soybeans

The soybean variety Nessen was released in 1982. It had been tested as HS1115 for 2 years in the regional variety testing programme. Nessen is a high yielding variety with a major gene, $Rps1^c$, for resistance to *Phytophthora megasperma* f. sp. *glycinea*. This gene confers total resistance to *Phytophthora* root and stem rot. However, it can be expected that mutation in the disease organism will enable it to break down this resistance in a few years' time.

At present, the main aim of the breeding programme is to obtain varieties with field resistance to the disease. This type of resistance is not total but it does ensure that losses from the disease are never high. This resistance is less likely to break down due to disease organism mutation.

Field resistance is already available at a good level in the varieties Davis and Hill and at a lower level in the varieties Bragg and Forrest. Among the current commercial varieties, Ross, Semstar, Fitzroy, Flegler, Canapolis and Wills are all quite susceptible to the disease and are likely to disappear from cultivation in *Phytophthora* infested areas in the next few years.

Several lines produced in the breeding programme from a Davis x Bragg cross are showing promise of high yields and good field resistance to *Phytophthora*. One line is currently undergoing final evaluation for possible release.

In the recurrent selection programme, 582 S_2 lines were selected from the first intermated population and tested in field trials. The mean yield of these lines was 2 938 kg ha^{-1} with a coefficient of variation of 11.5%. Sixty-one of these lines, with a mean yield of 3 812 kg ha^{-1}, were selected as parents of the next intermating generation.

The 61 selected lines were intermated in the growth chamber in 1981 and the resultant 780 F_1 seeds were sown in the field in December 1981. The selected lines looked so promising that they are being evaluated further at three sites this season. The population in this programme contains a wide range of maturity and selections suitable for all soybean areas of Queensland can be made. The population also carries different resistances to *Phytophthora* and also to soybean rust. It should therefore be possible to select high yielding, disease resistant lines from future cycles of testing.

Sunflowers

Fourteen trials were conducted in the 1980–81 regional variety testing programme, eight in southern Queensland and six in central Queensland. The 19 entries in these trials included all the best hybrids commercially available.

The average yield from the southern Queensland trials was 1.53 t ha^{-1} and from the central Queensland trials 1.38 t ha^{-1}. In general, the slower maturing hybrids outyielded the quicker ones and practically all outyielded the open-pollinated varieties. Oil percentage ranged from 36.7 to 41.6 (9% moisture basis) for individual oilseed types and was somewhat lower in southern Queensland than in central Queensland.

Four of the varieties with the highest overall seed yields, Cargill 205, Hysun 30, Hysun 31 and Sunking were also among the top group in oil percentage.

Departmental sunflower research has been directed towards understanding crop adaptation through studies of the responses of growth and yield to climate and management variables. Results of these studies have been used to construct a dynamic crop simulation model which incorporates the interaction of climate with phenology, crop growth, leaf area development and water use.

To evaluate regional strategies, simulation studies using this model with historical weather records from sunflower production regions have been undertaken. This has enabled the determination of yield probabilities associated with the various strategies.

Of the 41 sites used for model validation, 15 showed an unacceptable level of error in yield prediction. In all of the 15 cases, the predicted yield underestimated the actual yield showing that too much moisture stress was predicted. These sites were all on heavy uniform cracking clays and some work will be required to determine infiltration rates and water holding capacities in them.

Peanuts

In the breeding programme, a new rust resistant parent, EC 76446 introduced from India, has been crossed to the local Virginia Bunch variety and some high yielding introductions.

Populations from earlier crosses with rust resistant parents, obtained from the USA, are showing good levels of resistance to rust and leaf spots. Mass selection for kernel characteristics was carried out in these populations in the winter of 1981 and single plant selections are being made in the current season.

Twenty-nine recent introductions were evaluated in preliminary yield tests at Kingaroy and Walkamin in the 1980–81 season. For crop value, the best introductions exceeded the Virginia Bunch variety by 21 to 54% at Kingaroy and by 25 to 40% at Walkamin. Several of these introductions did well at both locations and are being more extensively tested in the current season.

In the 1980–81 season, 16 advanced Virginia Bunch selections together with seven introduced varieties were extensively tested in north and south Queensland. In north Queensland all the selections were superior to the Virginia Bunch variety but in south Queensland only one was superior. Of the introduced varieties, five were superior to Virginia Bunch in north Queensland while two of the five showed superiority in south Queensland.

All the selections had higher percentages of the large VK1 grade kernels than Virginia Bunch while some of the introductions had very much higher percentages. The best of these lines are currently undergoing further testing.

Both soil physical conditions and biotic factors have been identified as significantly limiting yields of peanuts on the red soils of the South Burnett. In a number of experiments designed to identify yield limiting factors, it was found that, of the total number of pods produced, only 55% matured commercial kernels.

As well as soil compaction, soil borne insects and nematodes and a number of plant diseases were shown to significantly depress yields of mature kernels. Experiments are now in progress to determine the relative magnitude of the effects of these factors under both natural rainfall and irrigated conditions.

Tobacco

The variety ZZ100 developed by Departmental staff in north Queensland has continued to gain in popularity with growers. It is now grown on two-thirds of the north Queensland tobacco area.

ZZ100 produces very high quality leaf and gives good yields. Unfortunately, it can suffer severe damage when infected by potato virus Y(PVY). The immediate objective of the breeding programme is to select a replacement which does not show severe damage by PVY. Several breeding lines appear to combine the high yield and quality of ZZ100 with a mild PVY reaction and most have a higher level of bacterial wilt resistance than ZZ100. Further testing is required to confirm preliminary results before considering a release.

Because of the general use of the fungicide 'Ridomil' to combat blue mould, the disease has disappeared from north Queensland tobacco districts. However, there is a danger that the effectiveness of Ridomil could break down, as has already occurred in several countries overseas. It is therefore vital that varieties with resistance to blue mould be developed for use if such a breakdown occurs. Screening for resistance is therefore carried out at Beerwah while further work is proceeding to develop a glasshouse screening technique.

Anther culture is now being used to produce fixed breeding lines and the method is much more rapid than the single seed descent breeding method. More than 600 lines have been produced using the technique, most of which are being screened for PVY reaction and tolerance to APT2.

Significant improvement in productivity of early winter tobacco plantings in north Queensland was obtained from a period of post-transplant moisture stress of 30 days. The stress delayed flowering and hence resulted in production of a greater number of leaves as well as improving the development of individual leaves.

A bonus benefit was a reduction in the percentage of alkaloid in the leaf. Combined with closer plant spacing which gave further increases in yield, this practice offers both savings in management inputs and increased production.

Cotton

In the programme to develop cotton plant resistance to *Heliothis* spp., the technique for measuring *Heliothis* antibiosis has been modified so that freeze dried material can be fed to *Heliothis* larvae. This allows many more genotypes to be screened each season.

Thirty-five new parental lines were evaluated during 1981 for *Heliothis* antibiosis and gossypol concentration and many showed better levels than HG247-1, the parent used in the crossing programme. Many of the lines with good antibiosis levels also had good fibre strengths. The correlation between larval weight gain and gossypol concentration was −0.38 which suggests that high gossypol concentration has a detrimental effect on the growth of *Heliothis* larvae. These lines are undergoing further evaluation to select the best parents for crossing.

Recent evidence from the USA suggests that biological activity of high gossypol lines may be associated with high condensed tannins or other chemical constituents of the plant toxic to *Heliothis*. This potential source of resistance is to be investigated following the introduction of high tannin lines from the USA.

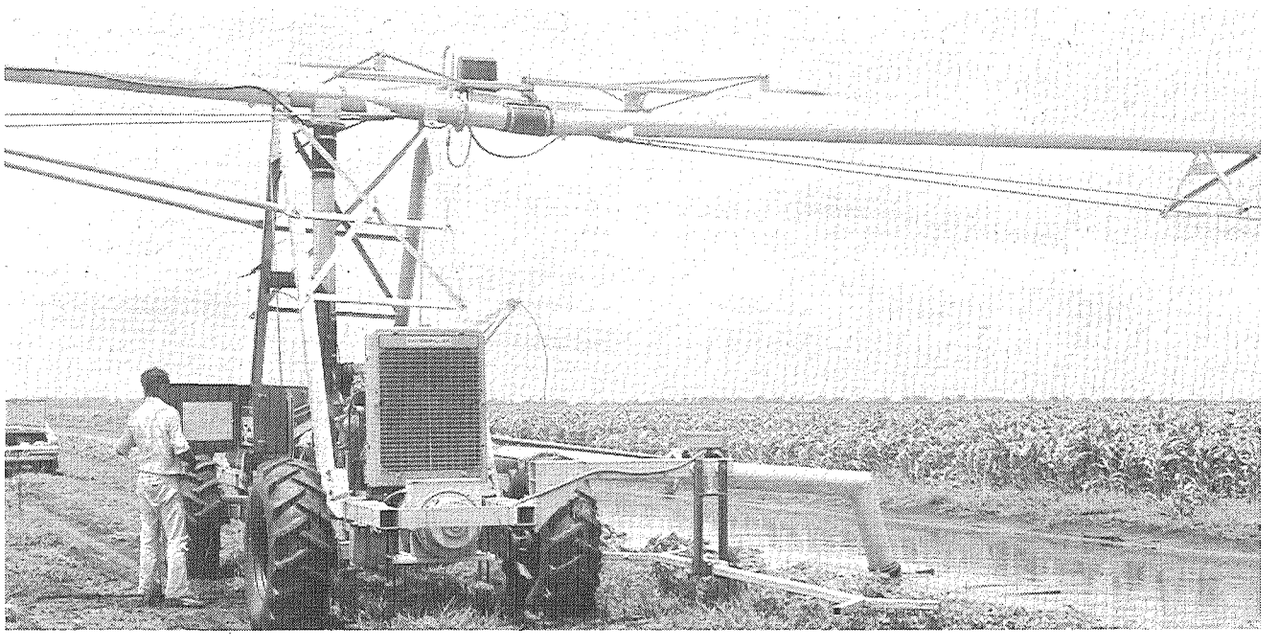
The Australian cotton cultivar trial was evaluated at five sites in New South Wales and five sites in Queensland. Cultivars looking promising for Queensland include SICOT 2 (at all locations), Deltapine 55 (central Queensland and Darling Downs), Coker 315 and SICOT 1 (southern Queensland).

Rice

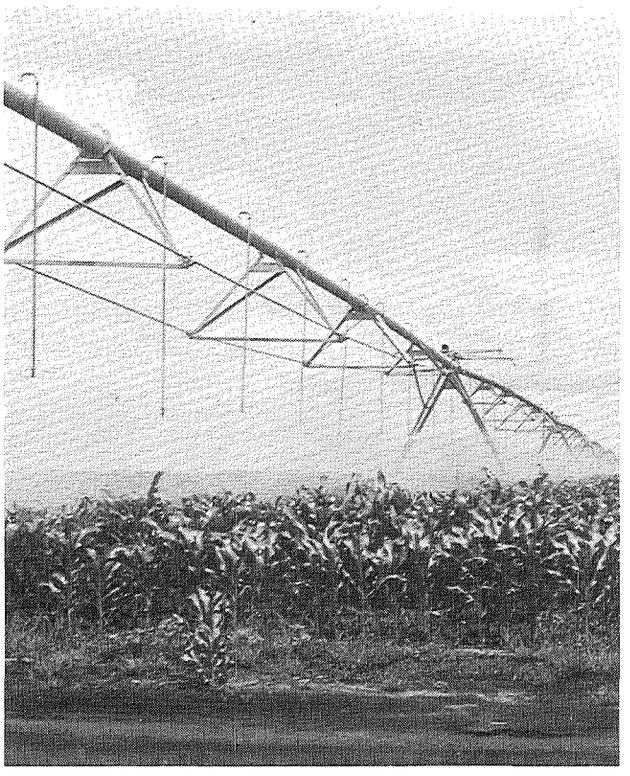
In the last 6 years, nearly 700 rice lines have been introduced from overseas and a further 30 lines obtained from Western Australia. Quarantine procedures and subsequent seed increase require a period of about 2 years but, to date, more than 200 lines have reached at least the stage of observation trials. The lines performing best in the observation trials are further tested in replicated trials.

Two early maturing lines, Bonnet 73 (ex USA) and 76A25 (ex Colombia), have consistently given good yields and reasonable millouts but tests for cooking quality have not been promising. The mid and late season lines Tikal 2 (ex Colombia), RD9 and RD11 (ex Thailand), together with 10 late season lines, have outyielded the commercial variety Starbonnet.

A plant breeder was appointed in November 1981 and is organizing a breeding programme aimed at combining the high yield of a number of introductions from Colombia, the Philippines and Thailand with the high quality of varieties such as Starbonnet and Bluebonnet.



These two pictures show the first lateral-moving travelling irrigator on the Darling Downs. This system, at Bowenville, covers 250 ha growing grain sorghum, soybeans and maize. Water is harvested from Oakey Creek, held in ring tanks and then fed into a central channel more than 3 km long.



Navy beans

Raingrown and irrigated variety trials were conducted at Kingaroy and Inglewood respectively to test varieties and advanced lines from the navy bean breeding programme. The mean yields were 1 197 kg ha^{-1} at Kingaroy and 2 089 kg ha^{-1} at Inglewood. There was considerable variation in the performance of the varieties between sites though the line T159B and the variety Actolac performed well at both sites.

Peanut mottle virus was quite severe at Kingaroy with more than 25% of plants affected in some lines. The lines M2 and W1401 appeared to be resistant to the virus while other lines showed varying levels of infection.

Trials to test large seeded lines were conducted at Kingaroy and Inglewood where the mean yields were 1 050 and 1 618 kg ha^{-1} respectively. All the large seeded lines were virtually free of peanut mottle virus though the check varieties, Selection 46 and Gallaroy, showed high levels of the virus. When quality testing is completed, consideration will be given to releasing a large seeded line for commercial use.

Coloured seed lines were also tested at Kingaroy and Inglewood. A black seeded line gave the highest yield at both sites. Royal Rouge, a large red kidney, and Rufus, a small red kidney, both yielded well and are under consideration for release to their respective specialist markets.

In 1982, a plant breeder was appointed to initiate an intensive navy bean breeding programme which was previously under the control of the soybean breeder on a part-time basis.

Chickpeas

The farming community is showing considerable interest in the chickpea crop. Two varieties are available commercially: the small brown-seeded variety Tyson is adapted to both southern and central Queensland while the large white-seeded variety Opal is adapted only to southern Queensland.

In central Queensland, the return from chickpeas appears to be 70% greater than from wheat. In southern Queensland the return is even better being about 130% greater than that from wheat.

A seed increase of the iron-efficient strain of the Tyson variety was successfully completed and the 15 t of seed produced was rapidly taken up by growers.

A further 131 lines underwent strain testing in 1981 and though a large number of them produced high yields, none significantly outyielded the commercial varieties Tyson and Opal.

Screening for resistance to *Phytophthora megasperma* was continued in 1981. Unfortunately, weather conditions gave rise to an uneven disease infection pattern. Nevertheless 21 lines with apparent resistance were selected for further testing in 1982.

Potatoes

The potato improvement programme aims at screening available varieties and seedlings from breeding programmes in southern States. The emphasis is on obtaining a suitable variety for winter plantings. An increasing proportion of the Queensland crop is being grown during the winter period and the current varieties have shortcomings when planted at this time.

Ten overseas varieties and 26 seedling lines from the Victorian breeding programme were tested in 1981. Though none of these cultivars appeared to be outstanding, 10 have been retained for further testing. A further 40 cultivars have been received from Victoria and are undergoing seed increase for testing in 1982–83. It is expected that approximately 30 new lines will come forward for test each year in future.

Onions and garlic

The Gladalan Brown and White onion varieties, which are high yielding and resistant to downy mildew (*Peronospora destructor*), produce seed stems rather than bulbs when planted before mid May. A selection programme produced a number of lines in which seed stem production was reduced from 95% to less than 5% in early plantings. These lines have been tested and the best are now undergoing seed increase before release for commercial production.

White rot, a soil-borne disease caused by *Sclerotium cepivorum*, is increasing in the Lockyer Valley. The disease, which is spread by flood waters and cultivating and harvesting machinery, renders infected soil virtually useless for further onion or garlic production.

The problem first came to attention in a garlic crop and a selection programme was undertaken in an attempt to obtain resistant lines. In 2 years, this programme is giving good results. In infected soil, the survival rate is about 70% of the selected material compared with 15% in the unselected variety. Further improvement is expected. A similar programme has begun for onions.

Cassava

The field studies at Coolum Research Station are complete and are nearing completion at Southedge and South Johnstone Research Stations.

From the data collected at Coolum, a number of observations can be made. The dry weight percentage of tubers varies seasonally being lowest from November to March when active growth is occurring. This will have implications for harvest timing with June to October being preferable. Early in the growing season (October to December) dry weight tuber yield decreases and provides an accelerated regeneration of the leaf canopy.

Allowing the crop to grow through a second growing season produces about double the tuber yield when compared with a single growing season. Planting before October is of little advantage with respect to tuber yield and increases problems associated with weeds. Planting later than December will lead to yield reduction. Hence in southern coastal Queensland, planting from October to December with harvest from June to October after two growing seasons (about 21 months age) would be the best strategy for tuber yield.

Sesame

Sesame, which is a high value oilseed, has been under investigation for a number of years. Two non-shattering varieties were identified and intensively researched at Gatton Research Station. Planting times from early November to mid January were found suitable. There was no variance in yield from plant populations between 100 000 and 400 000 plants ha^{-1} but a 33 cm inter-row spacing gave a significantly higher yield than a 66 cm spacing.

Sesame is an indeterminate plant and it has been found necessary to desiccate the crop so that it may be machine harvested.

This season, seed of the variety Palmetto was released to six growers for trial commercial production in the Lockyer Valley, Brisbane Valley, Darling Downs, Kingaroy and Biloela districts.

Jojoba

Jojoba has received much publicity in the last few years because of its potential for producing a liquid wax which, among other uses, can be substituted for sperm whale oil in the pharmaceutical industry.

Departmental experience with the crop has been limited to observations of establishment, growth and seed production at nine sites in southern and central Queensland. Results of these trial plantings suggest that jojoba is not easy to establish and seed production may fluctuate widely depending on seasonal conditions.

Establishment failures occurred at six of the nine trial sites. The three sites at which plants survived are Charleville, Gayndah and Emerald. At these sites, transplanted seedlings had a much greater chance of survival than those direct seeded.

At Gayndah, surviving plants are now 5 years old but, despite satisfactory vegetative growth, none has yet flowered. Plants at Emerald have made good growth, with half of them flowering within 3 years and producing a few seeds.

At Charleville, the original planting is now 10 years old and includes two female plants which have been producing seeds for 7 years. Seed production fluctuates widely depending on frost occurrences, the plot being irrigated to avoid effects of moisture stress. In the absence of frosts at critical flowering times, yields have reached nearly 2.5 kg per plant.

Weed control

Red rice is a serious weed in rice fields and the area of non-infested soil suitable for seed rice production is now very limited. While Molinate, at 5.5 L ha^{-1}, has given good control of red rice in rice crops, it will not completely eradicate red rice. Indications are that Molinate rates of 11 L ha^{-1} or greater are required for eradication of red rice but the cost of this treatment is high.

Research has shown that diuron is phytotoxic and glyphosate is selective in tea. Planting tea seed through plastic mulch and using post-emergence applications of glyphosate when necessary should control weeds very well during the establishment phase of tea plantations.

Label instructions state that, when atrazine is used as a pre-emergence herbicide on dry soil, it should be incorporated. Research in central Queensland has shown that incorporation causes a significant reduction in herbicidal activity irrespective of the surface soil moisture status.

In the continuing study of the biology of wandering Jew (*Commelina benghalensis*), pot trials were conducted with soils from many areas inside and outside the South Burnett district. It is apparent that there are no climatic or soil factors that would restrict the spread of this weed to other areas outside the South Burnett region, which is the only area where it currently occurs as a weed.

Research into the control of wandering Jew showed that dinoseb and bentazone were very effective up to the four-leaf stage, but the effectiveness reduced markedly on weeds with six leaves. At the largest growth stage, the mixture bentazone plus 2,4-D gave better control than either bentazone or 2,4-D applied alone.

Research into the efficacy of controlled droplet applicators was extended to cover droplet size when spray volume was maintained at 20 L ha^{-1}. It was found that, when droplet size was reduced from 250μ to 160μ, control of some weeds was not affected but in others efficacy was reduced.

In trials at Mt Emlyn and Westbrook to measure the effects of cultivation treatments on weed germination, it was found that the response of weeds is species dependent; germination of *Phalaris* spp. was increased while that of *Salvia* spp. was decreased following cultivation.

Chickpea is a comparatively new crop in Queensland and is increasing in popularity. The crop does not compete well with weeds and chemical weed control will be necessary under Queensland conditions. Trifluralin at 0.56 kg a.i. ha^{-1} had no detrimental effects on plant stand or yield but at 1.12 kg a.i. ha^{-1} the plant stand was reduced by 20% and the yield by 22%. Metribuzin, incorporated in the soil 4 weeks before planting, did not affect yield at rates up to 0.21 kg a.i. ha^{-1}. Higher rates, or surface applications at planting, significantly reduced yield.

Linuron at rates up to 2 kg a.i. ha^{-1} had no phytotoxic effects on chickpeas and in one trial appeared to increase yield by 26%. This may have reflected a fungicidal effect as *Phytophthora* root rot was present in the trial area. None of the foregoing treatments, however, provided adequate control of all weed species present in the trials.

Cultural techniques and soil surface management

Research on the Darling Downs showed that the use of presswheels gave faster emergence and better final stands of both summer and winter crops whether rain fell after sowing or not. The soybean crop and krasnozem soils were, however, exceptions to this general rule. Excessive presswheel pressure of more than 4 kg cm^{-1} width of wheel reduced sunflower emergence but not sorghum emergence.

There is a high positive correlation between mature plant height and coleoptile length in semi-dwarf wheats. There is also a positive correlation between coleoptile length, as measured in the laboratory, and field emergence. Hence the shorter the semi-dwarf variety, the shorter its coleoptile and the greater is the field emergence problem expected with deep sowings.

Compacted soils, surface crusts, high temperatures and seed size also reduce coleoptile length. The high soil temperatures in Queensland wheat growing areas not only create a need for deep sowing but reduce the length of the already short coleoptiles of semi-dwarf wheats. The problem can be reduced by not planting wheat when soil temperatures are high and/or avoiding the use of cultivating tines behind the sowing tines and by using presswheels.

Pre-soaking of seed and water injection at planting usually hasten emergence though improvements in plant stand do not always result. Recent work with sunflower showed that responses were additive to presswheel responses.

One of the major problems confronting no-till cropping is seedling establishment. Research has been conducted on the three major ground-tool components of no-till planters: coulters, openers and presswheels. Coulters are needed to cut straw and thereby reduce blockages but they also improve emergence, probably through the creation of a micro-seedbed in the seed zone. When no coulter was used, emergence was 54%. All coulter types improved emergence with the best being 65% when a 'Power-till' coulter was used.

There were no differences in emergence between a duckfoot and a spearpoint on the opening tine. Presswheels also improved emergence with the best type having a central raised rib which applied in-furrow as well as over-furrow pressure. This type of presswheel increased emergence from 48% to 60%. The beneficial effects of coulters and presswheels were additive so the most successful combination averaged 73% emergence under no-till conditions.

A project was commenced in 1978 on a sloping, brigalow cracking clay soil near Biloela to compare the effects of stubble retention and tillage method on water entry and storage, soil nutrient status, crop establishment and crop productivity in grain sorghum. Where stubble was retained, grain yields of conventional cultivation and blade plough treatments did not differ significantly in any of the three completed fallow-crop sequences.

These treatments significantly outyielded the minimum tillage treatment with stubble retained in 2 years, when lower plant establishment occurred in minimum tillage (1979 and 1981). In the third year (1980), with good establishment in all treatments, minimum tillage significantly outyielded conventional and blade plough treatments where stubble was retained. Stubble removal resulted in significant yield reductions in conventional cultivation in 1980 and 1981, and in minimum tillage in 1979 and 1980.

Stubble levels on the soil surface declined over the fallow period in all treatments. However, after planting in January–February, blade plough and minimum tillage treatments averaged 1.7 and 2.7 times higher stubble levels than conventional cultivation where stubble was retained. An average of 800 kg ha^{-1} of stubble was present on the soil surface in conventional cultivation after planting. There were no marked differences between treatments for either fallow or crop soil moisture levels, but treatments where stubble was removed tended to have higher nitrate levels in the top 60 cm of soil.

A surface management demonstration area was established at Biloela Research Station in 1980 to provide a long-term comparison of different surface management methods on an alluvial soil. Four treatments were applied following harvest of a wheat crop in 1980. They include stubble incorporated with disc plough, stubble retained on the surface with blade plough, reduced tillage (blade plough plus herbicides) and zero tillage.

The trial was planted to wheat in 1981 with good establishment in all treatments. Yields varied from 2.1 to 2.4 t ha^{-1} with treatments not contributing significantly to the differences.

Summer crop nutrition

Work on soil phosphorus test calibration in the South Burnett has advanced with the development of a method for detecting phosphorus (P) concentrations as low as 0.1 ppm. This method enables two-point P sorption 'curves' to be determined with high reproducibility. From these 'curves', equilibrium phosphorus concentration (EPC) and P buffer capacity can be derived, eliminating the need for the more empirical $CaCl_2$ extractable P and P sorption index determinations. P fertilizer requirements for the six trials carried out in the 1980–81 season were highly correlated with EPC and P buffer capacity both derived from the two-point 'curves' ($r^2 = 0.92$).

A soil potassium (K) test calibration study was commenced in the South Burnett at eight sites. These sites were selected on soil analytical values determined by M/20 HCl extraction—the only method in routine use at the time—and were mainly considered to have a low K status.

Only one of the eight sites responded significantly to applications of potassium. Intensive soil sampling was carried out on the sites and chemical analyses determined using various extraction methods. The one responsive site had a low level of extractable K when a 0.005 M $CaCl_2$ extraction solution was used. This site had similar extractable K levels to other unresponsive sites when other extraction methods were used and had the highest total K content of all sites.

A model used in north Dakota for estimating nitrogen requirements for sunflowers is being tested for possible use in Queensland, with data collected from sunflower fertilizer trials in central Queensland. The model includes a yield goal (YG) and extractable soil nitrate nitrogen to a depth of 60 cm determined in the soil before planting as follows—

$$\text{Nitrogen fertilizer rate} = 1/20\ YG - (NO_3 - N_{0\text{–}60}).$$

The yield goal is set at a yield slightly less than the highest yield ever produced for a particular field. The factor 1/20 YG is used for yields between 1 600 and 2 600 kg ha^{-1}. For yields below 1 600 or greater than 2 600 kg ha^{-1} slightly larger factors are used.

By using data of known applied fertilizer rates and soil nitrate nitrogen levels, estimated yields were obtained. These yields were, in all 13 comparisons within 85%, and in nine of the comparisons within 96% of the actual measured yield.

In soil phosphorus studies in central Queensland, where the yield of sunflowers was in the range 700 to 1 600 kg ha^{-1}, there was no correlation between seed yield and P soil test as determined by bicarbonate extraction methods. The P sorption index, which is proving useful in soybeans in the South Burnett, is to be evaluated in the growth of sunflowers on low P soils.

There is an indication that vesicular arbuscular mycorrhiza (VAM) may be active in making soil P available to sunflowers growing in low P soil. However, when acid and bicarbonate extract P levels are low, it is possible for $CaCl_2$ extract level and EPC to be high. This and the role of VAM are being pursued in the current season.

In the potato fertilizer study on the Atherton Tableland, it was found that, where high levels of mineral nitrogen were present in the soil at planting, heavy applications of basal nitrogen can lead to yield reductions. When basal nitrogen fertilizer was over supplied, urea reduced yield more than nitram. By applying part of the nitrogen as a side dressing, the risk of yield reduction from over fertilization was reduced but the effectiveness of the fertilizer, per unit of applied nitrogen, was also reduced.

In the study of empty pods or 'pops' in Virginia Bunch peanuts in north Queensland, it was indicated that water availability to the developing pods is of major importance. In well irrigated crops, low native soil calcium levels are adequate for pod-filling but in dry conditions pod-filling continues to improve with heavy rates of applied calcium.

In such conditions the high solubility of gypsum makes it a more effective source of calcium than agricultural lime. Even when native soil calcium levels were high, drought conditions prevented normal kernel development.

Winter crop nutrition

The study of the fate of early applied nitrogen was continued in 1981 with trials in wheat at Bongeen, Bowenville and Greenmount. It was found that 38% of the nitrogen applied to the fallow in January was lost by planting time in May while 25% was lost from applications made in March.

Sampling following the March application showed that the nitrogen loss occurred mainly in the period March–May as the recovery of January applied nitrogen was very high (over 90%) at the March sampling. The loss may be due partly to immobilization but some is apparently lost to the atmosphere.

Depth of placement of early applied nitrogen had no effect on nitrogen recovery at planting. Likewise there was no difference in the level of recovery of nitrogen when the stubble from the preceding crop had been burnt, incorporated or mulched.

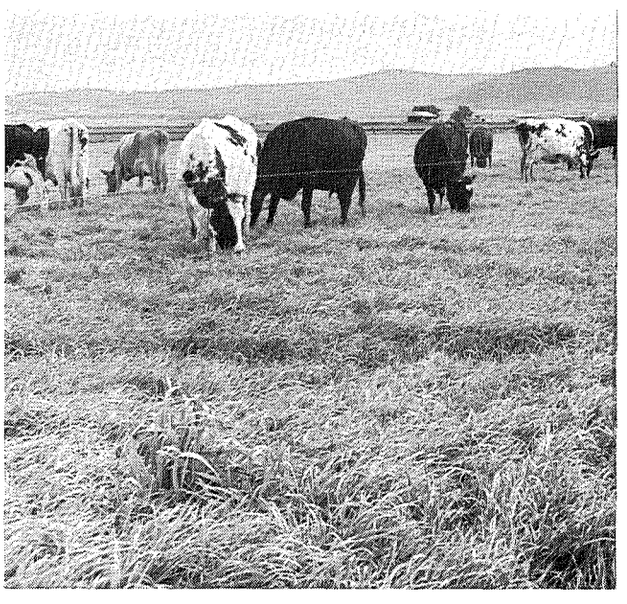
The loss of fertilizer nitrogen at the Bongeen site resulted in a reduced grain yield response to fertilizer. The yields from January and March applications of fertilizer were 30% and 16% respectively below that from the May application.

The possible loss of applied nitrogen from soil during periods of waterlogging is a major economic consequence for many Queensland graingrowers. The effective fertilizer application rate may be reduced if the soil waterlogs and some of the applied nitrogen is lost as a result of denitrification. Inhibition of nitrification of the applied nitrogen may offer a possible solution. If nitrification of ammoniacal or ammonium producing fertilizer may be slowed, nitrogen losses may be reduced by reducing the nitrate concentration in the soil during likely periods of waterlogging.

In 1980, nitrification inhibitors were applied diluted through water injection equipment and resulted in only slightly reduced nitrification rates of nitrogen applied as anhydrous ammonia. In 1981, nitrification inhibitor was applied undiluted using a micro injector. Six weeks after application only 27% of anhydrous ammonia had nitrified compared with complete nitrification of anhydrous ammonia applied without inhibitor.

It was formerly thought that copper deficient soils make up only a small proportion of Queensland wheat soils. From information obtained in the past year, it now appears that as much as 10% of the sloping (more than 2% slope) brigalow soils in the Drillham, Tara, Moonie, Yelarbon, Wyaga and Millmerran districts may be severely deficient and 20% may be marginally deficient in copper.

Cereal rye is the most tolerant of the winter cereals to copper and zinc deficiencies. Rye's greater tolerance is genetically controlled and can be transferred to triticale varieties by cross-breeding and to wheat varieties by chromosome substitution techniques.



Dairy cattle grazing irrigated, nitrogen fertilized ryegrass at Ascot on the eastern Darling Downs. This high quality forage is the basis of winter and spring production in many dairying areas.

These latter rye-substituted wheat genotypes are far more tolerant of both copper and zinc deficiency than their parent wheat genotypes and they cross readily with current hard wheat genotypes. Hence it may be possible to use traditional breeding techniques to insert rye genes for copper and zinc efficiency into modern wheat genotypes. A rye-substituted wheat genotype has been obtained and is currently being crossed to the wheat varieties Cook and Banks.

Agrostology research

Seed production research

The major work in north Queensland this year has involved publication of past studies, and the bulking of promising lines for further experimental work. Some 2 t of seed of 37 lines of grasses and legumes were produced, mainly from species such as *Stylosanthes scabra, Macrotyloma uniflorum, Lablab purpureus, Aeschynomene americana, Alysicarpus* spp., *Vigna luteola, Trifolium semipilosum, Centrosema pubescens, Panicum maximum, Brachiaria decumbens, Desmodium uncinatum, Neonotonia wightii,* and *Astragalus hamosus.*

The major destinations of this seed were the species evaluation programmes on the wet tropical coast around Mackay, the dry, subtropical pastures in the Rockhampton hinterland and the Mareeba dry-season-protein breeding programme. Some seed was used for establishment of nucleus and authentic seed stocks.

Commercial seed crops of Petrie green panic (*Panicum maximum* var. *trichoglume*) in the Biloela district of central Queensland were monitored for quality from before harvesting to completion of drying. The mature seed content of the pure seed fraction of the standing crops about to be harvested ranged from 54 to 88%, with an average seed viability (Tetrazolium test) of 87%. The viability of the headed seed sample before entering the drier was 78%, and after farm drying only 71%.

At Gympie, work has continued on crops such as Oxley fine stem stylo (*Stylosanthes guianensis* var. *intermedia*), which is now finding considerable grazier acceptance, but is being restricted by problems of seed production, and on Bargoo joint vetch (*Aeschynomene falcata*), another lower-growing, but very persistent legume with considerable potential in southern Queensland.

Since 1975, the efficiency of header harvesting of the tetraploid Rhodes grasses cvv. Callide and Samford has been assessed on a number of crops. Yields, harvest and crop conditions varied considerably. Efficiency of recovery varied from 15 to 59% (mean 37%) of hand-harvested yields on the Irish test, and from 16 to 74% (mean 41%) on the International test basis. Moisture contents varied from 34 to 60% depending on crop maturity and weather conditions, and purity of harvested seed (Irish test) from 29 to 80%.

Low caryopses counts were associated with either cold conditions or a poorly synchronized crop. Header harvesting showed some selectivity in recovering riper, filled seed, but completely removed some caryopses from the spikelets, though this was usually at a low level.

With Bambatsi panic (*Panicum coloratum* var. *makarikariense*) the use of nitogen fertilizer (0 to 200 kg N ha^{-1} $crop^{-1}$) approximately doubled inflorescence size. Percentage presentation yield (that is, maximum proportion of potential seed yield presented for harvest at any time) was about 40 to 60% in well-synchronized crops, but only 30% in poorly-synchronized crops.

Some preliminary screening of pre-emergence herbicides for legume and grass seed crop establishment has been undertaken at Gympie. Of the 12 chemicals tested on legumes, napropomide and trifluralin were the most promising. Five herbicides were screened on seven grasses. Except for atrazine on Silk forage sorghum (*Sorghum* spp. hybrid), all affected the grasses to some extent.

High rainfall tropical pasture research

On the Mackay coast, the testing of new legumes has continued with *Aeschynomene americana* placed under grazing in a 2.4 ha plot and planted with Callide Rhodes grass. It is persisting and spreading well. In attempts to find pasture species to control the invading unpalatable grasses, *Sporobolus diander* and *Eriachne triseta, Paspalum plicatulum* and *Stylosanthes scabra* cv. Seca have proved most promising in the Proserpine district.

Studies on the vegetative establishment of hetero (*Desmodium heterophyllum*) into pastures of *Brachiaria decumbens* at East Palmerston suggest that planting in bands, without seedbed preparation, but using a rotary hoe to cover the planting material, would be an effective and economical method of introducing this valuable legume to the large areas of *B. decumbens* that occur as pure swards on the northern, wet tropical coast.

Spelling, tine ripping, and disc ploughing were compared in an attempt to rejuvenate a degenerated Kazungula setaria pasture from which Siratro and centro (*Centrosema pubescens*) had virtually disappeared at Kuttabul in the Mackay district. The legume seedling populations increased with increasing soil disturbance for Siratro being 1.7, 8.8 and 14.1 plants m^{-2} for the three treatments respectively, and for centro only 1.5, 2.5 and 2.7 plants m^{-2}.

By April 1981, some 16 months after treatment, grass yields were 5 199, 5 150 and 4 577 kg ha^{-1} for the three treatments respectively, and legume yields 122, 187, and 502 kg ha^{-1}, indicating that spelling alone had little effect in restoring the legume component, and that severe cultivation was necessary if the legumes were to regenerate.

Under continued heavy grazing and fertilizing at Tedlands, the native legumes *Desmodium triflorum, Alysicarpus vaginalis,* and *Aeschynomene indica* have become very prominent, the latter two having increased from 17% and 5% occurrence respectively in 1978 to 27% and 41% occurrence in 1981. Yields of up to 2 000 kg ha^{-1} have been obtained from both of these species. The *Desmodium,* although widespread, is too low-growing to harvest with hand shears.

On the wet tropic coast, the production system grazing trials have continued at Utchee Creek. Belalto centro-Makueni guinea with one-quarter of the area as N fertilized signal grass remains the best treatment. Its stocking rate since April 1980 was 4.32 beasts ha^{-1} with a gain of 786 kg ha^{-1} liveweight from January 1980 to January 1981. At Tully, 300 kg superphosphate has been necessary every 2 years to maintain production levels, while cobalt supplementation has added 0.1 kg $head^{-1}$ day^{-1} to liveweight gains. Salt supplementation had no effect.

At South Johnstone, the fertilizer grazing trial involving 24 single-animal cells (four fertilizer treatments x three stocking rates x two replications) has been running for 6 years on an old *Brachiaria decumbens* pasture, which receives a basal dressing of 300 kg ha^{-1} of nitrogen each year. In 1980, significant pasture yield responses to phosphorus alone and to phosphorus plus calcium were measured. For the last 2 years, significant animal responses have been measured following the addition of phosphorus and calcium fertilizers.

The linear programming model being used to examine manipulation of pasture type, land class, and types of cattle has shown that the optimum pasture type selected for sloping and flat land is very dependent on beef prices. On poorly drained land, the main factors are seasonal selling strategy and property land class composition. Variation in the proportion of undulating land has little influence on the maximum gross margin from a given area of land, but markedly influences the selection of optimum seasonal buying and selling strategies and optimum pasture type selected for poorly drained land.

Dry tropics pasture research

On the basaltic soils of the southern Burdekin area, a number of legumes is still persisting at the Myuna, Havilah and Bluff Downs sites. Survival between sites appears to have been closely related to conditions in the establishment year: the better these were, the better the survival.

At Bluff Downs and under the most difficult conditions, only lines of *Desmanthus virgatus, Clitoria ternatea, Leucaena leucocephala* and *Stylosanthes scabra* (CPI–55868) are persisting. At Myuna, a number of annuals including *Centrosema pascuorum* CPI–55697, *Centrosema* sp. CPI–67641, *Desmodium dichotomum* CPI–47186, *Dolichos* sp. CPI–47056 and *Vigna trilobata* CPI–47510 regenerated well and produced well in the second season. *Indigofera schimperi,* the outstanding plant in the first year, has been removed from all sites pending clarification of its toxicity and weed potential.

In January 1980, 50 grasses from 17 genera were planted at eight sites in the Far North Queensland dry tropics representing a range of soils in the 700 to 900-mm mean annual rainfall zone. Fifty-two legumes from 18 genera as well as 28 browse shrubs from 15 genera were also sown at each of these sites.

From May to October 1981, the sites have been open to grazing. Persistence has been variable between sites. Most of the grasses at Southedge and Meadowbank persisted. At Mount Surprise, only *Cenchrus* and *Urochloa* spp. persisted. Of the browse shrubs, *Cajanus* was one of the most consistent survivors with *Tephrosia* and *Eriosema* also frequently present.

In another replicated, small-plot trial with 15 grasses, planted at three sites in January 1979, after common dry-season grazing with exclusion of stock over the wet season, *Bothriochloa insculpta* cv. Hatch yielded 6 000 kg ha^{-1} ODM at Meadowbank and Southedge. *Chloris gayana* cv. Callide (3 400 kg ha^{-1} at Meadowbank), *Paspalum plicatulum* cv. Rodds Bay (3 000 kg ha^{-1} at Southedge), and Callide (2 200 kg ha^{-1} at Southedge) were the next highest-yielding lines. Only Callide and several *Urochloa* lines persisted at Brooklyn.

The plant nutrition work from Mareeba is continuing as monitoring of existing trials. At Morecombe Station, Mount Garnet, on a red earth and a yellow earth duplex intergrade, fertilizers were applied in December 1978. Available soil phosphorus was still increasing as of the early dry season in 1981, and responses to phosphorus and sulphur were obtained. Phosphorus concentration in native grasses, but not in Verano stylo (*Stylosanthes hamata*), was decreased by the omission of phosphorus fertilizer but Verano populations were reduced in 1980 and 1981 by phosphorus omission.

Creeping bluegrass (Bothriochloa insculpta *cv. Hatch) has potential in grassing waterways in cropping areas of central Queensland as it establishes well on heavy clay soils. This seed crop was grown at the Kairi Research Station.*

On a red earth at Kalinga Station in Cape York Peninsula, only when 60 or 80 kg P ha^{-1} had been applied in 1975 was an effect on available soil phosphorus still recorded in 1981, although no dry matter response by the test legume, *Stylosanthes scabra* cv. Seca, was recorded.

At Morecombe Station on a near neutral red earth, the application of Super King in 1979 has increased the native grass phosphorus concentration in all 3 years since then, but has increased that of Verano stylo only in 1979. The effects of rock phosphate had disappeared by 1981.

In a comparison of N and P concentrations in the leaves of buffel grass on cleared brigalow at Havilah in the Burdekin area during early 1981, old pastures had leaf concentrations of P varying (from January to May 1981) from 0.41 to 0.19%, while on new pastures the levels were 0.47 to 0.30%.

These levels appeared to reflect the levels of available soil phosphorus (6 and 38 ppm bicarbonate extraction for the old and new planting sites, respectively). In January and February, leaf nitrogen concentrations on the new planting remained above 2%, while in the old pasture, it declined from 2% to 1.2%. In March, the leaf tip nitrogen concentrations were higher in the new than the old pasture, but by May 1981 had declined slowly to 0.6% in both pastures.

A number of breeder's lines of *Macrotyloma uniflorum* with different seed characteristics has been bulked to test the effect of such features as seed hardness and seed size on animal production in a co-operative feeding trial with the University of Queensland.

Pasture studies, central Queensland

The screening of chemicals for woody weed control has continued. Trichlopyr continues to be as effective as 2,4,5-T on all species tested. It can be applied in the same ways but is three times as expensive. Hexazinone is effective against most species but is also expensive. It is non-selective and requires special application techniques. The Symonds blade plough, a heavy-duty type, will give acceptable control of most species with a single ploughing 20 cm deep in late summer. It removes small stumps and does not invert the soil, but is unsuited to gilgaied areas.

In 1972–73, some 30 accessions of *Stylosanthes* were planted at three sites in central Queensland, managed, and sampled for the next 3 years. Then they were abandoned to uncontrolled grazing. Control was reimposed in December 1980.

In autumn 1981, plant populations and yields of the original plots were determined. At all three sites (Saltbush Park (160 km south of Mackay on a clay loam), Bouldercombe (20 km south south west of Rockhampton on a red duplex) and Westwood (50 km south west of Rockhampton on a clay soil)), Fitzroy stylo was the outstanding survivor in terms of density, spread and yield. Verano also had persisted and spread well. At Bouldercombe, *S. scabra* cv. Seca had the highest plant density (8.4 plants m^{-2}). *S. guianensis* var. *intermedia* cv. Oxley persisted well at Westwood and Bouldercombe.

The regional legume evaluation on contrasting clay, duplex and red earth soils, each at three centres in central Queensland, has continued. There has been extensive spread of the *S. scabra* lines on the duplex soils. There is still a marked residual effect of the phosphate applied 4 years ago to half the plantings at each site. A further series of tests will follow. *Atylosia scarabaeoides* remains the outstanding non *Stylosanthes* spp.

The effects of anthracnose on Fitzroy stylo throughout northern Australia was reassessed in 1981. After a wetter summer in the north, the lower rainfall limit is now less clear, but south of St. Lawrence, Fitzroy is little affected by anthracnose.

At Brigalow Research Station a major grazing trial is being mounted on the brigalow duplex soils. This follows the useful performance of Hereford steers grazing Fitzroy stylo in buffel grass (1 beast to 0.4 ha), which, in 131 days from January to May 1980, gained 57 kg (16%) more liveweight than similar steers on pure buffel grass. (The stylo had been planted in 1976). The major grazing trial was planted in January 1981 and grazing began in May 1982.

Treatments are four stocking rates (0.3, 0.6, 0.9 and 1.2 steers ha^{-1}) on Fitzroy stylo-Biloela buffel grass, two stocking rates (0.3 and 0.9 steers ha^{-1}) on buffel grass alone, and two stocking rates (0.3 and 0.9 steers ha^{-1}) on Fitzroy stylo-Biloela buffel plus 200 kg ha^{-1} superphosphate.

A 200 ha grazing study has also been mounted on Fitzroy stylo at 'The Springs' north west of Rockhampton on a duplex soil. This involves 4 x 50 ha paddocks of native pasture, grazing of which began in April 1980 with each paddock as native pasture alone. In November 1980, Fitzroy stylo was planted after a burn in two of the four paddocks at 2 kg ha^{-1} seed. In 3 years' time, one stylo paddock and one native pasture paddock will be fertilized with 100 kg superphosphate ha^{-1} each year for 3 years. The initial year's grazing indicates that these four paddocks are reasonably even.

Pasture studies at 'Brian Pastures'

The supplementation of breeding cows with leucaena at 'Brian Pastures' Pasture Research Station is now beginning to show effects. From May to November 1980, the breeders with access to leucaena lost only 11 kg liveweight hd^{-1}. In the fine stem stylo paddocks, they lost 39 kg hd^{-1}, and on native pasture with urea-molasses supplement the liveweight loss was 51 kg hd^{-1}. The mean 3-year calving percentages for the 3 years 1978 to 1980 are 76% (leucaena), 73% (fine stem stylo) and 71% (urea-molasses).

Despite a very dry winter and spring in 1980 with 53% less rainfall than the average for this period, and the declining productivity of the green panic ley pastures as they age, the final liveweight of growing animals in the intensive pasture system at 'Brian Pastures' was 443 kg hd^{-1} in 1980–81, compared with a target weight of 450 kg hd^{-1}. Over the 5 years 1976–77 to 1980–81, the mean winter-spring gains on green panic pastures have been 74 kg hd^{-1} from 1-year-old stands, 61 kg from 2-year-old, 50 kg from 3-year-old, 45 kg from 4-year-old and 35 kg hd^{-1} from 5-year-old green panic pastures, all grazed at the same stocking rates. This decline in performance has been related to the declining levels of N and S in the leaf, stem, litter and diet as the pastures age.

Within this system, the mean liveweight gains of the weaners (initially weighing 180 kg hd^{-1}) for the 5 years 1976–77 to 1980–81 have been June–August (green panic) 19 kg hd^{-1}; September–November (green panic) 34 kg hd^{-1}; December–February (native pasture) 58 kg hd^{-1}; March–mid April (native pasture plus leucaena) 28 kg hd^{-1}; mid April–May (crop residues) 22 kg hd^{-1}; June–August (crop products—feed lot) 90 kg hd^{-1}; total gain 251 kg; final liveweight 431 kg hd^{-1}.

Considerable progress is being made in the construction of a simulation model to use for the interpretation of past experimental data (PEDIM) within the PROBE (Primary Resource Options for Beef Enterprises) programme.

The relationships and information required to build a reliable and accurate pasture-forage model are: soil evaporation, green cover versus green yield, regrowth from ground level versus growth index, transpiration efficiency, death, detachment and litter decomposition rates, diet selection between green and dead, and diet quality. Relationships for the plant model can be calculated from plant yields and soil moisture measurements in bare soil, regularly mown plots and undefoliated swards.

The results for the native pasture-forage module are as follows—

- Regrowth (kg ha^{-1} day^{-1}) = 46 x growth index (R^2 = 84%). Growth index is calculated fom the water balance model WATSUP and temperature responses.
- Transpiration efficiency = 10 kg ha^{-1} mm^{-1} of transpired water calculated by tuning PEDIM for yield from a 6-weekly cut trial (1964–1970). Regression of observed (y) on predicted (x), $y = 1.10x - 81.1$, (R^2 = 88%).

The growth model was validated using 3-weekly cut data from the same experiment ($y = 0.97x - 8.0$ ($R^2 = 74\%$)), and for yields at the commencement of summer grazed native pasture ($y = 0.70x + 328$ ($R^2 = 72\%$)).

The rate of death, detachment and litter breakdown were calculated from monthly and seasonal presentation yields in current 'Brian Pastures' trials with R^2 for various components coming between 70 and 90%.

The ability to model the effect of stocking rate was tested using presentation yields at the end of summer grazing (1962–67) with stocking rates of 0.74, 1.24, and 2.47 beast ha^{-1} ($y = 81x - 5.6$ ($R^2 = 82\%$)).

The animal production model is still under development but already it is possible to predict monthly liveweight gain for each season with an R^2 of 70%.

The forage model so developed suggests accurate prediction of pasture yield (and hopefully animal production) can be achieved from a range of stocking rates and times of grazing with inputs of variable weather conditions. This module will be the basis for the development of property models and feed year plans.

The growth index model is a simple climatic derived predictor which, in the absence of more refined models, provides a method for analysing variability of animal production from different forage options. Optimal systems using historical weather records can be developed using iterative optimization techniques. The model is currently being expanded using PEDIM to develop feed year plans in a variable climate.

It is also proposed to marry these models to the nitrogen model NCYCLE, developed in Toowoomba, to attempt to account directly for variations in soil nitrogen fertility and its effects on pasture production.

Lucerne studies

The first tests of aphid resistant lucerne (*Medicago sativa*) cultivars at Biloela, Toowoomba and Gatton have been completed. Over 3 years at Gatton, C3 composite and CUF101 were the highest yielding lines with 49.5 and 46.4 t ha^{-1} gross yields. Hunter River's gross yield was approximately 20 t ha^{-1}. Under raingrown conditions at Toowoomba, Hunter River performed better. Matador, Falkiner, Cargo, PS581, and Salton were among the second highest yielding group at both centres.

A second series of plantings has been made at Biloela, Gatton, and six sites on the Darling Downs. These were planted in autumn 1981 and included newly bred Australian lines, such as the CSIRO-QDPI APC Cycle 3 material, and newer American cultivars. At Gatton, the initial yield leaders included CUF101, Granada, APC Cycle 3 and Matador.

At Gatton in January 1980, a small trial was planted of Australian bred material (APC Cycle 3 was not then available). Siriver, PS581, Siraf 80S and Siraf 80B were the highest yielding in the first 12 months. CUF101, Hunter River, DK167 and Falkiner had lower yields and Siraf 80A and Nova the lowest yields.

At Toowoomba in 1977, Hunter River and Siro Peruvian populations selected for anthracnose resistance were planted. Four years later, the bulk Siro Peruvian stand had lost 74% of plants from anthracnose, and the bulk Hunter River 35%. The stand losses in the F1 selected populations were only 58% and 23% respectively. In the F2, following a second cycle of selection, only 47% and 18% losses were recorded.

Annual medic studies

Under irrigation at both Warwick and Gayndah, Silk forage sorghum yield with annual medics was substantially greater than with no medics or no applied nitrogen and intermediate between 100 and 200 kg ha^{-1} of applied nitrogen. Responses, but of a lesser order, equivalent to 50 kg applied N, were also obtained under raingrown conditions.

Over the very dry 1980 winter, seed yields of a range of medic accessions were very low. *M. scutellata* cv. Robinson and *M. truncatula* cvv. Hannaford and Jemalong being the highest and most consistent and then averaging only 40 to 16 kg ha^{-1} of clean seed over all sites. In 1981 *M. polymorpha* (376 plants m^2), Jemalong (296), and Harbinger (286) had the highest average plant densities. Jemalong, Akbar, and Ghor had the highest average dry matter yields.

A further range of 96 annual medic lines, selected for tolerance to aphids, is being grown at Toowoomba as part of an Australia-wide evaluation. Nine lines from *M. truncatula, M. scutellata,* and *M. aculeata* have been selected from this collection for seed increase and further evaluation.

Temperate species studies

In southern Queensland, considerable winter rain can be received in some years. Scope exists for the use of a range of hardy, winter growing species, especially as improving irrigation technology permits the reliable bridging of winter feed gaps. Thus, the search for winter growing species other than the classical lucernes, medics and ryegrasses is being intensified.

The genus *Ornithopus* could be particularly useful on lighter textured acid soils. Thirty-two lines, representing a number of species ranging from early to late flowering, were planted at Toowoomba in mid June 1981. *O. compressus* cv. Pitman was late flowering.

In the field at Leyburn, outside Warwick, six lines of *O. compressus* proved superior to the current commercial lines cvv. Pitman and Uniserra, with the latter being the superior commercial line.

A range of 25 temperate legumes, including accessions from *Ornithopus, Trifolium, Medicago* and *Vicia,* were planted at six sites around the Downs and Near South West. *V. dasycarpa* cv. Namoi proved outstandingly vigorous at all sites in the first year.

Uniserrra serradella and Jemalong medic have been grown in the glasshouse in soil cores of 36 soils from throughout southern Queensland. There were no differences among the top quartile of soils (fertile uniform clays and duplex soils) with regard to medics

Purple pigeon grass (Setaria porphyrantha *cv. Inverell) has potential as a pasture species on the black clay soils of the eastern Darling Downs. The grass is a recent release and seed is just becoming available. This stand at Mount Irving, near Toowoomba, was sown on 11 December 1981 and was photographed on 24 March 1982.*

grown both with and without added nutrients, and serradella without added nutrients. Several medium and coarse textured soils gave good serradella growth when nutrients were added.

Under irrigation in south east Queensland, the South African rust resistant ryegrass cultivar Midmar continues to perform well. This is a diploid *L. multiflorum* of the 'Italian' type. It has rust resistance superior to that of other annual types, but is not completely free from rust in late spring. Earlier sowings of all ryegrasses were more severely rusted than late sowings. Mid April sowing was least affected.

Subtropical species evaluation, southern Queensland

Generally, southern Queensland provides a difficult environment for genera such as *Stylosanthes,* although accessions are being found which show some promise. Fine stem stylo (*S. guianensis* var. *intermedia*) is gradually becoming better known and the demand for seed is proving increasingly difficult to meet. Fitzroy, and even earlier flowering accessions of *S. scabra,* are also showing promise farther and farther south. Fitzroy and CPI49834 are being evaluated in the Burnett region. In one trial in the Moreton region, they equalled Siratro in production over the first 3 years, but following an abnormally cold winter and dry spring they failed to regenerate.

Further plantings of other *Stylosanthes* accessions are being made, especially as no *Macroptilium* lines superior to Siratro are available.

Some 336 tropical legumes, representing 38 genera and 113 species, have been sown on brigalow clay and deep sandy loam soils at Bringalily and Wandoan on the Darling Downs. Rainfalls 9% to 35% below average have been experienced. Even irrigation has given no better than 79% establishment of the lines planted in the third year. Highest productivity has come from *Clitoria, Macroptilium, Vigna, Desmanthus, Lablab, Macrotyloma, Rhynchosia, Sesbania, Cassia* and *Desmodium* accessions.

Over all species, sodium concentrations were little affected by site, but chloride concentrations were increased by 10% and 40% at Bringalily and Wandoan, respectively, relative to a non saline acid soil at Toowoomba.

Semi-arid species evaluation and establishment

Assessment of new plants for western Queensland has continued with both pasture and browse types under evaluation. In particular, material from Botswana and North Mexico has been examined.

In the grazing study established in 1976, the three *Cenchrus ciliaris* lines and the native *Thyridolepis mitchelliana* continued to increase, especially after favourable autumn and winter rains.

Freshly harvested seed of three native and one introduced grass, one native legume, and one herb was exposed in the field in nylon bags either on the soil surface, in heavy shade, or buried 2.5 cm deep. The introduced grass *C. ciliaris* Q10077 appeared to lose its dormancy and viability most quickly. Only under heavy shade did any viable seed remain after 2 years.

In the field, *C. ciliaris* establishment and growth was improved by the application of water soluble phosphates. Some 237 days after planting, the control plots had only 1.4% seedling survival while the addition of 200 kg ha^{-1} of monosodium phosphate gave 35% survival.

The use of water soluble phosphates as seed pellets has been effective in enhancing seedling survival in the field but only when adequate moisture was available.

Management studies in semi-arid pastures

A major part of all work in the west has been to gain an understanding of the reaction of different vegetation types to different management programmes so that the long-term productivity of the pastures can be maintained.

One aspect has been the monitoring of the relative populations of both useful and poorer quality grasses under differing grazing pressures. At Arabella, Charleville, on a mulga pasture, nearly all *Aristida armata* plants died in the 1979–80 drought but were replaced rapidly by seedlings once rain fell. Mortality and recruitment was not related to grazing pressure. Mortality of three favoured species was not as severe but still reached 80%. Seedling recruitment was lower so that, by late 1981, *A. armata* was approximately twice as numerous relative to the other species as it had been 2 years earlier when monitoring commenced.

Various *Aristida* spp. are susceptible to clipping, burning, and nitrogen fertilizer, but such treatments had no lasting effect on an almost pure *A. armata* population at Charleville. Kills of up to 80% of populations were achieved but rapid seedling replacement occurred.

Approximately 25% of monitored young mulga trees in the various treatments at Arabella died during 1980–81. Deaths were unrelated to treatment. Some ungrazed mulga grew above the browse level of sheep, but grazed plants made almost no growth. Basal areas have fallen substantially at all levels of use but have been greater at 50% and 80% than at 20% utilization. Wool production per animal and per hectare was greatest during the dry 1980–81 period in the 20% utilization treatment.

On the Mitchell grass areas, attempts to increase the herb content of pastures by burning and heavy stocking have not been successful although, under the favourable seasonal conditions of 1981, the modified (burnt and heavily stocked) paddock has given more and heavier lambs. This did not occur under the harsh conditions of the previous year.

At Burenda, Augathella, the 80% utilization paddock has fallen to its lowest basal area so far recorded (0.7% versus 3.5% in 1977). The basal area in the 10% utilization paddock is still at 2.4% although originally this was 4.9%.

Agricultural extension

Farmers, primary producer organizations and government instrumentalities at local, State and Federal level require technical information and managerial advice on field crop, forage crop and pasture production, soil, machinery and farm management.

Agribusiness firms and their representatives, hobby and part-time farmers and backyard gardeners as well as the commercial farmers are making increasing demands for assistance. The extension service exists to meet those needs.

The extension officer's role is to link industry with developing technology and to temper this with consideration and concern for the stability or improvement of soil, water and plant resources. Extension officers undertake specific projects emphasizing new problems or techniques, they engage in dissemination of technical and farm managerial information and they require frequent technical training to keep abreast of technical developments.

A significant proportion of their activities requires integration with officers of other disciplines. This is reflected in joint extension projects with officers of Soil Conservation, Beef Cattle Husbandry, Entomology, Plant Pathology and Dairy Field Services Branches.

The trend of recent years towards more farmer group activities has slowed. The past year has seen an upsurge in requests and demands for farm visits which has placed considerable strain on both staff and financial resources.

Group activities are used wherever appropriate particularly in management areas such as farm management, crop sequences and rotations and pest management. Discussion groups, workshops, farm walks, producer schools are useful to address these and similar production restraints but the recent upsurge in farm enterprise diversification and the influx of numerous new farmers from interstate and, to a lesser extent, overseas has necessitated a marked increase in the number of farm visits. In some instances, these farm visit demands have exceeded the staff and financial resources available.

Cropping continues to expand and the area being brought under cultivation in the Central Highlands, for example, is currently about 30 000 ha per year. In the Maranoa, it is estimated that the area of cultivation has doubled in the last 2 years and is expected to double again in the next 2 years. It is expansion of this magnitude that thas catalysed the upsurge in farm visits by many Branch extension officers.

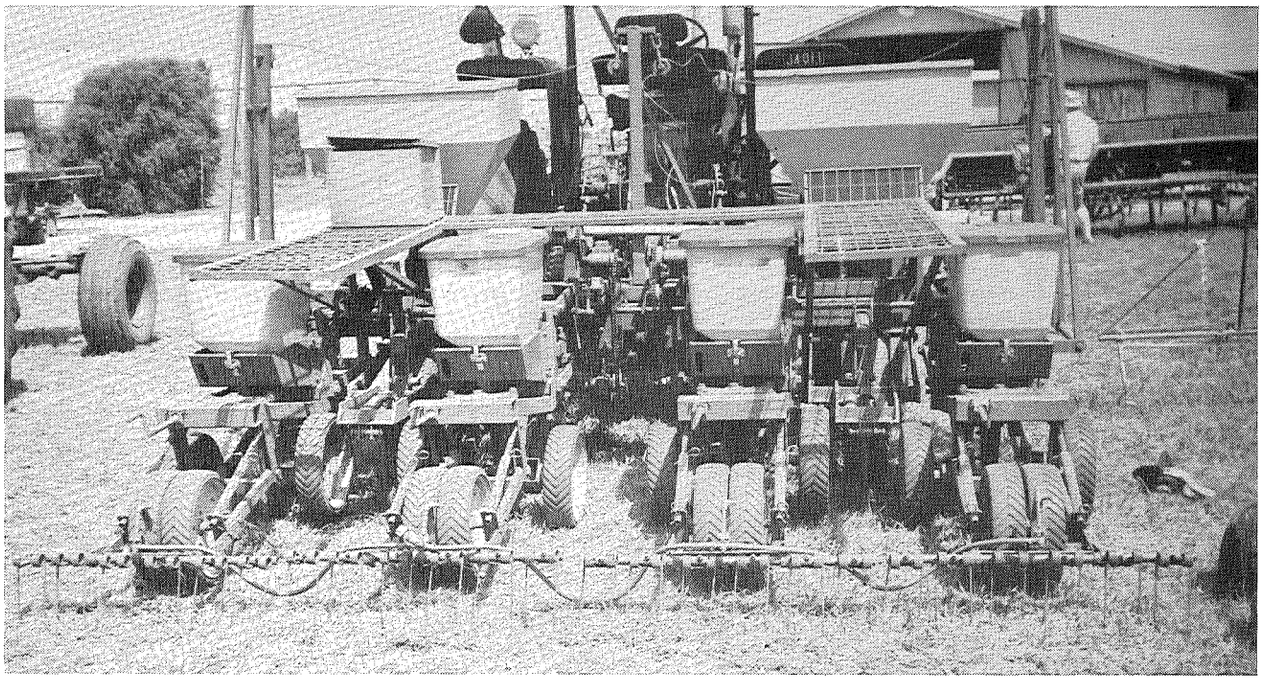
Pasture development has slowed in response to lower beef prices although some development is continuing. The sown pasture seed supply problems of recent years are being overcome. Adequate supplies of Seca and Verano stylo are now available and seed supplies of Oxley fine stem stylo and Fitzroy stylo are improving.

The pasture seed industry is expanding and gaining in confidence, particularly in the Wide Bay and Coastal Burnett districts and considerable extension activities are being directed at these seed producers.

Farmers continue to diversify their farm enterprises. As well as diversifying from grazing industries into cropping, the range of crops being grown on farms is expanding. On the Darling Downs, where farm enterprise diversification is probably greatest, the range of field crops being grown now covers sunflowers, soybeans, navy beans, cotton, triticale, chickpeas, mung beans, lupins and rapeseed as well as the traditional crops of wheat, barley, oats, grain sorghum and maize. Further, the area under irrigation has increased dramatically.

This farm diversification is occurring in all regions of the State.

Graingrowers, in particular, have sought advice on farm machinery management, modification and selection as farm machinery costs continue to escalate and threaten the profitability of grain enterprises. A second farm machinery extension officer has been appointed to train Branch extension officers in aspects of farm machinery management and to boost the Branch's ability to service these demands.



This one-pass unit for sowing, fertilizing and applying herbicide was demonstrated at a conservation cropping field day organized by the DPI on a private property near Kingaroy.

Conservation cropping

Conservation cropping activities have a high extension priority. Extension projects integrating the activities of both Agriculture Branch and Soil Conservation Branch officers have been implemented in a number of districts including the Atherton Tableland, the Central Highlands, the Dawson Callide, the South and Central Burnett, and the Darling Downs.

These conservation cropping activities also utilize the skills and expertise of experienced and established farmers and are directed at the development of tillage and other crop production practices which maintain or increase productivity and stabilize the soil resource.

These activities must produce new crop production technology which will be of relevance to broadacre crop production in all subtropical and tropical environments.

Recommendations on the appropriate crop varieties and/or hybrids to plant in each district have been continued. This service covers wheat, oats, barley, grain sorghum, maize, sunflowers and soybeans and enables grain growers to select top performing varieties and/or hybrids.

Inservice training activities have been somewhat curtailed or deferred because of financial restraints. A workshop to review winter crop production technology was the major inservice training activity for the year. Other training activities include a nematode workshop and several regionally organized activities such as a tractor performance workshop on the Darling Downs and a pasture seed production workshop in the Burnett Region.

Most extension programmes and projects are planned and implemented on a district or regional basis.

North Queensland

The legumes, Seca, Verano and Fitzroy stylo, are the basis of the extension effort in the dry tropics beef production areas of north Queensland. Development sites have been established at Mareeba, Georgetown and Laura and a further site is planned on the basalt country north west of Charters Towers.

The adaptation of these legumes continues to impress. The legumes are well established despite light seeding rates at the two Georgetown sites. The legume will spread, particularly through the grazing animal, but the Georgetown sites have not thickened as desired since being sown in late 1978. This has prompted a reassessment of establishment strategies.

These sites are now producing useful animal performance information which is urgently required. The sites have also been extremely useful in demonstrating these legumes to graziers. Some graziers are so impressed with these legumes that they are sowing significant areas on their properties.

At Bowen, interest in these legumes is very high and significant areas of Seca and Verano stylo have been sown into *Bothriochloa pertusa* pastures. More than 2 t of seed of each legume have been sown in the Bowen and Proserpine Shires.

A survey of graziers on basaltic soils of the McBride Plateau is in progress. The survey is assessing the state of property development and property management problems.

On the wet tropic coast, the Utchee Creek, East Palmerston and Tully grazing systems demonstrations were continued. These sites are demonstrating complex grazing systems developed for this environment at the South Johnstone Research Station.

Use of the Tully demonstration site for extension activities has been curtailed until emerging nutritional problems have been further researched. Development of the poorly drained country represented by this site is not being promoted until further technology is available.

In the dairying areas of the Atherton Tableland, co-operative work with Dairy Field Services Branch continues to boost dairy production. This project is directed at developing appropriate pasture based feed year systems. The major thrust in the past year has continued to be directed at nitrogenous fertilizer application on permanent grass pastures, the use of temperate clover based pastures in winter, maize silage and better management and regeneration of degraded grass legume pastures.

Monthly milk production, fertilizer sales and production from clover based pastures indicate the success of this project.

Mount Coolon is an isolated district 200 km south west of Bowen and a discussion group has been re-activated in this district to assist in sound sown pasture development to combat the threat of Parthenium weed and timber regrowth.

Extension activities directed at the multimillion dollar tobacco industry at Mareeba-Dimbulah emphasized crop hygiene to reduce disease and insect pest incidence. Significant improvement in crop residue destruction was achieved with 98% of farmers attempting to destroy tobacco stalks.

Another major project was in the area of irrigation management to prevent early flowering of tobacco. The success of these activities is difficult to assess because of seasonal influences but no early flowering occurred.

Weed control in rice crops is demanding more attention at Mareeba and in the Burdekin. At Mareeba, emphasis was directed at alternative herbicides to atrazine and propanil and at spray coverage and timing of herbicide application. In the Burdekin, control of rice off-types, mainly red rice, is of high priority. Until a selective herbicide becomes available, attention is being directed at cultural practices, improved seed handling facilities and the production of pure rice seed.

The development of suitable crop rotations for the rice growing areas is a high priority to maintain yields and to reduce the incidence of weeds, pests and diseases.

Low rice millouts in the Clare, Millaroo and Dalbeg areas of the Burdekin have significantly reduced growers' returns. The cause appears to be climatic, although some potential to reduce the problem is available through harvest at higher grain moisture. This aspect is being further investigated.

Extension activities directed at the north Queensland peanut industry have incorporated initiatives resulting from an industry-financed visit to peanut growing areas in the United States of America by the Atherton based extension officer.

For many years, the industry has sought a quick and easily used method of determining crop maturity. A method developed in the USA was field tested on the 1982 crop and is showing considerable promise. The method, which involves the determination, using a pocket knife, of pod maturity distribution at any stage of crop development, will be field tested again in 1983. If the 1982 results are confirmed, the method will be extended to all peanut growers.

The project which stresses the need to match peanut crop size with soil, machinery and labour resources has been continued and has been a considerable influence on peanut industry productivity and farm profitability.

The maize industry is well established on the Atherton Tableland and is enjoying a resurgence in the Burdekin. Extension activities on the Tableland emphasized Noogoora burr control but the recommended herbicides have not been as efficacious as desired.

The Burdekin is a major producer of navy bean approved seed and Ayr based officers are involved in all stages of seed production while Atherton and Mareeba based officers are assisting in the establishment of a commercial navy bean industry in those districts.

Capricornia

The area under crop continues to expand in all districts. This expansion has made enormous demands on staff and the Branch has appointed two additional officers to the region. After a suitable period of training, these officers will be based at Clermont and Emerald.

The demands for property development advice are difficult to meet other than through a farm visit and subsequent personal consultation. These activities consume considerable time and resources and affect other planned extension activities.

The development of conservation cropping practices is a co-operative project with Soil Conservation Branch officers and with commercial companies. The use of crops such as wheat, which provides more soil surface cover, is being studied and some 15 000 ha of early planted wheat was sown in 1982 on the Central Highlands. Interest is also being shown in this strategy in the Dawson Callide.

In addition, appropriate farm machinery modifications are being promoted and the effect of reduced tillage and alternative methods of weed control are being monitored in a number of districts in the region.

Summer crops have traditionally been difficult to establish in the Capricornia region and plant populations of commercial crops have been unsatisfactory. Considerable extension effort has been directed at encouraging growers to monitor and assess plant populations and to use modified planting equipment.

Soil insects have been a major influence on crop establishment particularly on the Central Highlands and grower response to extension activities on baits to control these insects has been enthusiastic.

Insect pests, particularly sorghum midge and *Heliothis*, were also significant production restraints in all districts of the region. Major grower seminars were held in the Dawson-Callide and at Rockhampton in November. Despite these and other extension activities, midge and *Heliothis* caused considerable damage to grain sorghum crops.

Weed control in winter crops was generally satisfactory but weed control in summer crops requires a lot more attention. The herbicide atrazine did not give adequate control of pigweed and further studies are required.

Herbicide usage is expanding in all regions as a result of farmer recognition of the need to reduce tillage operations and fuel costs. In addition, the suite of weeds present in Capricornia crops is expanding as cultivations age. Perennial weeds such as Peak Downs curse are spreading and nutgrass is a serious problem on the Dawson-Callide alluvials. Increased extension attention will have to be directed at all aspects of weed control.

The 1981–82 cotton crop in the region consisted of 17 000 ha of irrigated cotton, and 2 300 ha of dryland cotton. This will produce an estimated 68 000 bales of cotton, a 58% increase over the 1980–81 harvest. Pest control and irrigation strategies received emphasis from the Biloela based officers while extension activities directed towards the Emerald cotton growers were curtailed by the absence of an extension officer on study leave.

Weeds remain a major production restraint in all cotton growing areas and weed control and irrigation management are seen as the two areas requiring further extension effort.

Extension activities directed towards the beef industry have largely been directed from Rockhampton; officers in other districts of the region being almost fully occupied in field crop activities.

The performance of promising pasture species including Seca, Verano, Graham and Fitzroy stylos, leucaena, Hatch creeping bluegrass and Indian bluegrass is being monitored at a number of pasture development sites in the region. Grazier interest is high but further extension activities are thwarted by scarce seed supplies and lack of animal production information.

Considerable energy and effort have been directed at correcting pasture seed supplies. About 25 seed producers in the region have some 120 ha of Fitzroy stylo seed production areas; several growers have established Hatch creeping bluegrass seed production plots and increased quantities of Peru and Cunningham leucaena seed are reaching the market.

Mr Ken Jackson, an Agriculture Branch Agronomist, is rating safflower for the lead disease Alternaria carthami *at Biloela Research Station.*

Burnett and South Burnett

The recent expansion in grain cropping in the region was consolidated during 1981–82 and extension activities were directed at opportunities to improve crop husbandry and management.

In the South Burnett and in the Central Burnett, a number of conservation cropping projects was initiated in conjunction with Soil Conservation Branch officers. Activities in the South Burnett have concentrated on developing conservation cropping systems for soils other than the friable red earths and on the promotion and extension of an established conservation cropping system on the friable red earths.

Pilot farms have been selected at Merlewood, Byee, Haly Creek and Memerambi as sites to develop, in association with the farm owners, appropriate systems for soils other than the friable red earths. Considerable progress has been made on the Merlewood and Byee sites with herbicides and reduced tillage innovations being extremely successful. The extremely wet conditions of the 1981–82 summer limited progress on the other two properties.

Some 180 farmers and agribusiness people attended a successful field day on a friable red earth site at Wooroolin in March. This activity allowed farmers to study the conservation cropping system developed in previous years at another site and further assess machinery essential to the system.

Experience in 1981–82 has indicated that, while few farmers are prepared to adopt completely the conservation cropping system developed for the friable red earths, most have incorporated elements of the system into their operations. There is a definite and exciting trend in the South Burnett towards adoption of conservation cropping principles.

A major field day on tractor performance and machinery matching was held in the Binjour area which was enthusiastically received by local graingrowers.

In the Central Burnett, progress has not been as rapid but one pilot farm has been established and farmers are monitoring developments closely.

Weeds and weed control also received considerable attention. At both Gayndah and Monto, the efficacy of the commercial herbicides Vernam and Eptam in suppressing nutgrass in crops was studied. The herbicides are useful but techniques of application need to be further defined.

In the South Burnett, the use of controlled droplet application equipment for herbicide application was further studied. Despite satisfactory results in Departmental trials and demonstrations, some farmers are still experiencing problems particularly in the use of the herbicide dinoseb.

Another project at Kingaroy was directed at appropriate fertilizer use. The use of fertilizers in crop production has been widely accepted but fertilizer prices change and economic information on fertilizer use is regularly updated and distributed.

At Bundaberg, tobacco growers have improved fuel economy of curing barns mainly through avoiding overloading and curing only mature leaf. Disease control in the tobacco crop has also been improved significantly.

Landholders in the Coastal Burnett are also diversifying their farm enterprises. Information on crop adaptation and production restraints is becoming available through a series of 'new' crop demonstrations/trials. The triticale varieties Dua and Satu yielded in excess of 2 000 kg per ha at Yerra and offer promise as a winter cereal in the district.

Pasture seed production is also enjoying a resurgence in the Coastal Burnett. This enterprise is being promoted as a sideline to the beef industry. The species receiving attention are Callide and Katambora Rhodes grass, Hatch creeping blue grass, Fitzroy stylo and Oxley fine stem stylo. There are now 25 of these pasture seed producers in the district.

In the beef areas, extension activities emphasize the need for increased areas of sown pastures. The present economic conditions in the beef industry have retarded expansion but producers are enthusiastic about the development site established at Gaeta in the coastal speargrass foothills to monitor Fitzroy stylo performance. This and other sites throughout the Burnett are producing useful information on the adaptation of Fitzroy stylo, Oxley fine stem stylo and the browse shrub, leucaena.

Moreton

In the dairying areas, improved industry economic conditions have placed considerable demands on both Dairy Field Services Branch and Agriculture Branch officers for advice on feed year systems. Irrigated, nitrogen fertilized ryegrass is the basis of winter and spring production but considerable attention is being directed at incorporating winter growing legumes such as the clovers to reduce fertilizer inputs. Other aspects of the dairy feed year programmes receiving attention include over-sowing ryegrass into kikuyu pastures at Mount Mee, Dayboro, Woodford and Kilcoy, and the role of Callide Rhodes grass on both dryland and irrigated farms in the West Moreton.

The feed year options for dairy farmers in the region are at the fine-tuning stage and the widespread use of sown pasture-forage crops as a basis for dairy production has had a significant impact on the ability of dairy farmers to take advantage of the improved economic conditions in the industry.

Land management projects have been further pursued in association with Soil Conservation Branch in a number of districts. In the Lockyer Valley, the promotion of useful tree species such as leucaena and sown pastures to stabilize land slips continued. Established seedlings of leucaena have been distributed to landholders and seed has been provided to others.

Further studies on leucaena establishment practices under cultivation and zero tillage were also established during the year.

Plans are in hand to assess the performance of timber species on these sites in conjunction with the Forestry Department.

Salt pan and scalded area revegetation has also progressed with marine couch, salt water couch and tall wheat grass exhibiting most promise.

Weed control is a major issue in crop management in all districts of the Moreton region and considerable extension effort was directed at improving weed control practices, particularly in soybeans.

A major extension effort was directed at developing techniques in minimum tillage in the region. Soybeans and pigeon pea crops were successfully grown by direct drilling into pasture land using the herbicide glyphosate. Grazier interest in this initiative is high as it offers prospects of enterprise diversification.

Another project with Monsanto Australia Ltd. assessed the direct drilling of soybeans into cereal stubble. The same machinery was used as in the pasture situation. Sunken wheel track areas developed by the header during the cereal crop harvest resulted in reduced plant stand, the windrowed stubble caused planting problems and soil borne diseases were more evident in the direct drill areas than in adjoining normally cultivated areas.

Despite these setbacks, the crop yielded 2 t per ha and further work is warranted.

Co-operative activities with the Victorian Department of Agriculture have resulted in considerable reduction in damage to and delivery of low quality Victorian certified seed potatoes.

Darling Downs and Near South West

All officers report an increasing demand for services and officers on the Darling Downs, for example, handled 17% more office and telephone inquiries in 1981–82 than in 1980–81. Programmed extension has stimulated the number of farmer inquiries and farmers are becoming more businesslike as costs increase at a greater rate than farm commodity prices.

Considerable emphasis and attention was given to conservation cropping projects which are a joint activity with Soil Conservation Branch. These projects incorporate district activities supported by an overall regional programme. It is designed to improve farmer awareness and understanding of the importance and cost of soil erosion and the benefits of stubble protection and conservation cropping systems.

Farmer directed activities were more prevalent at Dalby, Pittsworth, Millmerran and Warwick although significant extension activities were conducted in all districts. Activities in the Near South West have mainly been directed at improving extension officers' expertise in farm machinery relevant to conservation cropping and significant farmer directed activities are planned for 1982–83.

Farm management extension activities were further intensified. Some 24 farmers attended the third farm management workshop held at the Dalby Agricultural College. This project, while led by the Dalby based Agriculture Branch extension officer, also involves officers from Economic Services Branch, Sheep and Wool Branch and Beef Cattle Husbandry Branch. Activities subsequent to the live-in workshop reinforce issues discussed at the workshop.

The farm management study with a group of grain farmers at Jondaryan was continued for a third year. This study has resulted in significant changes in both farmer attitudes to farm management and in on-farm practices. A second year's analysis of a group of 12 mixed livestock-grain farms at Oakey has also been conducted and again considerable progress has been made.

Extension activities in farm machinery management were also intensified. Major field days on tractor performance and machinery matching were organized at St. George, Brigalow, Millmerran, Oakey, Inglewood, Taroom, Drillham, Moonie and at Farm Fest, Toowoomba. Feedback from these activities has indicated a high degree of acceptance by farmers.

To complement these activities, some 22 meetings and seminars have been addressed on the topic and a regular column 'Talking Machinery' has been supplied to the newspaper *The Graingrower.*

In the Murilla and Taroom Shires, a significant project has commenced to assist farmers further to set, match and operate farm machinery efficiently.

Irrigation continues to expand in the region, particularly on the central Darling Downs, along the Macintyre and Barwon Rivers between Yelarbon and Mungindi, and at St. George. The project aimed at improving water use efficiency on the Darling Downs and studies on the effect of different watering regimes on cotton were initiated.

In addition, a Toowoomba based extension officer is undertaking post graduate training in irrigation and water use management at the University of California, Davis, on a scholarship significantly funded by the cotton industry, Darling Downs irrigators and the Queensland Grain Growers' Association.

In the St. George irrigation area, the project to eradicate grassy sorghum off-types has been pursued, with incidence of the weeds being maintained at a very low level.

In the rapidly developing irrigation areas along the Macintyre and Barwon Rivers, assistance has been given to new irrigators in site selection, irrigation layout, as well as in irrigated crop husbandry.

A major extension project involving Economic Services, Beef Cattle Husbandry, Sheep and Wool and Agriculture Branches to study livestock production from intensive irrigated ryegrass pastures has been initiated along the Border rivers. This study has revealed less than desirable fattening rates and the project is continuing with farmer co-operators.

Weeds remain a major production restraint in cultivations throughout the region and a number of planned extension activities have been mounted to address this issue.

The Johnson grass control activities were again pursued in the Cambooya, Jondaryan and Wambo Shires. The impetus in this project has slowed but much remains to be achieved in both on-farm and off-farm situations.

The increasing complexity of herbicide usage in weed control has catalysed numerous farmer inquiries on herbicide selection, efficacy, application and in crop tolerance to herbicides. While agribusiness is also handling an increasing number of weed control and herbicide inquiries, farmers are making increased demands on extension staff. These demands are arising from the farmers' perceived need to obtain independent, unbiased advice.

At Goondiwindi, a major extension effort is being directed at using crop rotation to control black oats. The thrust of the programme in 1981–82 was in improving grain sorghum crop husbandry techniques in this marginal summer crop environment.

Fertilizer usage is expanding rapidly and an estimated 55% of farmers in the Wambo Shire are now using fertilizer compared with fewer than 10% only 10 years ago.

A major seminar on fertilizer use in winter cereals was held in Toowoomba in March in association with Consolidated Fertilizers Ltd. This was attended by more than 200 farmers and reflects the increasing farmer interest in correct crop nutrition.

Zinc deficiencies are becoming more widespread on the central Darling Downs as farmers recognize this production restraint and significant extension activities have been directed at this issue.

In the Near South West, phosphatic fertilizers are rapidly gaining acceptance as a result of a concerted effort by extension staff.

Summer crop establishment has been monitored in the Miles, Wandoan and Taroom districts and a project has been undertaken to quantify the advantage of presswheels on planting equipment. Significant improvement—from 30% emergence to 50% emergence—was achieved with presswheels. Further improvement is necessary and presswheel pressure and its influence on different soil types require further monitoring.

In the dairying areas of the eastern Darling Downs, extension activities have been directed at the further development of feed year programmes. On many of Downs dairy farms, irrigation is very limited or not available. Consequently, winter and spring production based on irrigated fertilized ryegrass is not an option. Alternative feed options include oats, silage and concentrates and feed year programmes incorporating these options are being promoted.

In the granite and traprock around Stanthorpe, Inglewood and Texas, extension effort is being directed at the development of low cost sown pastures, management of native pastures to promote winter growing species such as *Danthonia* and the assessment of adapted sown grasses and legumes.

Pasture development continued in the western areas but at a slower rate than in recent years with the influences of rapidly expanding cropping and some lack of confidence in the beef industry.

Timber control and particularly timber regrowth control activities were numerous as graziers sought to maintain or increase production. This technology is available and recommendations have been largely followed.

In the Near South West, interest in the winter growing annual medics has been maintained as a companion legume in sown grass pastures, and as a legume to be sown with wheat or oats when a cultivation paddock is to be returned to pasture.

Horticulture Branch

THE horticultural industries in Queensland produce a wide range of fruit and vegetable products for both fresh and processing markets as well as an ever increasing range of quality cut flowers and potted ornamental plants. The food products make up a very important part of our daily diet. As well as their significant nutritional contribution, they make food flavoursome, interesting and enjoyable.

The work of the Horticulture Branch is directed towards the development of the productivity of these industries in the State while conserving our natural resources. Its activities include extension, regulatory and research services in major producing areas. As most fruit and vegetables are perishable, emphasis is also given to maintaining quality during the marketing chain from the farm to the consumer.

Extension services are available to producers in all districts. These services include the provision of a wide range of technical information incorporating latest developments and current trends. Producers are also encouraged to adopt sound farm management and conservation practices. These Branch services are in very strong demand in all centres but particularly where industries are expanding and new industries developing. Extension services are also provided in the post-harvest and marketing areas with a view to reducing wastage and improving the quality of fruit and vegetables reaching the consumer.

Investigations of problems and opportunities in the production of horticultural crops is a major function. This research is carried out in field trials on research stations and grower properties as well as in glasshouses and laboratories. In recent years, particular emphasis has been given to the introduction and testing of subtropical and tropical fruits. The development of improved vegetable varieties by introduction and breeding has also been a priority area. Post-harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory, Hamilton.

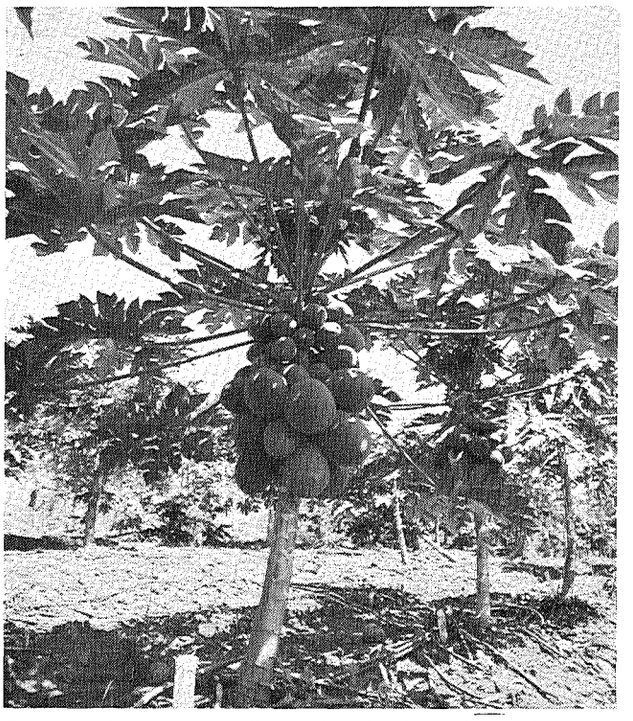
Regulatory duties are also undertaken by the Branch. It plays a major role in administering the *Diseases in Plants Act,* which is aimed at limiting the spread of pests and diseases of plants within the State and preventing their entry from other States.

As an agent of the Commonwealth, it also administers, within the State, the Commonwealth Quarantine Act (Plants) designed to prevent the entry into Australia of any pests or diseases of plants, or weeds which might constitute a hazard to primary production. As well as inspections of passengers and cargo entering the country, increasing emphasis is being given to monitoring and surveillance of the northern areas of the State to prevent the spread of serious pests and diseases from neighbouring countries.

Research

The major aim of the research programme of Horticulture Branch is to improve the quality, range, and availability of fruit, vegetables and ornamentals to the consumer, while minimizing production and distribution costs; and to make the production of these commodities more efficient, more reliable and less labour intensive.

The work covers plant introduction and breeding, the development of improved cultural and management systems, the integration of mechanized production and harvesting systems, and



Breeding for better quality and fruit shape is an important segment of the papaw research programme.

improvement in methods of handling, transport, storage and distribution. Some emphasis is also given to the development of potential new crops and extension of some existing crops to new areas.

Vegetable breeding and varietal introduction

The breeding programme aimed at producing a cold tolerant, stringless French bean cultivar for the Queensland winter bean industry centred on Gympie has achieved one of its major goals with the release to the industry this year of the varieties Redlands Wintercrop and Redlands Wintergreen.

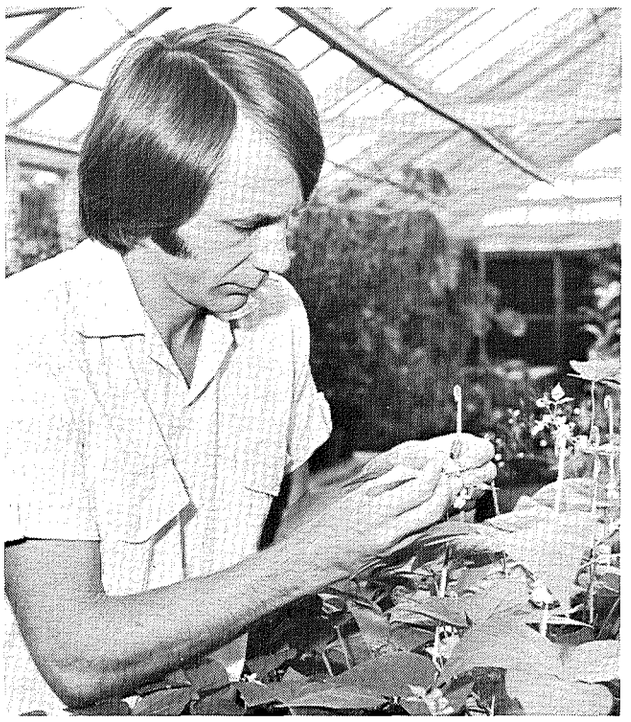
Redlands Wintercrop, known experimentally as CT 15, produces high quality pods similar in shape to those of Redlands Greenleaf C, the present major winter variety, but in addition the pods are stringless. This variety has easily outyielded Redlands

Greenleaf C in winter trials at Redlands and in the Gympie district, with the average yield advantage over a number of years being 47%.

Redlands Wintergreen, known experimentally as CT 60, produces similar high quality pods, but they are slightly shorter and darker green than Redlands Wintercrop. In a recent winter trial at Gympie, Redlands Wintergreen outyielded Redlands Greenleaf C by 42%.

Both varieties are currently being multiplied by commercial seed companies for supply of seed to growers.

The bean breeding programme is now aiming at producing cold tolerant varieties with round pods, improved resistance of the seed to mechanical damage, and improved disease resistance. A major review of French bean varieties for the processed vegetable industry is planned for this coming year.



A plant breeder hybridizing French beans.

The tomato breeding programme at Bowen is especially concentrating on developing a tomato cultivar similar to Flora-Dade but also having resistance to the new race of Fusarium wilt (Race 3) which has recently appeared at Bowen. Resistance to this new race has been identified in some advanced breeding lines from Dr Alan Stoner in the United States and in several lines of *Lycopersicon pimpinellifolium.*

Breeding programmes to incorporate both types of resistance into commercial cultivars are in progress. Twenty single plant selections from a cross between Walter and US 638 (ex Dr Stoner) have been advanced to the F6 stage for evaluation as true-breeding lines during 1982. This material offers the potential for an early release of a variety resistant to Fusarium wilt Race 3. A number of other varieties, including Flora-Dade and six new Florida releases, have been crossed with US 638 and are being advanced for evaluation as commercial cultivars.

The breeding programme, using the more complete Fusarium wilt Race 3 resistance in the small fruited *Lycopersicon pimpinellifolium* selections, will take longer to bring to fruition, as several generations of backcrosses to the original parent are required to increase fruit size.

Other aims of the tomato breeding programme at Bowen include the incorporation into commercial varieties of more concentrated fruit setting and fruit maturity patterns, resistance to PVY virus and improved fruit size especially for fruit set during the winter. Resistance to PVY virus has been identified in a line of *Lycopersicon hirsutum* and an interspecific cross with a commercial tomato variety (*Lycopersicon esculentum*) to transfer this resistance across has been successfully achieved this year. This is a most significant advance in view of the prevalence of the virus in all tomato varieties grown at Bowen.

The Bowen breeding programme is also assessing fruit quality on promising advanced lines using laboratory tests for sugars, acids, and firmness. US 638 has high fruit quality characteristics and it is aimed at maintaining these desirable attributes in any new varieties released to overcome the Fusarium wilt Race 3 problem.

The plant breeding and introduction programme to develop improved tomato varieties for trellised production in southern Queensland continues. An indeterminate hybrid, produced from the cross Flora-Dade x Scorpio selection, has excellent fruit quality and carries resistance to bacterial wilt, Verticillium wilt Race 1, and is also expected to carry resistance to Fusarium wilt Races 1 and 2. The variety will be released to industry after glasshouse screening tests evaluating Fusarium wilt resistance have been completed.

A high level of resistance to Verticillium wilt Race 2, a new disease strain recently identified in south east Queensland, has been confirmed in the introduced variety Morden, and the breeding programme is incorporating this resistance into a Flora-Dade type. Also, a high level of resistance to bacterial speck has been confirmed in the breeding line ONT 7710 and a backcross programme has been initiated to incorporate this resistance into a commercial variety. Of the varieties which we have introduced, Hayslip and Burgis from Florida are resistant to Verticillium wilt Race 1 and Fusarium wilt Races 1 and 2, have good fruit size and are attractive.

Breeding work in capsicum is especially directed towards the development of a variety with similar fruit shape to Northern Belle, but also having resistance to bacterial spot, potato virus Y (PVY), and tobacco mosaic virus (TMV). Recent virological studies with PVY by Plant Pathology Branch have identified three isolates of this organism present in Queensland.

Genetic resistance has been identified to all three PVY isolates and the breeding programme is incorporating these into a commercial capsicum variety. Breeding lines have been established to the F3 generation of Northern Belle x PI 322719 and a series of backcrosses have been made.

A plant breeder examines capsicums for disease resistance.

Variety introduction and evaluation trials continued throughout the year to find superior Brassica varieties for the Queensland industry with 76 new varieties of broccoli, cabbage and cauliflower being imported and evaluated.

The cabbage variety Rampo, identified at Redlands Horticultural Research Station as suitable for summer production in south east Queensland, was extensively grown by producers this past season and reports have been very favourable. Winter cabbage production is now well served by the varieties Green Coronet, Hi-Yield and Hybrid 33.

Tomato agronomy

Queensland's production of fresh market tomatoes has continued to expand in recent years with increasing quantities being marketed interstate. Much of this production occurs during the winter and spring months when cool temperatures may result in poor fruit set followed by excessive vegetative growth of the plants and reduced yield and fruit quality. Luxury supplies of available nitrogen and water to the plants aggravate this problem.

To minimize the effects of these problems, a tomato production system is being developed where the plants are grown on raised beds covered with plastic mulch, and irrigation is applied via a trickle irrigation line laid on the soil surface beneath the mulch. Because the application of water and nitrogen can be regulated, a high degree of control over the production of vegetative and reproductive plant material can be achieved. The plastic mulch also controls weeds and reduces the opportunities for the development of plant and fruit diseases.

A bed-shaper which can produce a slightly dome-shaped bed for use with this system has been developed by Departmental engineers. This arrangement allows for drainage of rainwater off the bed to keep the bed surface as dry as possible to minimize disease development. Other engineering activities include the design and construction of machinery to lay plastic mulch across the bed and fold it into the soil on either side, and other equipment to apply soil fumigants and to train the vines onto the beds during plant growth. The ultimate aim is to mechanically harvest the fruit from the vines in the field.

A more concentrated maturing variety is required to suit this system and introduced varieties are being assessed for potential in this regard. The new Florida variety Hayslip, and the F_1 hybrids Baron and Duke show promise, with the breeding lines Florida 1A and 1B having potential for introducing a smaller bush size through a plant breeding programme.

Attempts to control Fusarium wilt in soils at the Bowen Horticultural Research Station using solarization (heat treatment of the soil under clear plastic mulch) and soil fumigants have not proved successful to date. Temperatures achieved under the mulch ranged up to 50°C at 5 cm depth to 37°C at 30 cm depth. While this would be expected to be high enough to kill the Fusarium organism, plants grown in the treated plots succumbed to the wilt disease. Fumigation treatments of methyl bromide, Vapam, and Ditrapex combined with plastic mulch and trickle irrigation also failed to control the Fusarium wilt disorder.

A custard apple tree is examined for fruiting spurs after defoliation to produce commercial cropping in a shorter time.

Lockyer salinity investigations

A joint project involving Horticulture, Agriculture and Soil Conservation Branches and Queensland Agricultural College continues to investigate the problem of inadequate water supply and salinity of the underground storages in the Lockyer Valley. Approximately 200 selected irrigation bores were sampled during 1980–81, and a detailed land unit map was produced showing the distribution of these bores and their respective water quantity and quality data.

The effects of water quality and soil salinity on the germination and emergence of beetroot and carrots have been studied in a specially designed pot system at Gatton. In a soil with a medium initial soil salinity, it was difficult to establish beetroot with irrigation water containing 1 000 ppm Cl. Since water chloride levels up to 1 500 ppm Cl are found in the beetroot growing areas of the Lockyer Valley, this information suggests that the establishment problems being experienced with beetroot in that area are, at least in part, a direct result of the use of highly saline irrigation water.

In a soil with a medium initial soil salinity, it was difficult to establish a satisfactory stand of carrots with water containing 750 ppm Cl. Again this appears to explain establishment problems with carrots in the Lockyer Valley where many of the farms used for this crop have over 500 ppm Cl in the irrigation water.

Subtropical and tropical fruits

Avocado production continues to increase rapidly in Queensland but the need continues for *Phytophthora* resistant rootstocks, virus-indexed trees, and improved varieties. A field block of virus-indexed avocado trees at the Maroochy Horticultural Research Station has been registered with the Australian Avocado Growers' Federation and is supplying high quality propagating material to industry. The important Californian variety Pinkerton has now been added to this virus indexed collection. In addition, two Guatemalan rootstock clones have been indexed and released to the industry for seed production for rootstocks.

The need continues to exist for improved *Phytophthora* resistance in avocado rootstocks and techniques of clonal propagation of the best rootstocks available are being studied. It is planned to commence a breeding programme in the near future with the aim of developing rootstocks with resistance to *Phytophthora* as none of the stocks presently available is adequate in this regard.

The custard apple variety African Pride has demonstrated superior early cropping in trials at Maroochy Horticultural Research Station. However, a variety with less seed is required. A total of 38 custard apple varieties is under test at the centre and an additional 100 breeding lines and 300 seedling progeny have been developed to add to this assessment programme. Management factors being studied to increase yield and to control cropping in custard apple include the use of urea and ethrel foliar sprays, pruning, and controlled fertilization.

Kiwifruit continues to show promise as a commercial crop for elevated areas inland from the southern Queensland coast. The major New Zealand variety Hayward has not performed well in Queensland, but the variety Bruno is showing sufficient earliness in maturity, quality characteristics and yield to be a competitor in the market place. It is especially recommended for plantings in Queensland where the crop can be marketed before the seasonal imports from New Zealand arrive. In later maturing areas, the variety Abbott, grown with good cultural and pruning treatments, gives suitable fruit size and quality to compete with Hayward.

In southern Queensland, the litchi varieties No Mai Chee and Wai Chi have continued to perform well and the publicity of these findings has led to a demand for this material beyond the capacity of all nursery suppliers. As well as having high productivity, these varieties also mature at a time of high demand for the product in South-East Asia.

The cultural procedure of cincturing, coupled with the principles of managing the vegetativeness of litchi through a restricted supply of water and nutrients during the pre-flowering and flowering period, has again proved to be an effective tool in significantly improving the reliability of fruiting in this crop. Trees must be kept vigorous by providing adequate water and nutrition before and immediately after harvest and this assures a strong midsummer flush. Cincturing is then performed immediately after this flush matures to hold the plant in check through autumn and until flowering in late winter. In cincturing, the whole tree by way of the trunk or major limbs is treated.

Detailed studies over the past 2 years have established the floral and fruit development pattern of macadamia. Flower initiation occurs in mid May with racemes occurring visually by the end of May and developing slowly through winter with anthesis in mid September. Initial nut development is slow with a rapid linear increase after 8 weeks from anthesis. The embryo reaches its maximum fresh weight at 12 weeks but continues to increase in dry weight up to maturity at 25 weeks from anthesis. Major nut fall occurs 5 to 6 weeks after anthesis and before the rapid development of the embryo. Research aimed at improving nut set and preventing nut drop continues to confirm the value of NAA and more recently boron for achieving this.

The genetic improvement programme in macadamia made a major step forward this year with the planting of more than 600 progeny of open-pollinated selected seed lines on a grower co-operator's property. A further 850 progeny will be planted in the spring of 1982. This is the first major organized planting for progeny testing of macadamia in Australia.

The initial harvest from an earlier trial, where seven Australian selections are being compared with three major Hawaiian varieties, has shown that the Australian selections compare more than favourably for quality with the imported lines. A technique for the recovery of rootstocks from high performance field trees has been developed and this, along with the development of a successful technique for striking cuttings, opens the way for the development of clonal rootstocks with potential for high and uniform production in commercial orchards.

A large collection of mango varieties is now available in Queensland for evaluation, and importation of promising new varieties from overseas continues. A particular aim of the programme is to expand the production and marketing season for mangoes in Australia. Because the industry is presently based on the one variety, Kensington, which has a relatively short production period, the fruit are available on the markets for only a relatively short time. Promising new varieties identified include Glenn, Banana I, Zill, Sensation, Edward, Irwin, Van Dyke, Ono, Fascell, Kent and Zillate.

Most varieties studied to date show poor fruit set in areas of coastal Queensland where rain falls during the flowering and fruit setting period, principally due to Anthracnose infection of the flowers and fruit. However, the variety Tommy Atkins produced highly coloured, good flavoured fruit this year at Maroochy Horticultural Research Station, through a season when other varieties failed to carry fruit.

Introduced mango varieties are being assessed under Queensland conditions.

The pineapple genetic improvement programme took a major change in direction this year with the planting out of 2 100 seedling progeny. These came from 15 crosses of parental material derived from Cayenne and Queen types, and hybrid material with known *Phytophthora cinnamomi* resistance. This new approach will complement the present already proven successful Cayenne clonal selection work which has resulted in a major shift in the industry towards the use of this clonal material. In addition to *Phytophthora* resistance, the industry requires improved fresh market types.

There is high interest in north Queensland in the potential for commercial development of a range of exotic tropical fruit crops. The research programme is assisting these activities by the introduction and evaluation of a wide range of varieties of many exotic tropical fruits.

Of these fruit crops, litchi, rambutan, longan, carambola and mangosteen are emerging as having most potential at this stage. The rambutan varieties R3, R168 and Jit Lee show potential, and cincturing techniques are being studied for controlled cropping and promoting yield. The carambola varieties Arkin and Fwang Tung show the best commercial prospects of the varieties evaluated to date.

Two experienced coffee growers have now estalished approximately 150 ha of *Arabica* coffee in granitic sandy soil near Mareeba. The research programme is especially aimed at assisting this new potential industry by importing improved coffee varieties and lines from overseas. Currently existing local lines and material from Papua New Guinea and Hawaii are in the propagation nursery at Kamerunga Horticultural Research Station, and a further 45 lines from Costa Rica, Florida, South Africa, Portugal and the Cameroons are currently undergoing quarantine.

Bananas

The north Queensland banana industry continues to expand with 1981 production of approximately 4 120 000 cartons valued at $31m. A production level in excess of 4 500 000 cartons is expected in 1982.

Research studies in north Queensland continue to emphasize the importance of adequate water supply in banana production for fruit yield and quality. Three irrigation experiments have now been completed in the covered banana lysimeter system at Kamerunga Horticultural Research Station and a promising new lead on the banana maturity bronzing problem has emerged from this work.

Maturity bronzing is a reddish brown discoloration of the fruit skin which, although it does not affect eating quality, renders the fruit unmarketable. The disorder is most important and is estimated to result in lost production in the north Queensland banana industry of around $2.5m a year. The irrigation experiments have shown that moisture stress in the plant around the stage of bunch emergence increases the incidence of maturity bronzing in the fruit subsequently harvested. Further confirmation of this important lead is required because the results just failed to achieve statistical significance.

Moisture stress at other developmental stages did not affect maturity bronzing incidence, but generally extended the time to bunch harvest, and reduced the green life of the fruit. Moisture stress before and during bunch emergence reduced yield but moisture stress during the bunch filling period had little effect on this factor. Although summer rainfall is generally high, moisture stress is common in banana plantations in north Queensland at other times during the year and supplementary irrigation systems are becoming increasingly common in the industry. Management strategies need to be developed to ensure that moisture stress does not occur at critical stages of growth.

Nutrient leaching models to define the rate of nutrient movement in tropical soils under high rainfall conditions are being developed to assist in defining optimum fertilizer practices for bananas in north Queensland. In addition, soil buffering curves have been developed for the major soil types used for banana production in north Queensland. The pH increase response to lime over the range 0 to 7 t lime per hectare is linear for alluvial soils, but metamorphic and krasnozem soils show non linear responses.

Plant spacing trials are studying optimum plant density and sucker management techniques for both single and double row plantings. Best yields consistent with adequate quality, finger length and shelf life are at densities in the order of 2 020 plants per ha for double rows and 1 852 plants per ha for single rows, for the first ratoon crop.

Citrus

The use of ethephon for thinning Imperial and Murcott mandarins has continued to gain acceptance in the industry for regulating crop load and for overcoming the biennial bearing pattern experienced with these varieties. Further trials with the Murcott variety this year have again confirmed that the use of 150 and 300 ppm ethephon as a thinning agent will solve the major management problem of overcropping which has restricted the grower acceptance of this variety.

An important finding this year is that even trees with a light set of fruit are not over thinned by using these ethephon concentrations. The use of the thinning spray results in a substantial increase in yield and gross return and is expected to accelerate increased plantings of Murcott as a highly profitable, late variety.

The addition of 10 ppm 2,4-D to the normal gibberellic acid sprays applied to Ellendale mandarins to delay fruit senescence has been shown to reduce the incidence of fruit drop on crops left for a late picking. This was shown by an increased percentage of fruit held on the trees, and a stronger pull-force required to remove the fruit from the stalk. The use of these two sprays in combination prolongs the life of the fruit on the trees and therefore allows for a more extended marketing season.

A visit to Queensland this year by Dr Albrigo, a citrus specialist from Florida, confirmed the presence of citrus blight in orchards in the State. The disease has not been transmitted artificially and it has no proven cause. Visual symptoms have been confirmed on seven blocks in the Central Burnett and Beerwah districts. A major State-wide survey is planned to determine its distribution. The rootstocks rough lemon and Troyer citrange are both very susceptible to the disorder and alternative rootstocks are being recommended.

Deciduous fruits

The breeding and plant introduction programme in apples, plums, peaches and nectarines has continued and several new varieties are under test on growers' properties. A major aim of the plant improvement programme is to extend the production season for these fruits, especially through the development of early maturing varieties.

The apple breeding programme has now evaluated in excess of 10 000 lines with the Delicious x Earliblaze and Delicious x Early McIntosh progeny showing the most potential.

In the plum breeding programme an additional 1 142 progeny were field planted last September bringing the total under evaluation to 3 312. In addition, more than 40 000 plum flowers were hand-pollinated in spring and more than 3 800 seeds have been collected for further progeny evaluation. Some superior lines which have been selected to date include four which mature approximately 2 weeks before Wilson. R3T91 appears to be the most promising of these lines. Budwood of the superior selections has been distributed to 15 growers for commercial evaluation.

The peach and nectarine plant improvement programme chiefly centres around introductions and their evaluation, although two superior peach lines and one nectarine line from an earlier breeding programme look very promising. The peach breeding line N1T6 has now performed well over three seasons and has good blush, size and firmness.

In total, more than 120 new stone fruit varieties have been introduced over the last 3 years, the majority being peach and nectarine varieties.

Low chilling peaches are being assessed in subtropical environments.

The programme of introduction, evaluation, and industry development of low chilling peaches and nectarines has been most successful. These low chill varieties mature much earlier than standard varieties and can be grown in warmer districts. Fruit quality is good. It is estimated that more than 30 000 trees of low chilling peach and nectarine varieties have now been planted in Queensland and further plantings are planned.

Flordasun peach and Sunred nectarine are the most popular varieties. Flordasun commenced picking this year in the Nambour region in mid September, and 2 weeks later on the Atherton Tableland. Trees of a number of new varieties including Culemborg, Peach 2-2, Peach 3-1, Flordagold, Maravilha and Sunlite were distributed to centres throughout the State for evaluation this year.

A fertilizer trial with Granny Smith and Delicious apples, now in its ninth year, has shown a significant increase in tree girth with increased nitrogen applications. Increased fruit yield has been recorded in Delicious with increased nitrogen and potash fertilization and this has been primarily due to increased fruit size rather than fruit number. No yield or tree growth responses have been obtained with phosphorus fertilizer applications, but high rates of this element have decreased marketable yield of Granny Smith apples.

The programme aims at developing leaf analysis diagnostic information to allow fertilizer recommendations to be adjusted to nutrient status of specific blocks of trees.

Cytolin sprays applied as a mist to the flowers at 10% bloom promoted an elongated shape in Delicious apples. This elongated shape is attractive to buyers and treated fruit averaged $2 more per case on the Brisbane market.

The programme to make available virus tested budwood of pome fruit, stone fruit and grapes to industry is proceeding with further plantings of mother trees and vines at Granite Belt Horticultural Research Station. Budwood of additional virus-tested clones is being obtained from Fruit Variety Foundation plantings for further field plantings. This programme should result in a substantial improvement in industry productivity as virus infected trees are gradually replaced with clean material.

Research to assist the developing wine industry in the Granite Belt has continued with cultivar assesment trials, laboratory production of wine from these trials, and advice to producers on wine making technology. Showery weather near maturity affected the quality of fruit produced this season. The early maturity varieties in the trial at Ballandean produced good fruit, but the late varieties Shiraz, Ruby Cabernet, and even Cabernet Sauvignon had splitting and disease problems. Fresh grape production in the Granite Belt also suffered from the showery weather. Southern produced sultanas continue to compete strongly on the fresh grape market with Queensland produced grapes. Sultanas do not perform well in the Granite Belt and the search for a suitable seedless grape for the fresh market continues.

Post-harvest research

A study of tomato fruit maturity and eating quality has shown that, contrary to popular belief, optimum eating quality at the ripe fruit stage occurs if the fruit are harvested just before colour develops, that is, at the mature green stage. However, fruit harvested before the mature green stage, that is, immature, show reduced eating quality, less sweetness, more acidity and softer pulp.

The more fruit were allowed to colour on the plant before harvest, the lower their eating quality when fully ripe, and this was associated with lower sugar-acid ratios, higher acidity, and softer pulp. Ripening mature green fruit in the presence of ethylene, as compared with ripening in air, resulted in improved eating quality.

Cool-room trials have previously shown that pineapples show chilling injury when stored at 21°C or below, and that the symptoms are similar to the blackheart disorder which occurs in the field. Research is continuing to select clones with high resistance to chilling injury, and then to determine whether these clones will show resistance to the blackheart disorder in the field. Clone 53/116 has shown a strong resistance to chilling injury.

Other research with pineapples has shown eating quality of the fruit is better related to specific gravity than to external colour. By observing the flotation of the fruit in two solutions of different specific gravity, the eating quality of the fruit can be closely predicted. Further commercial trials using this method of assessing fruit maturity are planned.

Food processing studies with macadamias are integrated with the field research programme designed to improve the yield of kernels per hectare and to optimize kernel quality to the consumer. Studies have shown that a linear relationship exists between the specific gravity of raw macadamias and the eating quality of the roasted kernel.

Further work aims at using this information to produce maturity prediction curves based on the specific gravity of the raw macadamias. This should enable growers to ensure that nuts have reached maturity before harvest. Forty-five promising macadamia selections were evaluated during 1981 for yield and kernel quality, and four of these were rated highly and selected for further detailed study.

Plantings of guava have continued to expand and production of this crop will increase rapidly over the next few years. The post-harvest group in conjunction with field research staff have developed technology for the processing of guava products and have identified the line GA 11-56 as the outstanding line for the production of guavas for processing.

A study of the post-harvest behaviour of guava fruit for ripening physiology, control of fungal rots, and storage characteristics will allow the industry to utilize the product to best advantage. The use of hot benomyl dips considerably reduced rotting of the fruit in storage. Optimal cool storage temperature for most guava cultivars was 5°C and this allows the post-harvest life of the fruit to be extended by 2 weeks. The fruit showed only a limited response to treatment with ethylene.

The development of models to predict the failure of fruit and vegetable material under stress continues in conjunction with engineers at the University of Queensland. This work has been expanded to develop models to predict damage sustained by fruit and vegetables during transport by road freight. In addition, a framework has been developed for the management of the total distribution system for fruit and vegetables.

Extension

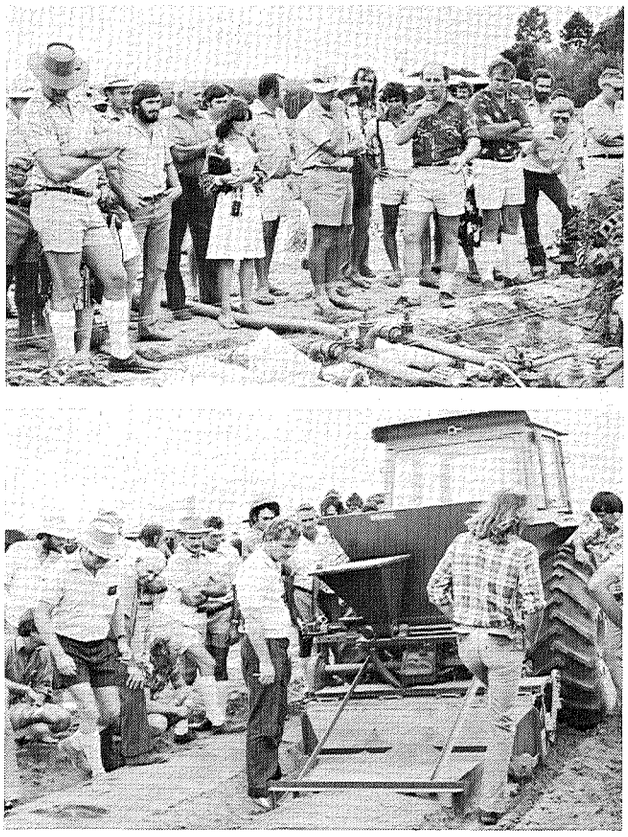
Planned extension activities achieved some worthwhile successes, but the escalating pressure of inquiries from both non commercial and commercial growers consumed a high proportion of extension officers' time. Whenever possible, pamphlets were used to supply the required information but the writing and production of these pamphlets are themselves time consuming.

Considerable use was also made of departmentally produced bulletins and digests, the *Queensland Fruit and Vegetable News* and local newspapers as a means of mass communication with commercial producers. Field days have again been used as a means of demonstrating and promoting technology to the farming community, with farm walks and other peer group activities also being used more extensively as a means of extension.

Planned extension projects were conducted on a range of subjects suited to the needs of the different regions and industries in the State. In several regions, the subjects for these projects were selected with the assistance of consultative groups of local growers. All extension work was discussed with growers at the annual crop advisory committees, which are attended by representatives of the State's horticultural industries along with representatives of the Department's extension and research staff.

Extension activities

Following is a summary of the more important extension activities in the various regions during the year.



Field days provide opportunities to demonstrate new techniques such as trickle irrigation (top) and bed forming equipment.

On the **Granite Belt,** considerable extension effort was given to providing advice to growers to ensure effective control of pests and diseases. The information provided included the Deciduous Fruit Spray Schedule, the black spot warning service (four warnings were issued), and promotional items in the local press, on radio and in the Granite Belt Horticultural Digest.

Particular effort was devoted to promoting the importance of post-harvest dipping of apples. More than 1 000 stone fruit trees from interstate were condemned when they were found to be affected by crown gall. Horticulture Branch staff co-operated with Plant Pathology Branch in evaluating new spraying equipment, particularly in comparing the effectiveness of a low volume sprayer with conventional high volume spraying equipment.

The benefits of virus tested deciduous fruit and vine planting material were promoted through press and radio. Positive steps were taken in co-operation with the industry to eliminate the shortage of virus tested material by 1985.

A highly successful 2-day workshop was held to provide local retail outlets with information on the design, operation and maintenance of trickle irrigation systems. The workshop was organized in conjunction with the Water Resources Commission and was designed to service the high rate of adoption of trickle irrigation by Granite Belt growers.

The project to promote the marketing of produce in plastic returnable crates received a setback when the crate preferred by growers was withdrawn by its financial backers. The need remains for efficient unitization of consignments to reduce marketing costs.

In other extension activities on the Granite Belt, vegetable growers were encouraged to use plastic mulch; new varieties of stone fruit were promoted and budwood was distributed; growers of Delicious apples were encouraged to use Cytolin (R) to improve fruit shape; export requirements of deciduous fruit and grapes were publicized, and improved broccoli culture was promoted. Several new pamphlets on aspects of commercial horticulture were distributed and two issues of the Granite Belt Horticultural Digest were published.

In the **South Moreton** region, extension activities were strongly directed towards promoting the adoption of the results of research at Redlands Horticultural Research Station. Forty-four articles were published in two issues of the South Moreton Horticultural Digest, a wide selection of pamphlets was published on the culture of various crops and on specific farming problems, and several field days were conducted.

Two hundred and thirty growers attended a field day in the Redland Bay area on modern packing shed design and post-harvest handling. As a result of the field day, three leading growers installed the system of ripening rooms, forced air cooling rooms and post-harvest handling equipment which was promoted at the day. A further five growers installed small cooling rooms or upgraded existing facilities and several other growers are also planning to install cool rooms.

Three hundred people attended a kiwifruit field day at Mount Tamborine, where talks and demonstrations were presented on the culture, packaging and storage of the crop. The field day was held in conjunction with the opening of a new packing house in the district. At another small field day, demonstrations of pruning and fruit maturity determination were given to a group of active kiwifruit growers.

Because of the high incidence of bacterial wilt of tomatoes in the region, many growers have shown interest in growing F_1 hybrids of tomatoes bred at Redlands Horticultural Research Station which are resistant to the disease. As commercial seed is not yet available, 14 growers are producing their own hybrid seed with assistance from extension officers.

Extension officers in the Lockyer Valley are active participants in the Processing Vegetables Technical Discussion Group, which is designed to encourage co-operation between growers, processors and the Department of Primary Industries in overcoming problems within the industry. Major technical problems dealt with during the year involved spray technology and limitations in quality and quantity of irrigation water.

Drought during the year gave rise to major salinity problems in parts of the Lockyer Valley, and considerable effort was directed towards making growers aware of the problem and assisting them to deal with it. A specially prepared pamphlet 'Management of Saline Irrigation Water in the Lockyer Valley' was a useful adjunct to the extension programme.

In the **North Moreton** region, appointment of a full-time banana inspector has enabled extension officers to devote more time to planned extension projects. Task groups have been formed to undertake projects which require a co-ordinated approach to satisfy needs that are common throughout the region.

One example is the New Grower Project which is being developed to service the needs of the large numbers of potential and new horticultural growers in the region. An information package has been prepared which includes pamphlets containing basic information on potential crops, case histories and an audio-visual display designed to alert the clients to the many pitfalls to be faced.

Extension staff were involved in the formation of two grower organizations: the Sunshine Coast Subtropical Fruit Group and the Maleny Local Producers' Association, which will provide opportunities for the Deparment to service groups of growers with common needs.

Departmental involvement and encouragement of the Local Producers' Association at Chinchilla have brought significant changes to the horticultural industry in that district. In the last 3 years, the supply of grapes from that district to the Brisbane Market has risen from 2 000 to 24 000 cartons and plantings are now about 100 ha. Rockmelons and a range of vegetables have shown a similar trend and, with peaches now being planted, the horticultural industry continues to expand in size and breadth in the district.

Work by the Department has determined varietal performance, introduced pre-cooling and stimulated better transport facilities. These latter areas were critical factors limiting development some 5 years ago in this somewhat isolated district.

A high level of adoption has been recorded in the litchi industry of methods which have been promoted to eliminate erinose mite from planting material, to obtain better plant establishment and to extend the shelf life of the fruit.

Market agents have commented on the marked improvement in the quality of Gympie grown vegetables, and the growers have received substantially improved prices. These benefits were derived from a concerted extension effort over several years, with particular emphasis on the benefits and technology of pre-cooling. Eleven new cool rooms were installed during the year, and all existing installations were thoroughly checked and appropriate advice was offered to correct deficiencies in their operation.

Promotion of hot water treatment of mangoes has resulted in the construction of at least 10 treatment tanks in the Gympie district. Growers have adopted disease control programmes and a new mango processing unit will continue to operate next season.

Development of an extension package using fluorescent dyes to evaluate the performance of spray application equipment was finalized, and officers in the region were trained in its use. Associated work showed that growers' spray equipment usually requires changes in management, adjustment and design to achieve efficient spray application.

Herbicide drift from groundsel spraying has been a source of conflict, particularly in the Noosa Shire. At a meeting of interested parties arranged by the Department of Primary Industries and the Cooroy Fruit and Vegetable Growers' Association, several agreements were reached that will help to stabilize the situation. The agreements related to the season of spraying and the spray equipment used.

The 'Irrigation Manual for Horticulture Crops' produced in the North Moreton region continues to be well used by officers of the Water Resources Commission and the Department of Primary Industries. The author of the manual was co-opted by the Youth Extension Section of the Education Department to co-ordinate and present a Rural Youth Irrigation School for Horticulture. This is one of many examples of the wide use of extension packages and literature generated within the North Moreton region.

In the **Burnett** region, press, radio and printed handouts are used widely to support the extension programmes. However, unsolicited home garden inquiries continue to consume significant amounts of field officers' time particularly in coastal districts. Central Burnett citrus growers and Bundaberg tomato growers benefited from meetings with visiting overseas agricultural experts arranged by departmental officers.

A horticultural consultative group was established in the Bundaberg area to assist the extension staff in identifying the major problems and opportunities of concern to the growers. This group has already contributed to the initiation of major extension projects in trickle irrigation and pest and disease control.

Problems of poor establishment of rockmelons and cucumbers during winter have been overcome in the Bundaberg area by the use of container grown seedlings and black plastic mulch promoted by local extension officers. Following several years of extension effort, most rockmelon growers routinely apply post-harvest dipping treatments that improve fruit quality and shelf life.

Fifty Bundaberg vegetable growers are now using trickle irrigation, following an extension programme to advise growers of the benefits of the technique and to inform them of the best methods of using it in vegetable crops. An extension programme has been conducted in conjunction with the Australian Bureau of Statistics, and the Bundaberg Vegetable Growers' Association to promote more complete and accurate recording by growers on the agricultural census forms.

Surveys to evaluate the potential for fruit tree crops are continuing in the areas of erosion hazard around Childers and Gin Gin, where sugar-cane was grown previously. Because of the wide variability of the soils and because of the difficulty of storing water, it has been found necessary to evaluate each farm individually.

In the Central Burnett citrus growing area, the development and testing of air blast spray application machinery are almost complete and six more growers have purchased machines. Testing showed that a tower should be fitted for spraying trees taller than 3 m and two growers have made this adaptation to their machines. Low volume sprayers are currently under test.

As a result of a combined development and promotion programme conducted by Horticulture and Entomology Branch officers, eight citrus growers are now employing an entomologist to control their integrated pest management programme.

The use of ethephon sprays for controlled thinning of Imperial mandarin crops is now an established practice, but extension is continuing to improve the precision of spray timing.

An inexpensive and effective system of container propagation of citrus is being developed, and Central Burnett nurserymen are already adopting some of the techniques.

In **Central Queensland** the level of inquiry from home gardeners and hobby farmers has been reduced considerably to about 20% of total inquiries, allowing extension officers to spend more time servicing commercial producers. This improvement was achieved by encouraging commercial nurseries and garden centres to service inquiries, by publishing lists of appropriate books available in libraries and by making timely contributions to the local press and radio stations.

Extension activities were continued to promote pre-cooling of fruit and vegetables, and four new adopters were assisted in planning and implementing the system.

The current drought in central Queensland forced male papaw trees into producing a high yield of late summer bisexual fruit. The opportunity was taken to promote the use of a locally devised technique using this fruit, to select improved, disease-resistant lines of papaws.

A soil conservation layout system suited to small fruit and vegetable farms was devised in consultation with Soil Conservation Branch officers. An extension programme to promote its adoption will soon be initiated. In another co-operative venture, Horticulture Branch and Economic Services Branch officers published an issue of the Central Queensland Pineapple Newsletter dealing with the economics of local commercial pineapple production. Other publications designed for use by central Queensland growers included crop summaries and district technical summaries, a new series dealing with technical subjects that transcend specific crop disciplines.

Within the **Dry Tropics** a wide range of horticultural crops is grown in the various climatic regimes and irrigation developments in the region. Priority is given to the Bowen area where a high level of technology is applied to the significantly expanding cool season vegetable industry, and where the growers are enthusiastic about adopting further improved cultural and marketing technology.

Close liaison with the industry has resulted in improved presentation of rockmelons and other produce at the markets and almost universal adoption of the container propagation of seedlings.

A farm business seminar organized by Departmental officers in conjunction with Bowen growers was well supported by growers eager to obtain information on budgeting, taxation, insurance and other aspects of the farm business.

Burdekin bean seed producers have been reluctant to adopt aspects of the recommended procedures for production and storage of bean seed, and an extension project has been designed to increase the adoption rate.

Interest in tropical fruit production is high in some districts, and field days were held in Mackay (250 participants), Proserpine and Bowen to help to satisfy the demand for information. There was also a field day at Rollingstone for pineapple growers. Technical support for these tropical fruit field days was provided by officers from other regions.

In the **Wet Tropics** region, there is a very high level of inquiry on the culture of tropical fruits from local, interstate and overseas sources. These inquiries reduce the time available for extension on more commercial crops.

In the coastal banana growing districts, the Banana Industry Liaison Group was used to guide the research and extension activities of relevant Branches of the Department in servicing the northern banana industry. The benefits of surface drainage are now more widely accepted by banana growers, particularly by those new growers whose land is undulating.

Papaw growers in the Mareeba and Innisfail areas were serviced by farm visits. A farm walk was held on new growers' properties in the Innisfail area so that experienced growers could assist the new growers to identify their problems. Efforts are being made to stabilize the local industry by keeping publicity to a minimum and not attracting speculators to enter the industry.

Coastal litchi growers are planting the recommended Tai Tso group of varieties which are favoured for their earlier and more regular bearing in north Queensland. In the Mareeba and Atherton Tableland areas, assistance was provided to the expanding horticultural industries by individual contact and a range of group activities.

North Queensland, and particularly the Torres Strait islands, are recognized as very important areas in Australia's quarantine strategy. Consequently, an active quarantine education programme is being conducted with the relevant transport authorities, the military services and school children.

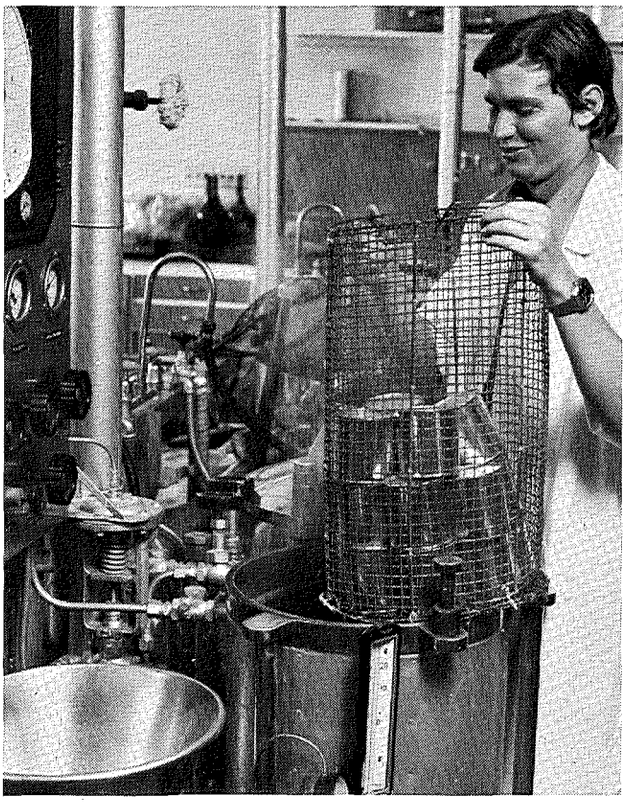
Recent activities on the Cape York Peninsula and Thursday Island have concentrated on eradication of the banana disease, black sigatoka. Unfortunately, the island communities have tended to ignore quarantine education as they have been unable to perceive any benefits they can gain. Consequently the programme has been more effectively directed to the transport operators, nurses, teachers and community leaders in the area.

Staff of the **Sandy Trout Food Preservation Research Laboratory** continued to maintain close liaison with industry and also provided support to advisory committees and field days. Research in both fresh market and processing technologies is designed to meet the needs and to foresee the opportunities of industry.

Information was provided to 23 major processing companies on research developments and priorities at the Laboratory.

All wineries in the State were visited and 15 wines were subjected to diagnostic analyses. Wine judging continued as an important function of the Laboratory.

Close co-operation with macadamia growers and processors made possible the co-ordination Australia-wide of the evaluation technique used to assess raw macadamia quality.



A food technologist prepares canned fruit for cooking.

The Market Extension Service has been further expanded and now comprises three professional officers and a technical assistant based at the Sandy Trout Laboratory. Three issues of an internal news sheet were distributed to keep field extension officers informed of handling and marketing developments.

Promotion, development and assessment work was carried out on two types of plastic returnable crates; both performed well for a variety of crops and situations. Although growers and transport operators were keen to adopt the returnable crates, an attempt to introduce them into the marketing system failed because wholesalers and retailers were daunted by security and recording problems.

Further training in cool room design and the selection of forced air cooling equipment was provided for field extension officers, who are now competent to handle at least preliminary inquiries from clients wishing to adopt the system. Specific field problems with cooling were investigated and recommendations were offered for improvements. Adoption of forced air cooling by growers and industry is increasing and Queensland's expertise in the field is being drawn on by other States.

Design, development and promotion of improved packaging is continuing, particularly to suit the requirements of palletized handling and forced air cooling. Alternatives are being sought and tested to replace increasingly costly waxed cartons. In other work, marketing problems (particularly problems with maturity of produce) are being brought to the attention of growers.

Servicing activities

Strawberry Runner Approval Scheme

This Scheme is operated by the Committee of Direction of Fruit Marketing and is supported technically by the Department of Primary Industries. The Scheme is designed to provide the strawberry industry with virus free, high quality, true-to-type planting material. For the last few years, the Scheme was supplied by a single contract grower located at Crows Nest, but a second contract grower from Mount Tamborine will begin supplying runners in 1983.

In the 1982 season, 895 725 Redlands Crimson and 404 076 Earlisweet runners were supplied to 261 growers. These were increases on 1981 figures but supply was sufficient to meet the demand. Very few substantiated complaints were received.

A demand has developed for frozen runners which provide high yields early in the production season. Because of technical problems with producing frozen runners under Queensland conditions, growers are being advised to import their requirements from interstate certified sources.

The value of the Scheme was highlighted when some runners imported from interstate for the 1981 season were found to be virus infected.

Bean Seed Scheme

There was a further decline in bean seed plantings in 1981 to 677.6 ha (including 280 ha unregistered crops) compared with 738.6 ha in 1980. The decline in the industry is probably due to competition from seed imported by bean processors for distribution to contract growers. However, increased plantings for the production of bean seed have been notified for 1982.

More than three-quarters of Australia's bean seed crop is grown in the Burdekin area where a legislated quarantine system is in operation to protect the industry against incursion by disease. Most of the remaining bean seed is produced in the Callide-Dawson area where the risks of bacterial disease infection are higher, and commercial navy bean plantings could well replace registered bean seed plantings in the future.

Citrus Budwood and Seed Distribution Scheme

During 1981, Queensland nurserymen and orchardists were supplied with 152 590 citrus buds (8% rise over 1980) and 218 L of citrus seed (14% decrease since 1980). Because of the variable moisture content of the seed, there was a change in practice to selling the seed by volume rather than by weight. The supply of most lines of citrus budwood was sufficient for the demand, but exocortis virus free Navel orange buds were in short supply and exocortis virus free Joppa orange buds were not available.

The propagation facilities at Gayndah have been extended and are now sufficient for the propagation of citrus budwood mother trees. Although there were no new plantings in either mother block during 1981, considerable planting will be carried out during 1982 and planting of both blocks should be completed during 1983.

Regulatory

Plant Quarantine

In Queensland, the administration of Plant Quarantine is performed by Horticulture Branch on behalf of the Commonwealth.

The major responsibility of this section is to prevent the introduction of exotic insects, diseases, weeds, and other pests likely to cause losses to Australian agriculture.

The greatest volume of cargo continues to be imported in containers, this trade having increased by 102% since 1977–78. The opening of Fisherman Islands during the year has permitted further expansion in this area by enabling the port to accommodate larger vessels.

Both passenger and freight movements by air continue to increase. International airport facilities at Townsville have been completed and regular flights now operate between there and New Zealand. In addition, services have been proposed to link north Queensland with South-East Asia.

The purchase of two way radio equipment during the year has significantly streamlined operations. All Brisbane field staff are now in contact with their headquarters, thus ensuring greater utilization of available manpower and an improved service to importers.

Boil smut of maize (*Ustilago maydis*) was detected in northern New South Wales and in the Beaudesert and Gatton regions of south east Queensland in March this year.

The area covered by the outbreak, coupled with the ability of disease spores to remain active in soil for many years, precluded eradication, but measures now in progress aim at preventing the movement of seed from diseased regions into other major production areas.

The possibility of exotic pests entering Australia through remote areas such as Torres Strait and Cape York has been of concern to Plant Quarantine for years. The fruit fly monitoring campaign introduced in 1974 and then expanded in 1979 with the appointment of a full-time officer at Thursday Island was further diversified this year with visits to the region by experts from within the plant pathology and botanical disciplines.

This exercise was immediately rewarded with the detection of two serious banana diseases—black sigatoka (*Mycosphaerella fijiensis* var. *difformis*) and freckle (*Phyllosticta musarum*)—on the Australian mainland. An eradication programme is now in progress.

Combined with monitoring campaigns undertaken across northern Australia, Plant Quarantine is attempting to gain better understanding of the pest status of our immediate northern neighbours. To this end, an extensive fruit fly survey of Indonesia has been made.

The national publicity campaign involving Harry Butler has again received considerable television attention. Locally, this programme has been supplemented by mounting displays at major agricultural field days and in some large Brisbane and Gold Coast shopping centres.

The following table gives details of passenger movement and cargo imports that were supervised by Plant Quarantine Officers during the year.

——	1980–81	1981–82
Total No. of passengers by sea and air..	205 388	260 086
No. of inspections by appointment	2 870	3 412
Containers from overseas.....	36 497	40 146
Timber (m^3).....	70 721	123 626
Consignments of plants released from quarantine	363	372

Treatment of plants for interstate movement

New South Wales authorities have relaxed the restrictions on plants entering that State from Queensland. This has relieved field officers of the onerous commitment to treat the many interstate consignments of plants. Two new Western Australian schemes allowing certified nurseries to export to that State without Phylloxera and soil treatment declarations will also be of assistance to the nursery industry and field officers.

Banana Industry Protection Board

The campaign to control the spread of banana diseases and to eradicate neglected and abandoned banana orchards was maintained by the Board during 1981–82.

The number of banana growers in the State has reduced to 1 184 and the area under crop has stabilized at 3 813 ha.

In the Southern Banana Quarantine Area, bunchy top disease continues to be a problem with a total of 952 infected plants being found on 173 commercial orchards. This is equivalent to one diseased plant per 1.9 ha of commercial plantings in the bunchy top infected Southern Banana Quarantine Area.

In addition, 1 003 infected plants were found on 137 residential properties in Nambour, Buderim and the Brisbane metropolitan area. Many of these were found in the Nambour and Buderim areas where the residential subdivision of rural land area has enabled pockets of abandoned and diseased bananas to be located in areas that are steep, timbered and previously inaccessible. The appointment of a full-time inspector at Nambour has greatly increased the detection and eradication of such areas.

The campaign to eradicate bunchy top in the Brisbane metropolitan area has continued. Some suburbs have been covered by a second inspection and the low incidence of infected plants is an indication of the effectiveness of the original inspection. A few isolated pockets of abandoned diseased banana plants were uncovered where land had been cleared for subdivision.

Abandoned banana plants are a major source of bunchy top infection throughout south east Queensland. The Board is continuing its policy of eradicating abandoned or neglected plantations, whenever they are located, to prevent the development of their hidden inoculum sources.

Plans have been made for the erection of roadside signs on highways in the Nambour area warning motorists not to carry banana plants. Movement of banana planting material from the Southern Banana Quarantine Area could introduce bunchy top disease into the buffer area and eventually introduce the disease into the banana growing area of north Queensland.

During the year, the levy payable by commercial growers of bananas in Queensland was increased by 25% to 2.5 c per 13 kg carton of fruit marketed. This levy is matched by a Government endowment and funds are used to offset the cost of operation of field inspections of banana throughout the State.

The Board visited the north Queensland and Nambour banana growing areas during the year and met representative groups of growers. Discussions at these meetings gave the growers a better understanding of the activities of the Board and the role of the banana inspector.

Agricultural Chemistry Branch

THE work of the Agricultural Chemistry Branch covers the categories of research, regulatory and supporting analytical services for research and extension. With its city and country laboratories, the Branch provides chemical services and specialist advice in a diverse range of activities which includes analytical chemistry, soil science, pesticide science, cereal chemistry, plant chemistry and land evaluation.

Research

Pesticide chemistry

As good control of fruit fly with dimethoate dipping of horticultural commodities has been obtained, its stability for practical use and the possibility of combining it in existing benomyl dips are being studied.

Dimethoate solutions (500 mg per L) at pH 4, 6 and 8, with and without benomyl, and stored at 25°C and 52°C are being analysed. The half-life and rate constant for each combination will be calculated when sufficient results are obtained. The presence of the benomyl has no effect on the stability of the dimethoate.

Pesticide residue trials must be carried out to establish levels of residues resulting from a particular application schedule. Laboratory scale dipping of mangoes in dimethoate was used to provide samples for residue studies. Residue levels in mango flesh and skins will be used to provide data for registration of this post harvest dipping treatment.

Residues of copper in tobacco were measured after copper-based fungicide sprays were used for wildlife control. The residues decreased with time after the last spraying.

Wheat samples (68) from silo pilot-usage trials using the pyrethroids deltamethrin (0.1 and 1.0 mg per kg) and fenvalerate (1.0 mg per kg) were analysed for residues at 0 months and 9 months after storage. As with previous work on these compounds, only a slight reduction in pyrethroid level was observed during the storage period.

Cypermethrin (4 mg per kg) and cyfluthrin (2 mg per kg) on wheat are being analysed as part of silo experiments to provide data for the Codex Alimentarius Commission. Samples will be taken at 0, 1½, 3, 6 and 9 months from treatment. Preliminary analyses (0 and 1½ months) indicate that no significant breakdown has occurred. Residues in the milled fractions and bread baked from the flour will be examined after completion of the 9 months' storage.

A pesticide residue survey on 37 samples of beetroot, carrots and potatoes for total heptachlor, dieldrin and DDT showed that most samples examined contained either no detectable residues or had residues below the MRL.

With the intention of keeping bees away from crops sprayed with insecticides, the synthesis and testing of bee repellents has continued. Compounds structurally related to heptan-2-one, an alarm pheromone of bees, have been synthesized and tested. Several shortcomings of the glasshouse testing procedure have become obvious, although some useful results have been obtained. The testing procedure can be used only in fine weather and a pollen substitute is required to overcome problems of maintaining the hive in a closed environment.

Plant chemistry

Development of a prototype Oil Quality Analyser has been completed. Using the relationship between the refractive index and the degree of unsaturation of sunflower oil, the instrument automatically compares the test sample with a reference oil and displays per centage of linoleic acid, percent oleic acid, iodine value and refractive index at 25°C on digital readouts.

It is expected that the Oil Quality Analyser will be useful in helping field research as well as in the area of oil processing and marketing. The development was funded by a grant from the Oilseeds Research Committee. A provisional patent application has been made.

The effect of Rutherglen bug infestation on maturing sunflower seeds has been examined by measuring the yield, oil content, fatty acid composition, free fatty acids and peroxide value of the oil from selected plots. Plots sprayed with endosulfan provided control samples. Under the experimental conditions, peroxide values remained unchanged while the level of free fatty acids increased in insect damaged seeds. Yield and oil content were only slightly reduced.

Lesley Ruddle, a technician with Agricultural Chemistry Branch, tests sunflower oil samples on the Oil Quality Analyser, an instrument designed and built at the Indooroopilly laboratories.

The laboratory evaluates the gossypol content of cotton samples in the cotton breeding programme which is aimed at developing lines resistant to *Heliothis* spp. To breed a high gossypol cultivar with acceptable yield and quality characteristics for Queensland conditions has proven a difficult task. The results of relevant overseas work with other suggested sources of antibiosis are being evaluated as the programme continues.

Waters

In collaboration with Pig and Poultry Branch, the tolerance of pigs to nitrate and nitrite in water was assessed. No noticeable effect on pigs was observed with the highest levels of nitrate tested (500 mg per L). When nitrite at 50 mg per L was tried, analysis showed breakdown of the nitrite before ingestion by the pigs.

Cereal chemistry

The cereal chemistry section stationed at the Queensland Wheat Research Institute is responsible for the quality assessment within the Department's wheat and barley breeding programmes and also conducts research in quality methodology.

In the final stage of testing in the wheat programme, 16 crossbreds were evaluated. The results were used to support the registration applications of two cultivars. These crossbreds, QT 7765 and QT 274, were released in May as the varieties Flinders and Hartog respectively. Flinders has large grain size and good milling and baking qualities while Hartog has general quality features which make it well suited to the export market. In addition, five of the remaining crossbreds had acceptable quality and will again be tested in the 1982 season.

In the barley programme, extensive testing on 1981 harvest samples confirmed our previous conclusion that the malting quality of the crossbred, BUS/ZEP 166, compared favourably with that of Clipper. Quality results from 4 years' testing were used to support its registration in April as the variety, Grimmett. Further commercial evaluation of this variety has been delayed because of the presence of sprouted grain in some of the first loads delivered to maltsters.

During the year, work has continued into the use of near infrared reflectance spectrophotometry for measuring quality characteristics of wheat and barley. The major achievement to date has been the establishment of methods for obtaining an accurate and stable calibration for wheat protein content. A calibration established on 1979 harvest samples has been validated using samples from both the 1980 and 1981 harvests. No modification of the original calibration equation has been required over the entire operation period.

Crop nutrition and soil fertility

Diagnosis and correction of phosphorus (P) deficiency in crops and pastures continues as the major area of plant nutrition research.

Fertilizer trials with soybeans in the South Burnett have shown a recently developed P sorption measurement to be a better estimation of soil P fertility than the acid and bicarbonate extraction methods currently in use. Phosphorus studies with tropical legume pastures on the Atherton Tableland have also revealed discrepancies in the standard soil P tests and the P sorption measurement is to be tested there too. However, with wheat in the Central Highlands, a series of 46 field trials has given a good relationship between response to superphosphate and standard soil P measurements. Such data will provide a valuable guide to fertilizer usage by wheat growers of this region. Field research into P requirements of sorghum and sunflower is also under way in the Central Highlands.

The value of Duchess rock phosphate as a long term P fertilizer for tropical legumes on acid soils is under investigation. After 3 years of a projected 10-year trial, there is evidence that the insoluble rock P is becoming available to plants while superphosphate at low application rates is being exhausted.

A tobacco cropping sequences trial to evaluate cropping rotation practices has now completed its second and last 4-year cycle, although chemical analyses are not yet finalized. There is an indication of a large build up of some soil nutrients (especially phosphorus) in those plots growing tobacco each year. This is, no doubt, a reflection of the excessive fertilizer use common in the industry.

Other nutritional problems being investigated include nitrogen requirements of wheat, rice, potatoes and summer crops, and deficiencies of potassium in soybeans, calcium in peanuts, copper in wheat and cobalt in pastures.

Evaluation of sulphur coated urea for rice in the Burdekin showed that this form of N fertilizer successfully slowed down the conversion of ammonium to nitrate, thus minimizing nitrogen losses during flooding. Potato trials on the Atherton Tableland have shown that this crop's N requirements are determined more by seasonal conditions and management than by the mineral N in the soil at planting. However, another research programme has shown that the mineral N present in the soil at planting is a useful guide to N fertilizer requirements of wheat.

Potash trials in the South Burnett are indicating that the routinely used measurement of 'Exchangeable K^+' is a poor index of the soil potassium available to soybeans. Alternative soil test methods for potassium are under investigation.

Experiments at Mareeba have shown that gypsum is superior to lime as a source of calcium for peanuts. However, to prevent the formation of 'pops' in Virginia Bunch peanuts, it was found that adequate moisture during nut development was equally as important as an adequate supply of soil calcium.

A study of cobalt in pastures has revealed levels low enough to cause cobalt deficiency in stock at sites near Julatten, Bundaberg and King Ranch. Grass species were lower in cobalt than legumes. Low cobalt pastures were generally associated with soils of granitic origin.

Another important field of soil fertility research involves long-term studies into effects of land clearing and land management on soil fertility decline. At one experimental site near Biloela, clearing and cultivating virgin scrubland have halved the soil organic matter content after 5 years and increased soil density by 30%. Such changes are detrimental to both physical and chemical fertility and experiments to monitor the effects of various management practices are being carried out on both the Darling Downs and the Central Highlands.

Soil physics

Soil water

Cracking clay soils support much of Queensland's agriculture. Shrinkage with drying is a key factor in the physical behaviour of these soils. Studies at Emerald confirmed that the soil surface falls about 1 mm for each 3 mm of water lost. This height change can be used to schedule irrigation.

A soil physicist on study leave at the Australian National University is working on the effect of management on the water balance of catchments, in conjunction with CSIRO. Methods and techniques will be valuable in future projects in Queensland.

As part of cotton irrigation studies at Emerald, techniques for measuring furrow flow have been developed. A microprocessor is a vital component allowing detailed records not otherwise possible.

Soil management

Yield decline on peanut soils has been examined in a co-operative project at Wooroolin. Deep ripping did not increase yield or reduce root distortion. Root distortion may be related to seed damage. Soil water, diseases, nematodes and insects were factors limiting yield.

A continuing project at Gatton Research Station examined the effect of gypsum, weed control methods, deep ripping and previous crops on soil attached to machine harvested potatoes. Gypsum reduced clods but also reduced yield. More soil stuck to potatoes when the soil was wetter. Weeds helped to dry the soil.

The joint Dalby Agricultural College—Wheat Research Institute long-term stubble handling and tillage systems demonstration was badly scoured by floods. Barley yields were about 15% higher where gypsum had been applied, because more water was stored in soil deeper than 90 cm. Work to develop a laboratory test to identify gypsum responsive soils has been continued.

A co-operative project will monitor runoff and soil loss under different crop and tillage systems in contour bays at Capella. Soil profile features, soil water relations and site uniformity have been characterized. At Brigalow Research Station, a co-operative project is monitoring soil changes when brigalow scrub is cleared for crops and pastures. Soil water relations, salinity, nutrients, runoff and soil loss will be measured. The long-term project monitoring soils on six farms under irrigation at Emerald continues. Cotton yields were lower than expected. Soil changes so far are slight and are not implicated in the lower yield.

Land degradation—salinity

Soil salinization associated with shallow water tables is causing concern in several areas of Queensland. In a joint project with Queensland Water Resources Commission (QWRC), tile drains partially remedied shallow water tables under irrigated cotton on an Emerald farm. Yield suffered if the water table was within 1 m of the surface.

Clearing of hills several kilometres away is implicated in an outbreak of dryland salting at Thangool. Water moves deep within Permian sediments and rises when blocked by Tertiary clays.

Land clearing and unusually wet seasons are involved in a number of seepages in the Ayr-Proserpine region. Groundwater has risen 0.5 to 1.5 m per year in instances studied. An extensive saline seepage associated with a large farm dam in the Burdekin valley is the subject of a joint project with QWRC. Water moves through weathered granodiorite and rises when blocked by dykes or clay layers.

Several valley floors on the Darling Downs have areas of salinization. Detailed studies at one site (near Oakey) show water moves through basalt and is obstructed by impermeable sandstones; at the other (near Bell) the water chemistry suggests a sandstone origin.

There has been increasing concern on the quality of groundwater supplies for irrigation. Projects relating water chemistry to geographical location and rock types are under way in the valleys of the Don (Bowen), Don (central Queensland), Callide and Dee Rivers and Lockyer Creek.

Irrigation suitability criteria for Queensland waters have been based on overseas work. A project to check the soundness of the criteria and to examine interactions between water quality, soil

Some 200 ha of the Emerald Irrigation Area have been affected by high salinity due to shallow water tables. In one of these areas (the dark patch on the picture), shallow drains are slowly reclaiming the soil for cotton growing.

type, crops and farmer management inputs is under way in the Lockyer Valley. Initial results show a direct link between irrigation water salinity and soil salinity. Appropriate management has successfully prevented excessive salinity accumulation in some soils.

Land resource assessment

Soil surveys of reference areas in the South Burnett at 1:25 000 are continuing. The Hopevale and Memerambi areas totalling about 1 100 ha have been completed and work is in progress on the Boonenne area.

A 1:50 000 soil survey of 61 000 ha of the Lockyer Valley alluvia is continuing. A soils legend has been developed which includes 27 soil profile classes. Four representative soil profiles from Laidley Creek catchment have been sampled for laboratory analyses.

Detailed soil surveys of several Departmental research stations were undertaken. A 1:5 000 Brigalow Research Station catchment soil survey, a 1:10 000 soil survey of Gatton Research Station, and a 1:25 000 soil map of Redvale Block have been completed.

A 1:5 000 soil survey of the Redlands Horticultural Research Station will give detailed data on the soils for planning purposes.

Soil surveys are also being carried out at Mutdapilly Research Station at 1:10 000 scale and at 'Brian Pastures' Pasture Research Station at 1:50 000.

Soils and groundwaters along the proposed pipeline route from Boondooma Dam to the Tarong power station were investigated for corrosion potential of pre-stressed concrete. Laboratory analysis of soil and water samples suggested soils at a number of sites on the route will be corrosive. A report was forwarded to the QWRC, and consultants have reported on the laboratory results.

Evaluation and planning of State projects

A 1:25 000 soil survey of 15 000 ha of the right bank of the Nogoa River in the Emerald Irrigation Area provides the soil inventory for the subdivision of irrigation farms by the QWRC. Distributions and correlations between different soil properties have been examined to help understand soil variability.

A 1:25 000 soil survey of 3 000 ha of commandable land to be irrigated from Clare Weir on the Burdekin River right bank is in progress.

A 1:100 000 soil survey of the Lower Burdekin-Left Bank, Barratta Creek-Haughton River area has been completed for planning irrigation and pastoral development and management. A total of 68 soil profiles was sampled for analysis and a number of useful relationships found. Soil pH was found to be linearly related to exchangeable sodium percentage at 50 to 60 cm depth. At the same depth, chloride constituted about 80% of the soluble salts as measured by electrical conductivity.

Method development

Method development, modification and testing are a continuing process in analytical chemistry today. Increasing demand for uncommon determinations together with a rapidly changing technology is responsible.

High performance liquid chromatography (HPLC) has been further examined for upgrading many analytical methods. Vitamins A and B_2 can now be routinely measured in stockfeed premixes with further development needed for normal rations. Vitamin E will be included in further studies.

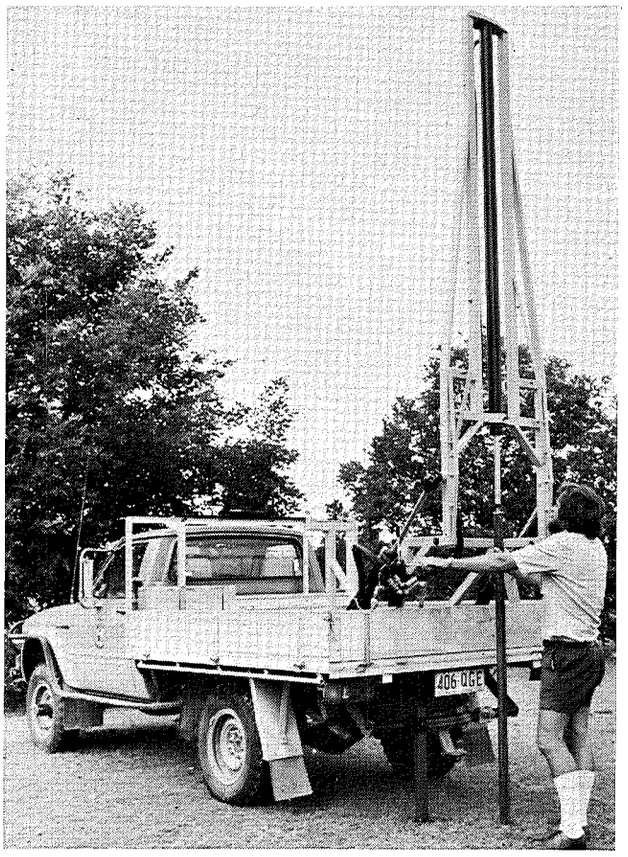
HPLC methods have now been developed for benzimidazoles which previously presented analytical problems.

Extensive method development was required to enable the measurement of chlorothalonil residues in peanut foliage and peanut hay. A gas liquid chromatographic (GLC) method was developed. Information on residue levels was required so that the effect of different spraying equipment could be evaluated.

Analysts were again involved in international collaborative method testing with CIPAC. Samples analysed were various formulations of deltamethrin requiring determination by a specific HPLC method.

Analysts were also involved in an interlaboratory quality assurance programme using standard reference plant materials. Each of six samples was analysed for 15 elements, some by using up to three different methods. The results of this Australia-wide collaborative method testing are now being statistically evaluated.

A microprocessor-based data translation unit is being constructed and controlling software is being written to interface an electronic balance and NMR oilseed analyser directly to the PDP-11 Computer. This will permit the direct data acquisition of these analyses to proceed without the analyst having to note results, make calculations and type them back into the computer.



An efficient hydraulic vehicle-mounted soil sampling rig has been designed and built by Mr Bob Outhwaite, Agricultural Chemistry Branch, in collaboration with soil scientists.

A manual of analytical methods for plant and regulatory chemistry is being compiled. Ten methods evaluated for performance are now in the manual. Also included are notes on laboratory safety and care of equipment together with an outline of water analysis and calculation of results.

For more accurate analysis of liquid samples using the Inductively Coupled Plasma Spectrometer, it was found necessary to achieve a more stable plasma. The atomizer which converts liquid into a fine mist for introduction into the plasma has a substantial effect on plasma stability and sensitivity of instrument response.

For this reason, a prototype atomizer has been developed and partially tested. Indications are that a significant increase in both plasma stability and instrument sensitivity has been achieved.

There has been collaboration with CSIRO Division of Soils with respect to comparisons of methods used to determine cation exchange capacity, exchangeable cations and base saturation status of certain Queensland soils. The Branch has an on-going programme to determine the most suitable means of measuring these important properties in acidic Queensland soils that have low activity clays and variable charge characteristics. Soil aluminium is also important in such soils and is itself the subject of a separate investigation in which extraction procedures and methods of estimation are under examination.

Regulatory

The Branch provides the chemical expertise for officers of the Standards Branch who administer the *Agricultural Standards Act* and the *Agricultural Chemicals Distribution Control Act.* The number of samples analysed for these purposes were—

Pesticide formulations	190
Veterinary medicine formulations	25
Fertilizers and limes	88
Stock feeds	351
Pesticide residues	63

The pesticide residue analyses relate to complaints under the ACDC Act over the incorrect distribution of pesticide by aircraft and ground sprayers.

Also, 69 export grain samples were analysed for the Australian Wheat Board for protein content, upon which the export price is based. Twenty stone fruit samples were tested for fungicide residues. The testing of fumigation chambers for certification has been continued.

General chemistry and services

Analytical services and chemical expertise provided by the Branch are widely used by the Divisions of Plant Industry and Land Utilisation, and to a lesser extent by other Divisions within the Department of Primary Industries. Other Departments which have made use of the services in the last year include Works, Mines, Local Government, Education, Premier's and Prisons. Almost all of the plant analyses and 69% of the soil analyses derived from research projects or surveys.

Branch support for agricultural extension in Queensland is provided in two significant ways. In one, soil, water and some miscellaneous samples are analysed when laboratory data are needed by advisory officers to strengthen the advice giving process. In the second, there is a result interpretation service. Soil fertility ratings are defined for all advisory soil analyses, and more specific interpretations are provided on request. For water analyses, detailed interpretations of suitability for agricultural use are made on a routine basis.

Most soil submissions for extension purposes were made on behalf of primary producers in Queensland, but some samples originated from tobacco growers in northern NSW. Branch personnel and analytical resources were also used to identify soil fertility problems severely limiting the growth of pigeon pea on certain soils of Fiji.

Other analyses and specialist expertise were also provided to assist with soil physical problems, soil classifications, the use of agricultural chemicals and identification of damage from them.

Samples analysed at the Indooroopilly laboratory were—

	No. samples	No. determinations
Plants		
Elemental analysis	13 403	38 751
Oilseeds for oil content	1 907	1 907
Oilseeds for fatty acids	147	588
Tobacco for alkaloids, etc.	324	1 296
Lysine in maize	507	507
Soils		
From research projects	4 979	69 108
From soil surveys	2 373	
For extension purposes	4 990	32 092
Other samples		
Waters	2 338	14 028
Miscellaneous pesticides	54	

Entomology Branch

THE objectives and functions of Entomology Branch are—

- To develop practical and economic methods of controlling insect and allied pests of plant crops (excepting sugarcane and forest products) and crop products grown in Queensland.
- Through the extension services to make these control measures available to the primary producing community.
- To investigate the taxonomy, biology and ecology of economically important insects (whether pests or beneficial species) with the aim of establishing a sound, scientific basis for the development of pest management systems.
- To provide an insect identification service for other Branches of the Department, quarantine authorities, primary producers and the community in general.
- To develop improved methods of beekeeping and to provide an advisory service to apiculturists.
- The Branch operates on a decentralized basis from Branch headquarters at Indooroopilly, six field stations in southern Queensland, three in central Queensland and two in north Queensland.

Pest activity

Heliothis

During early spring, heavy *Heliothis punctiger* infestations were recorded in seed sunflower crops on the Darling Downs, but these populations did not persist.

The usual summer crop infestations occurred on the Darling Downs and, although there were some severely affected plantings, overall activity was moderate. Peak moth flights for the Cecil Plains area occurred during mid December with another minor peak in mid January, this latter peak being composed predominantly of *H. punctiger*. *H. armiger* activity did not dominate the species complex until the third week of January although populations after that time never attained high numbers, except for a late minor peak in mid March.

There were no reports of poor control of *Heliothis* infestations by conventional insecticides. Use of the pyrethroid products was widespread and gave good results. Analysis of this season's resistance data for *H. armiger* indicated that there was no change in the susceptibility levels for the commonly used insecticides, apart from what could be considered natural fluctuations in the baseline levels.

In the Emerald Irrigation Area *Heliothis* activity was moderately heavy during late spring–early summer. Early season damage by *H. punctiger* to the apical growing points of cotton plants was widespread and required several insecticide applications to bring the infestations under control.

In the Callide–Dawson region of central Queensland, intense activity by *H. punctiger* during the period December to early February necessitated numerous applications of insecticides to cotton crops in the area. Under the hot, dry conditions experienced during the early part of the season, the residual life of the preferred insecticide, endosulfan, was short. This factor, together with the intense level of infestation due to sustained egglaying by *H. punctiger*, induced many growers to change to synthetic pyrethroid sprays.

As most cotton crops in the Dawson–Callide region were planted early, *H. armiger* was not a major problem in cotton. However, infestations of this pest in sorghum were severe and widespread during the period from March until May. Aerial applications of carbaryl and fenvalerate gave good control and an estimated 70% of sorghum crops in the area were sprayed. During the same period, *H. armiger* activity was intense also in the Emerald Irrigation Area where crops of sorghum and soybeans were damaged.

In the South Burnett district, the activity of *Heliothis* was below average on most crops. However, some sorghum, soybean and navy bean crops were sprayed to control infestations of *H. armiger*. Large populations of *Heliothis* occurred on peanuts during January and insecticide applications were needed in many crops, particularly those of the Red Spanish variety.

In north Queensland, *Heliothis* species again were the major pests of field tobacco. As in past seasons, infestations of *H. armiger* occurred almost exclusively during the vegetative phase of tobacco growth. In late September to early October, there was a massive influx of *H. punctiger* moths, which coincided with the flowering period of approximately 80% of the tobacco crop in the Mareeba–Dimbulah district.

Although *Heliothis* activity in the district was intense, plant damage was slight owing to the activity of the endo-parasitic wasp *Microplitis*. The parasite develops within the body of the host larva and emergence of the adult wasp, which usually occurs during the fourth instar of the host's larval development, results in death of the host larva. Consequently, parasitized *Heliothis* caterpillars die before they attain the later stages of larval development, which are the most damaging to the crop.

Sorghum midge

Sorghum midge (*Contarinia sorghicola*) was again a serious problem in most grain sorghum production areas of the State. In the Central Highlands, adverse seasonal conditions were responsible for delayed and staggered plantings. The resultant, extended flowering periods increased crop vulnerability to midge attack and many crops were severely damaged.

In the Dawson–Callide region of central Queensland, several growers attempted to avoid midge attack by planting early. However, wet weather during November and December led to an unusually severe, early build-up of midge populations by late December. September planted crops suffered only slight damage, but crops that flowered during December and January were severely damaged. Patchy, below average rainfall from January to April resulted in very uneven crops during this period, which were very vulnerable to attack by sorghum midge. Most mid to late season crops in the region were sprayed for sorghum midge or for joint control of midge and *Heliothis* infestations.

By contrast, midge infestations in sorghum crops in the South Burnett district were much less damaging than they had been last year, although some late-planted crops were heavily infested.

Grain pests

The lesser grain borer (*Rhyzopertha dominica*) was the most important pest species in the central grain storage system during the past year. Comprehensive testing has not disclosed any

evidence of resistance to either bioresmethrin or carbaryl, which are the two regularly used, approved grain protectant insecticides. The infestation problem appeared to relate to particular behavioural characteristics of the pest insect and shortcomings in application techniques for the above insecticides. The major part of the problem occurred with wheat where bioresmethrin was used exclusively.

The other major pest species, rice weevil (*Sitophilus oryzae*), rust red flour beetle (*Tribolium castaneum*) and tropical warehouse moth (*Ephestia cautella*) also were very common on farms. However, there is as yet no evidence that these species have developed resistance to the organophosphorous insecticides currently used as grain protectants.

Apart from problem infestations of the lesser grain borer, insect problems in central storages during the year were relatively few despite near-record harvests of winter cereals and grain sorghum. The two insects most frequently involved were the maize weevil (*Sitophilus zeamais*) and the dried fruit beetle (*Carpophilus dimidiatus*), the maize weevil having been most common early in the season.

Several other species of beetles occurred less commonly and also necessitated treatment of grain before delivery because they are types of insect that could persist in stored grain. The problem seems to be one that is likely to increase with the expansion in growing of summer grain crops.

Locusts

Locusts did not constitute a serious problem in Queensland during the past year.

Numerous low to medium density swarms and large numbers of hopper bands of the Australian plague locust (*Chortoicetes terminifera*) infested the Injune and Goondiwindi–Texas areas during the period October to December. Aerial spraying of bands and swarms was undertaken by the Australian Plague Locust Commission and by late December only a few, small, low-density swarms remained. Small bands and swarms or scattered adults were reported from several localities in the Far South West, Warrego and Maranoa districts during the same period, but they caused no problems.

Occasional adult concentrations of the spur-throated locust (*Austracris guttulosa*) were reported from the Central Highlands region of central Queensland but, in general, activity of this locust and also of the migratory locust (*Locusta migratoria*) was low throughout the year.

Research

SIRATAC evaluations for cotton pest management

This season, nine trials were conducted throughout the State to evaluate the applicability of the SIRATAC programme to each of the main cotton growing districts and to develop modifications to the programme to cope with problems specific to each area. The work was carried out in conjunction with the Entomology Department of the University of Queensland.

SIRATAC is the computer-based insect pest management programme that was developed in the Namoi Valley of New South Wales and which now is widely used by commercial cotton growers there. The basic philosophy of the programme consists of applying control measures only when the benefits of any control outweigh the costs involved.

By undertaking this programme, a grower can obtain the best yield and greatest net return in relation to pest control. At the same time, this rational programme of strategic pest control will minimize the risk of development of insecticide resistance by pest species and will reduce the possible occurrence of any undesirable effects on the environment.

The philosophy is not new and Departmental entomologists have been working towards this goal for some years. What is new is the use of an 'on-line' computer to determine the appropriate control strategy. The data on insect populations, crop development and weather conditions are entered into the computer from a remote terminal, using normal telephone lines to communicate with the computer. The SIRATAC programme then makes an objective pest management decision for the grower and this is typed out on the terminal.

Although all the trials have not yet been harvested, the data that have been collected indicate that, with no difference in yield potential, the computer management system used slightly fewer sprays at a significantly lower cost compared with the normal commercial pest control programmes for each site. The main cost advantage to the SIRATAC plots came from reliance on ovicides and endosulfan rather than on the more expensive and more disruptive pyrethroid insecticides used in the commercial plots.

Before commercial acceptance of the SIRATAC programme can become a reality in Queensland in cotton growing areas, however, it will need to be refined further to be able to cope with thrips and tipworm infestations in south Queensland crops and pink spotted bollworm infestations which commonly occur in central districts.

Baiting trials against adult soil insects

Recent field trials carried out in the Central Highlands region have shown that, in areas where soil-inhabiting insects are a problem, baiting is an effective, inexpensive method of keeping pest populations in check long enough to allow satisfactory establishment of sunflower seedlings.

False wireworm beetles, wingless cockroaches, field earwigs and crickets are the soil-inhabiting insects most responsible for substantial seedling losses in sunflower plantings in the Central Highlands. Spraying with insecticides is ineffective against these pests and, at times, damage can be severe enough to necessitate replanting the infested area.

In the trials, baiting successfully controlled adult soil insects. Various baits were tested and those based on crushed wheat or crushed sorghum and containing chlorpyrifos, 2% a.c. by weight and sunflower oil 5% by weight were the most successful. Comparisons of broadcast baiting (2.5 kg ha^{-1}) with bait trails spaced every 2, 4 or 8 m apart found that broadcast treatment is the better application method, as the level of control declined as the distance between bait trails increased.

Insect-resistant crop varieties study

During past years, intensive studies have been carried out at Kingaroy to evaluate experimental soybean breeding lines for resistance to some of the major insect pests of this crop. Further experiments carried out recently confirmed earlier findings that some of the germplasm lines under study possess useful levels of resistance to *Heliothis* species and to the lucerne crown borer (*Zygrita diva*).

On some germplasm lines, crown borer larval populations at crop maturity were less than half those on standard commercial cultivars. In other field studies, populations of the green vegetable bug (*Nezara viridula*), another serious soybean pest, were four times greater on commercial varieties than on the resistant lines. It is clear that insect-resistant varieties could make a significant contribution to the soybean-growing industry.

Plant cultivars that are resistant to insect damage form a valuable component of pest management systems because their use generally allows a reduction in insecticide usage without commensurate loss of yield. In some crops, however, a reduction in quality is equally as important as a reduction in yield. In this respect, development of insect-resistant sweetcorn cultivars would be a considerable advantage as very little damage to sweetcorn cobs can be tolerated without loss of marketability.

Until now, comparative resistance to corn ear worms (*Heliothis* spp.) of the Australian germplasm has been virtually unrecorded. Repeated screening of 20 commercial sweetcorn cultivars at the Redlands Horticultural Research Station at Ormiston has established that four cultivars, and in particular 'Midway' and 'KSC 467', already possess pronounced resistance. These and other cultivars will be evaluated further in large-scale plantings.

Reports of tomato breeding experiments in the USA have indicated that the wild tomato *Lycopersicon hirsutum glabratum* offers a source of resistance to the American tomato worm, *Heliothis zea*. In a comparison with six commercial tomato cultivars at Ormiston, an accession of *L. h. glabratum* showed marked resistance to the Australian tomato grub, *Heliothis armiger*. This source of insect resistance should prove useful in Australian tomato breeding programmes.

Fresh fruits disinfestation studies

Quarantine regulations of certain States within Australia and some overseas countries demand commodity treatment against the Queensland fruit fly (*Dacus tryoni*) before fruit destined for export markets will be accepted. At present, these treatments rely on gaseous fumigation of fruit with ethylene dibromide (EDB).

However, this fumigant is under threat of de-registration in the USA and its withdrawl from the list of acceptable treatments could prejudice both the interstate and overseas marketing of Queensland fruit. For this reason, extensive research is being carried out to devise suitable alternative treatments.

Several disinfestation methods have been tested including phosphine fumigation, cold storage for extended periods, hot water dipping and dipping of fruit in insecticide solutions. Many of the treatments, although effective, have undesirable side effects.

The most promising treatment consists of dipping infested fruit in solutions of the insecticide dimethoate. Dips of 300 to 500 ppm dimethoate and dip times of 1 to 3 min have proved very effective against fruit fly infestations in capsicums, mangoes and tomatoes. The treatment does not damage or taint the fruit commodity and it leaves minimal insecticide residues—well within the maximum residue limits recommended by the Commonwealth Department of Primary Industry.

Sorghum midge activity studies

Behavioural studies carried out in commercial sorghum crops on the Darling Downs and in the Biloela district have provided useful information on the times of greatest egg laying activity by

the sorghum midge (*Contarinia sorghicola*). The information will be of considerable benefit to farmers, who are confronted with the problem of regularly scouting sorghum crops to detect midge activity when planning control measures. Factors such as crop flowering stage, temperature and wind strength affect midge activity. Incorrect spray decisions and therefore ineffective spray application could result from observations made outside the period of maximum midge activity.

Temperature had an important influence on the initiation of midge activity. Few midges were observed until the temperature had exceeded 20°C. This would seem to be related to the threshold temperature for emergence of female midges from over-wintering pupae, which lies in the range 18 to 20°C.

During the period December to March, the peak of midge activity occurred between 9.00 and 11.00 a.m. Possibly, if midges were active in late-planted crops during the cooler months of April and May, peak activity may occur later in the day. Although on some occasions midge numbers remained quite high in the afternoon, egg laying activity declined rapidly after midday.

The observations also confirmed that sorghum heads were most attractive to egg laying midges at mid flowering. Prior to anthesis, sorghum heads are infested by egg laying midges only when midge populations are excessively large.

This information has already proved its value to farmers and commercial scouts in enabling them to gauge midge activity accurately and so determine the need for spray applications.

Maize pests studies

Insecticide trials, together with studies on the biology and ecology of the white fringed weevil (*Graphognathus leucoloma*), have led to the development of an effective control strategy for combating this pest in maize crops on the Atherton Tableland.

The part played by insecticides in reducing white fringed weevil populations hinges on control of the adult weevils which are sprayed with methamidophos (145 g a.c. ha^{-1}) as soon as they emerge from the soil. A second spray applied 2 to 3 weeks later eliminates the majority of the remaining adult weevils.

Ecological studies on the pattern of seasonal development of the white fringed weevil pinpointed the most effective times to apply insecticides. The insecticide treatment is complemented by an equally important cultural treatment that consists of eliminating volunteer peanut plants from within the maize crop by cultivation or by application of the herbicide atrazine. On the Atherton Tableland, peanuts and maize are usually grown in rotation, but peanuts were found to be the preferred host of the pest. In biology studies, adult weevils fed on peanuts survived for much longer than those fed on maize and they also laid many more eggs.

The respective nutritional values of the two crops also influence larval development. Growth rates of white fringed weevil larvae fed on maize were only fractions of those of larvae fed on peanuts. Consequently, with the elimination of volunteer peanut plants from a maize crop, any weevils that survive insecticide treatment are deprived of their favoured food source and soon die.

In other trials carried out on the Atherton Tableland, the influence of soil inhabiting white grubs on the yield of maize crops was investigated. These insects, which are the larval stages of a beetle (*Lepidiota* sp.), feed on the roots of plants and, although their distribution within a crop tends to be patchy, they can be quite destructive. The investigation found that damage to maize roots by the grubs severely affects the rate of growth and can reduce the final yield of the crop by more than 35%.

However, field insecticide trials have proved that both the soil fumigant EDB 193 applied at 15 L ha^{-1} and the insecticide terbufos applied at 2 or 4 kg a.c. ha^{-1} effectively control the white grubs. Although the application rates for terbufos seem comparatively high, treatment costs are more than compensated for by the value of the crop saved.

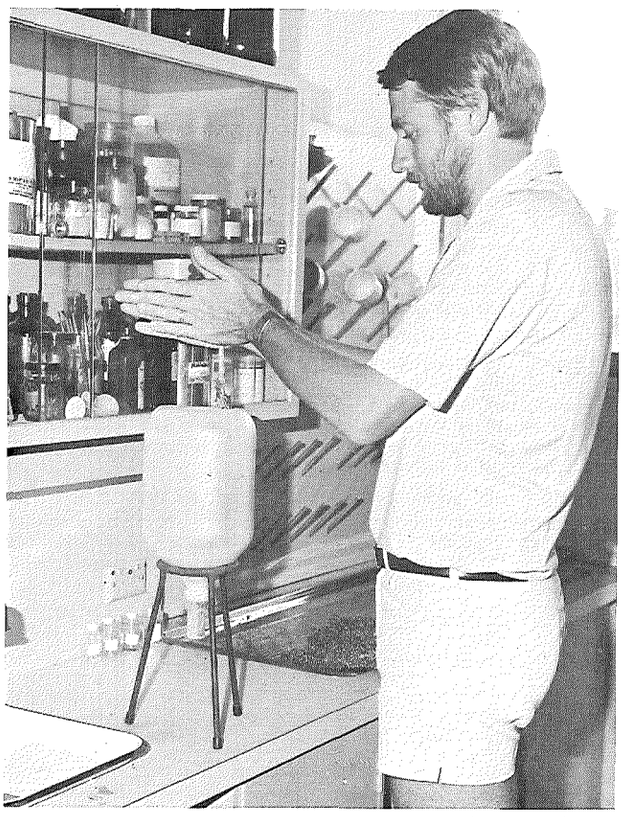
Reflective mulches reduce WMV in cucurbits

In trials carried out in north Queensland, a mulch of reflective aluminium strips was more successful than insecticides in retarding transmission by aphids of watermelon mosaic virus (WMV) disease to cucurbit crops such as zucchini. Watermelon mosaic virus (WMV) which is a serious disease of cucurbits in coastal areas, causes deformation of the fruit.

When disease epidemics coincide with the main fruit-setting period, they can cause a devastating loss of production. Although the disease is transmitted by aphids feeding on the plants, controlling the aphid infestations by means of regular insecticide sprays does not protect the plants from infection by the virus. However, reflective aluminium mulch has a repellent effect on aphids, deterring them from landing and feeding on the plants, which results in a reduction in transmission of the virus.

In one trial which was conducted during a particularly severe virus epidemic, 65% of the plants with aluminium mulch were free from virus infection at a time when plants in all other treatments were completely infected. Furthermore, the yield of fruit from plants with aluminium mulch was five times greater than that from untreated plants.

Aluminium mulch is expensive, however, and this could be a possible barrier to its use by commercial growers. In subsequent trials, a silver-sided, 'Visqueen' (TM) mulch proved as effective as the aluminium strips in retarding WMV infection, and was superior to insecticide sprays. In addition, 'Visqueen'(TM) improves weed suppression and plant growth. These advantages, together with its comparatively low cost, may open the way for use of this material on a commercial scale.



An officer of Entomology Branch spins a sorghum head in a collecting container to extract sorghum head caterpillars for counting. This study is designed to discover the level of pest infestation that causes economic damage.

Study on sorghum head caterpillar control

The seasonal development of infestations of two pest species, corn ear worm (*Heliothis armiger*) and sorghum head caterpillar (*Cryptoblabes adoceta*) in grain sorghum was investigated in field trials in central Queensland to determine appropriate control strategies for these insects.

The investigation found that *H. armiger* moths lay eggs in sorghum heads until the end of flowering and one application of an appropriate insecticide soon after the completion of flowering should control this species for the remainder of the life of the crop.

As oviposition by *Heliothis* is restricted to the flowering period of sorghum, it is important that all cultural operations be carried out to ensure as even a crop and flowering period as possible. This will reduce the risk of flowering coinciding with peaks in the egg laying activity of the *Heliothis* moth population. In addition, uneven flowering resulting from uneven crop development leads to protracted oviposition by *Heliothis* moths. The resultant larval populations are composed of caterpillars of varying size and age, which makes control by insecticides difficult.

In contrast with *Heliothis,* larval infestations of the sorghum head caterpillar (*Cryptoblabes adoceta*) are more prevalent after the completion of flowering and reach a maximum when the developing sorghum grain is at the hard dough stage.

A trial to determine the infestation level at which *C. adoceta* larvae inflict economic damage showed that a grain sorghum crop could tolerate up to 10 larvae per head without suffering significant, economic loss of yield.

Grain pests dispersal studies

Recent research on dispersal of the major grain pests has concentrated on field infestations. There is increasing interest in storing large bulks of grain in temporary storages, some without insecticide protection, and the risk of re-infestation needed to be assessed. For the last 2 years, traps have been placed in a grain-growing locality on the Darling Downs to determine the level of migrant insects arising from farms. Traps placed in the field caught only 1 to 2% of the numbers of insects found in traps in farm buildings, but owing to low field trap density, these numbers represent substantial insect flights with high potential for infesting grain storage sites.

Insects were caught in every month except July and August, with peak flight occurring during the period October to December. The catch during the second year was only 14% of that recorded during the first, so yearly variation could be important in predicting infestation potentials.

C.Q. distribution of pinkspotted bollworm

The pinkspotted bollworm (*Pectinophora scutigera*) has been recognized as a mid late season pest of cotton in the Dawson–Callide region of central Queensland for many years. With the expansion of the cotton growing industry in the Emerald district and the recent discovery of some pinkspotted bollworm specimens there, it became important to know the distribution of the pest in relation to the main central Queensland production areas.

Survey methods for *P. scutigera* have been helped by the development of pheromone traps. The pheromone trap uses a synthetic lure of similar chemical composition to the natural, sex attractant emitted by the female *Pectinophora* moth before mating. Male moths are attracted to the trap in the mistaken belief that they are flying to a female. As numbers of males and females in the population are about equal, the pheromone trap gives an accurate and reliable indication of *Pectinophora* moth activity.

Pheromone traps were placed at 20 km intervals along the Dawson Highway from the Calliope Range to Rolleston and south to Theodore on the Leichhardt Highway. They were serviced at monthly intervals throughout the year. The results showed that pinkspotted bollworm moths were widely distributed throughout the region and present at all times of the year.

Moths were particularly numerous in the spring owing to peak emergence of overwintering insects. The largest numbers of moths were trapped in the irrigated, cotton growing areas at Biloela and Theodore, while much smaller numbers were caught at sites up to 30 km from the nearest cotton crop.

Cotton obviously is the main host plant in the cotton growing areas and prompt, end-of-season ploughing-in of crop residues is important in reducing the overwintering population.

The pheromone trap monitoring in the cotton production areas gave growers timely warning of intense activity of *P. scutigera* moths during the late December–January period. By using one or two insecticide applications, growers were able to reduce the numbers of moths and minimize boll infestations. This resulted in considerable financial benefit to growers, as established infestations of this pest are very difficult to control.

Grain protectant studies

Intensive studies on newer grain protectants continued during the year. Field work carried out in 1981 on stored wheat from the 1980–81 harvest involved pilot usage trials in which a high concentration of synergized deltamethrin was compared with combinations of fenitrothion with synergized fenvalerate or synergized deltamethrin at a low concentration, for control of grain insects.

All three treatments were successful. No insect infestations were recorded in any of the treated storage bins and no significant failures occurred in any of the laboratory tests.

It is especially pleasing to report that residues of fenvalerate consistent with its use as a grain protectant were accepted by the Codex Alimentarius Commission at Stage 4 of its procedure on the basis of data accumulated from these grain protectant studies. This acceptance of fenvalerate is a prerequisite to an approach to overseas markets regarding its possible use on grain held in central storage pending export.

The cost of the fenvalerate treatment should be less than half the 55c per tonne of treated grain currently incurred for bioresmethrin. The low concentration of deltamethrin also will be available as a competitive alternative to bioresmethrin, subject of course to approval by the regulatory authorities.

Field work on silo scale experiments with fenitrothion-carbaryl dust used either as a surface application or incorporated in the grain mass has been completed, but final laboratory tests are still in progress. The insecticide mixture has controlled all test insects, and residues from the surface application appear to be within acceptable limits. Residues of carbaryl from the admixture treatment are variable owing to the physical characteristics of dust application, and some exceed the maximum residue limits. This may restrict the maximum application rates for dusts containing carbaryl.

Parallel work involving incorporation of Dryacide (a silicon-based aerogel) gave good but not complete control of test insects. As expected, this treatment altered the physical properties of the grain resulting in an increased angle of repose and reduced rates of flow of the grain through some machinery. Experiments on the removal of the dust during processing have still to be finalized.

Laboratory experiments on grain stored for 12 months have established that the minimum effective doses for the newer pyrethroid insecticides cyfloxylate and cypermethrin (both synergized with piperonyl butoxide) were around 2 and 4 mg kg^{-1}.

Heliothis life table studies

Heliothis species have long been considered to be among the most serious insect pests of Australian agriculture. In tobacco, in the absence of insecticidal sprays, they have the potential to cause millions of dollars worth of crop damage each season. Consequently, these pests have been the subject of considerable research.

Recently-completed field work carried out in the Mareeba-Dimbulah district of north Queensland has enabled the compilation of life tables, similar to those used in actuarial studies, for *Heliothis* species in vegetative tobacco.

Life tables are basic tools of population studies, as they record population changes throughout the life cycle of a species, in the first instance, in its natural environment. In compiling the life tables for *Heliothis*, the studies were conducted in fields of unsprayed tobacco. Life tables compiled for several sites over consecutive seasons identify and establish the value of particular mortality agents acting on the study species.

The studies carried out in unsprayed tobacco have shown that the first stage larva is the most vulnerable stage of the *Heliothis* life cycle. A cumulative mortality of 30% at the end of the egg stage increased to 90% by the end of the first larval stage. There seems little doubt that the toxic effects of the natural alkaloid chemicals in the tobacco plants were responsible for the death of most of the Stage 1 larvae.

Using the information derived from the life tables, it should be possible to manipulate population processes to our advantage. Results from this study will provide the comparative base for judging the success of future, potential control processes, such as biological control, in regulating *Heliothis* populations on tobacco.

The long-term goal is to maintain tobacco yields and quality without total reliance on insecticides, thereby reducing production costs and also minimizing the risk of environmental contamination by excessive use of chemical pesticides.

Services

Insect identification service

Recognizing an insect in its various stages of development has always been an essential prerequisite to any control programme. However, insect identification can be a daunting task in Australia where the insect fauna is estimated to consist of 108 000 species.

Biological and integrated pest control programmes require substantial taxonomic support and, during the past year, 3 200 identifications were provided in this area.

With the increased traffic of goods and people between countries, the chance of importing an unwanted insect pest is greatly increased. Early detection is our most effective weapon so quarantine authorities require a rapid and accurate identification service. Approximately 625 identifications were provided during the year. Health authorities frequently find insects associated with foodstuffs. However, before effective action can be taken, identification of the offending insects must be made. Such determinations are provided by officers of Entomology Branch.

Cotton pests activity monitoring service

Continued operation of a pest monitoring programme during the past summer enabled the activity of the major pests in the cotton growing areas of central Queensland and the Darling Downs to be plotted through the recording of numbers of insects caught in light traps and pheromone traps. The information on pest activity derived from this programme was of considerable assistance to growers in planning their control strategies.

As usual *Heliothis* species were the main pests in all areas and, in the Emerald district, significant activity of *H. punctiger* continued through into late January. As expected, *H. armiger* was the dominant species during the latter part of the season and was particularly prevalent in March.

On the Darling Downs, sex pheromone traps were used for the first time as an alternative to the light trap system for monitoring *Heliothis* moth activity. The pheromone traps proved entirely reliable in surveying the species composition of the *Heliothis* complex, but the data from the traps were not reliable for assessing the intensity of *Heliothis* egg laying. Consequently, infestation levels still need to be assessed by visual examination of the crop.

Pheromone traps were used also in the Dawson–Callide region of central Queensland to advise cotton growers at Biloela and Theodore of activity levels of pinkspotted bollworm (*Pectinophora scutigera*). *P. scutigera* moths are attracted to light traps less readily than other insect species and the use of pheromone traps offers a distinct advantage in monitoring activity of this pest.

Quarantine survey of fruit flies

Departmental entomologists have continued the fruit fly survey of far north Queensland and the Torres Strait islands at the request of the Plant Quarantine Service of the Commonwealth Department of Health. This survey was specifically designed as an early warning system to detect any possible introductions of exotic pest fruit fly species.

Bi-monthly collections of fruit flies from the Torres Strait islands of Boigu, Dauan, Saibai, Darnley, Yorke, Yam, Murray, Badu, Sue, Thursday, Wednesday, and Horn were sorted and identified. In addition, two air-charter trips around Cape York were undertaken from Mareeba. These trips enabled regular monitoring of important localities such as Normanton, Mitchell River, Edward River, Weipa, Bamaga and Iron Range. Intensive monitoring was also carried out in the Cairns district by a road-based survey team. No exotic pest species of fruit flies were among the specimens collected from any of these areas.

Extensive fruit fly collections were received from Indonesia and Papua New Guinea and these, too, have been sorted and identified. Specimens not already represented in the Department's fruit fly collection were added to the collection, thereby augmenting its undoubted value as an essential reference tool.

The data accumulated from the quarantine survey have continued to provide the Plant Quarantine Service with valuable information on the distribution of fruit fly species in islands to the north of Australia.

Tobacco pests prediction service

During the past season, Departmental entomologists continued to operate the Tobacco Pests Prediction Service to advise tobacco growers of levels of pest activity so that they could take appropriate control action.

The population levels were monitored by visual checks of pest numbers in blocks of unsprayed tobacco distributed throughout the Mareeba–Dimbulah production area. When pest activity rose to unacceptable levels, growers were advised through radio broadcasts of the need to spray and of the most appropriate time to spray to achieve maximum control.

Plant Pathology Branch

THE objectives and functions of Plant Pathology Branch are—

- To develop and incorporate into field practice more effective and economical methods of reducing losses caused by fungi, bacteria, nematodes and viruses in crops other than sugar-cane.

  This involves the accurate diagnosis of diseases, including those intercepted in quarantine, studies of causal organisms and the factors affecting their severity, disease control by chemical, cultural and biological methods including cultivar resistance and the dissemination of disease control information.
- To maintain a record of all plant diseases found in Queensland, other than those in sugar-cane, with reference specimens stored in an herbarium and a collection of plant pathogens particularly fungi and nematodes.
- To develop more effective strains of rhizobia for legumes, particularly tropical pasture legumes, and to improve their field performance.

Research

Agricultural crops

Barley. Powdery mildew (*Erysiphe graminis hordei*) continues to be the most important foliar disease of barley in Queensland.

In field trials, seed treatment with triadimefon has consistently given good control of the disease for up to 8 weeks after planting. To evaluate seed dressing with triadimefon under commercial conditions, the Barley Marketing Board treated 150 t of seed cv. Clipper with triadimefon (15 SD) at 1.0 and 1.5 g per kg and sold it to interested growers. Twenty-seven crops were visited to select seven sites where the two rates of triadimefon could be compared with the standard carboxin treatment.

A significant increase in yield was detected at only one site. This reflected the low level of mildew generally present in all but a few early crops. A significant (P=0.05) increase in grain size was recorded at two sites. Overall the use of triadimefon instead of carboxin gave no detectable increase in yield through control of powdery mildew during early crop life. There was no difference between the two rates of fungicide.

Cotton. A study was initiated to determine the economic importance of bacterial blight which is caused by the bacterium *Xanthomonas campestris* pv. *malvacearum.*

Cotton crops with a specific cropping history were surveyed at the seedling and mature boll stages to estimate the quantity of cotton trash on the soil surface, the amount of seedling blight and the number of bolls with bacterial blight lesions. The amount of blight was correlated with the level of trash on the soil surface.

Laboratory experiments under controlled conditions indicate that the pathogen can survive as an epiphyte on cotton leaves under dry conditions and infect the leaves, resulting in blight lesions, when the relative humidity increases.

Maize. Co-operative work with Agriculture Branch continued with field and glasshouse screening of breeding lines for resistance to sugarcane mosaic virus—Johnson grass strain (SCMV-Jg). Particular attention is being given to the development of virus-resistant hybrids for use in south Queensland. Recently identified sources of resistance were BL6 from Advanced Burnett population 1 and Oh 514 from the USA.

Twenty-five hybrid cultivars submitted to the regional testing programme were screened at Gatton for resistance under conditions of high inoculum pressure. Nineteen had adequate field resistance for use in areas where mosaic can be a problem.

Leafhopper-transmitted viruses of maize were not severe, probably because of frequent early summer rains. Breeding for resistance to maize sterile stunt virus is being combined with the introduction of resistance to sugarcane mosaic virus (SCMV-Jg) in crosses of lines B 37 and H 84 with Pa 405. Early tests of selfed backcross progeny indicate that the inheritance of resistance may be more complex than expected from the fully resistant performance of F_1 progeny.

Pastures. Anthracnose (*Colletotrichum gloeosporioides*) is a serious problem particularly in seed crops in north Queensland.

Development of the disease in 18 *Stylosanthes* genotypes is being assessed at three sites in north Queensland. Further pathogenic specialization has been found within both Type A and Type B variants of the fungus. A new Type B race is highly virulent on *S. guianensis* cv. Graham, while a range of races with varying levels of virulence on *S. scabra* cv. Fitzroy has been identified.

Studies in controlled environment cabinets have shown that Type A disease develops at 20 to 34.5°C, while the Type B disease develops at 20 to 30°C. Both Type A and Type B variants require at least 24 hours of leaf wetness to develop, after which disease development is independent of atmospheric humidity.

Studies on the genetics of host resistance to *C. gloeosporioides* are being made in collaboration with the CSIRO Division of Tropical Crops and Pastures.

Within *S. guianensis,* analysis of F_2 and F_3 progenies has shown that the accession C.P.I. 18750 carries a single dominant gene for resistance to Type B race 1. This gene is also effective against races 3 and 4 but not against race 2. Within *S. scabra* the resistant cv. Seca was found to carry two dominant genes for resistance to the two Type A races, one conferring complete and the other partial resistance.

Peanuts. Peanut seed is treated with fungicide before planting to ensure good emergence. In north Queensland, growers reported poor emergence and attributed the failure to the use of a slurry treatment containing captan, dicloran and a binder by the Peanut Marketing Board. Before this season, the Board had dusted seed with a mixture of quintozene and captan.

A study of the problem indicated that poor seed quality was the major factor responsible for the problem although the slurry treatment resulted in lower seed germination than after dust treatment.

In field trials in north Queensland, the fungicides biloxazol, CGA 64250 and a mixture of CGA 64250 and flowable mancozeb were no more effective than chlorothalonil on controlling leaf spot (*Cercosporidium personatum*). Biloxazol was also effective against rust (*Puccinia arachidis*).

Soybean. Phytophthora stem rot (*Phytophthora megasperma* f.sp. *glycinea*) was recorded in all the major soybean growing areas of south Queensland, but has not yet been found in the Central Highlands or north Queensland. In the West Moreton and Lockyer districts at least 30% of fields were affected with 80% death of plants in some fields.

The disease was not as severe as in the 1980–81 season and this is attributed to the widespread use of field resistant cultivars such as Davis, and the tendency for farmers not to plant soybeans in fields where heavy losses were suffered the previous season.

Field trials have indicated that the cultivars Hill, Collee, Davis and Bragg have high levels of field resistance. Systemic seed treatment with metalaxyl increased the yield of cultivars which possessed field resistance.

Testing new spray equipment for disease control.

Sunflower. Rust (*Puccinia helianthi*) occurred in many crops with levels of 40 to 50% leaf area affected being recorded in some hybrids which had previously shown good levels of resistance. To determine the reasons for this increased rust intensity, the development of a rust isolate collected in 1979 and another collected from hybrid crops in 1980 was studied on nine lines and cultivars.

Data on reaction type, generation time, pustule number and pustule size suggested that a change in the rust population was responsible for the increased intensity of rust on some hybrids.

The wild sunflower species *Helianthus argophyllus*, collected from the central Queensland coast, was found to be highly resistant to infection by several isolates of *Puccinia helianthi* and *Alternaria helianthi.*

Tobacco. Blue mould (*Peronospora hyoscyami*) was not recorded in north Queensland in 1981. In glasshouse experiments, several systemic fungicides gave complete control of the disease, but all are closely related to metalaxyl and would probably not be suitable alternatives to metalaxyl should resistance develop.

Wheat. Long fallow disorder is characterized by poor growth of wheat in some soils of the Darling Downs. Results of field trials suggest that the condition is the result of heavy infestations of the root-lesion nematode (*Pratylenchus thornei*) and reduced mycorrhiza infection.

The nematicide-insecticide aldicarb, applied at seeding increased yield of cv. Gatcher by 70%. Cultivars varied in their ability to grow in soils with a history of long fallow disorder, with Gatcher being the most susceptible and Cook the most tolerant of the current commercial cultivars. Selections within Gatcher and some breeding lines are more tolerant than Gatcher. Barley is not affected and grows satisfactorily where wheat fails.

Screening and evaluation of rust resistance in wheat lines was continued in a joint project with Agriculture Branch. The high-yielding mid season cultivar Flinders was released from this programme in May 1981 and should be a valuable replacement for Oxley; this cultivar possesses the gene Sr 26, probably Sr 5, and other genes for resistance to stem rust as well as adult plant resistance to leaf rust.

One hundred and six samples of rusted cereals and grasses were collected and forwarded to the University of Sydney Plant Breeding Institute as part of the Australian Cereal Rust Survey. Of particular interest among these were samples of stripe rust (*Puccinia striiformis*) collected for the first time in Queensland on wheat and on cocksfoot.

Despite an intensive search, the disease was not found in commercial cultivars which generally possess good resistance to the strain 104 E137 found in Queensland. The ability of stripe rust to develop readily under Queensland conditions indicates that this disease has the potential to become a serious problem should a virulent strain of the pathogen develop or susceptible cultivars be released.

No new strains of *P. graminis tritici* or *P. recondita tritici* were recorded. The Oxley-virulent strain 343—1, 2, 3, 5, 6 of *P. graminis tritici* continued to predominate while 104—2, 3, 6 was the most prevalent strain of *P. recondita tritici.*

With the introduction of stubble mulching, yellow spot (*Pyrenophora tritici-repentis*) has increased in importance. A technique for screening wheat lines for resistance to yellow spot was developed, and an additional 400 cultivars selected from a wide range of breeding programmes have been screened to find sources of resistance.

In co-operation with plant breeders, backcrosses have been made to incorporate yellow spot resistance from poorly adapted cultivars into Banks and Cook. Because of the absence of dominance and the complex nature of resistance it will take several years before resistant lines are ready for yield and quality evaluation.

Studies of resistance of wheat cultivars to common root rot (*Bipolaris sorokiniana*) were continued and new sources of resistance found in Hybrid Titan, the Durum cv. Durati, a Canadian line 680-11-6, Pusa 111 and QT 2338/9. Hybrid Titan was significantly more resistant than Kite.

Horticultural crops

Apple. Premature death of apple trees is a problem throughout the Granite Belt. Glasshouse tests of apple rootstocks for resistance to white root rot (*Dematophora necatrix*) have shown that some rootstocks are more resistant than others. The more resistant rootstocks will be evaluated in white root rot affected orchards.

Interest in improved methods of spray application has increased in recent years. In a trial in the Granite Belt, low volume application of 4.3 kg of captan 83W in 330 L of water per ha with a controlled droplet orchard sprayer gave better control of bitter rot (*Glomerella cingulata*) than 4.3 kg in 3 200 L of water per ha through a conventional high volume sprayer.

Avocado. Soil treatment with currently recommended rates of metalaxyl will control root rot caused by the fungus *Phytophthora cinnamomi* but is expensive. Reduced rates (that is, 1.25 and 2.5 g a.i. m^{-2}) prevented aerial decline of avocado trees in a root rot situation. Foliar applications of aluminium ethyl phosphate also give good protection but this material will not improve trees with advanced decline.

Development of a fungicide treatment for post-harvest control of anthracnose (*Glomerella cingulata* var. *minor*) and stem-end rot (*Dothiorella aromatica*) is well advanced. Optimum conditions for dipping and/or spraying the fungicide on fruit after harvest have been defined and the treatments have been tested under packing house conditions.

Lack of phytotoxicity of the fungicide on a wide range of cultivars has been determined and taint and residue tests were conducted before the material was registered for use in Queensland.

Field sprays for the control of anthracnose and stem-end rot have been assessed in conjunction with the New South Wales Department of Agriculture. A fungicide, which may replace the current standard treatment using copper oxychloride, has been identified. The experiments have also allowed losses from anthracnose to be quantified and, as a result, the full severity of the disease is realized.

Banana. A new race of the Panama wilt fungus *Fusarium oxysporum* f.sp. *cubense* which affects Cavendish bananas is causing concern in the Wamuran district of southern Queensland. The movement of planting material from the affected areas has been halted in an effort to contain this potentially devastating disease. Research is currently in progress to compare this new race of the fungus with possibly similar new races recently found in Taiwan and South Africa.

Capsicum. Isolates of potato virus Y (PVY) from capsicum showed considerable variation when tested on a range of resistant cultivars. Some readily infected the PVY resistant cultivar Northern Bell whereas some recently introduced cultivars were resistant to the range of isolates tested.

Cucurbits. Pumpkins and zucchini resistant to watermelon mosaic virus (WMV 1 and 2) are being bred in a joint programme with Horticulture Branch.

Adequate resistance was maintained in *Cucurbita maxima* x *Cucurbita ecuadorensis* progeny selected from open-pollinated, backcrossed material grown at Gatton Research Station and Indooroopilly. This material has been screened for resistance to WMV by manual inoculation and also by inoculation by infective aphids in the field.

Selection for resistance to WMV is combined with selection for fruit type, colour and flavour. Unfortunately selections for fruit types similar to the Queensland Blue cultivar of pumpkin have been associated with poor fruit set but this should be overcome by sibling crosses during the next generation.

Backcross material of butternut pumpkin (*C. moschata*) x *C. ecuadorensis* has not maintained adequate virus resistance but some F_2 plants of this cross have good resistance. These will be used in conjunction with recombinations from the backcross in further crosses.

New outcross progeny are being prepared and tested for the zucchini lines, (*C. moschata* x *C. ecuadorensis*) x *C. pepo* using the F_1 and an outcross made previously.

In tests of various sources of resistance to local and exotic isolates of WMV 1 and 2, *C. ecuadorensis* was the only species with wide spectrum resistance which was compatible with *Cucurbita* species.

Collecting soil samples from a pineapple root rot trial.

Grapes. Grey mould (*Botrytis cinerea*) causes serious losses of grapes when prolonged wet weather coincides with maturity. Fungicides give partial control but it is difficult to get fungicide penetration into the bunch. In a field trial, much better control was achieved when benomyl was applied by a low volume sprayer applying 130 L of spray per ha than with a conventional application of 530 L per ha.

Ornamentals. Neck rot (*Stromatinia gladioli*) causes serious losses in commercial gladioli plantings and growers are continually forced to seek new land. In a glasshouse experiment, the fungicides benomyl, thiabendazole, iprodione, vinclozolin, dicloran and methoxyethlymercuric chloride were evaluated as 30 min dip treatments.

Disease incidence was assessed after the treated corms had been grown in a sterilized potting medium of 21 weeks. Benomyl and thiabendazole were superior to the other fungicides.

The use of clear plastic sheeting as a ground cover to heat soil by solar radiation (solarization) for 4 weeks from 5 March, 1981 before planting gladioli did not reduce the severity of neck rot.

Pea. In a survey of several Lockyer Valley farms, the incidence of black root rot (*Aphanomyces enteiches*) varied from 3% to 86%. Significant yield losses were associated with a high disease incidence.

Pineapple. Root and heart rot of pineapples caused by the fungus *Phytophthora cinnamomi* is controlled by the fungicide metalaxyl. However, there is a need to test alternative fungicides because of the possibility of development of resistance to this fungicide.

In field trials, aluminium ethyl phosphate gave good control of root and heart rot whereas the experimental fungicides R.M. 442, R.M. 445, R.M. 449 × Dowco 444 were ineffective.

Stonefruit. Dieback remains a serious problem in stone fruit in the Granite Belt. Drenching peach trees severely affected by *Armillaria mellea* with Armillatox (R) failed to control the disease in a trial at Severnlea.

Studies of affected peach trees have shown roots 70 cm deep and 5 m from the crown covered with rhizamorphs of *A. mellea.*

Sweetcorn. Approval has been given for the release of a second hybrid cultivar from the co-operative programme involving Plant Pathology, Agriculture, and Horticulture Branches. The high resistance of this cultivar to sugarcane mosaic virus is derived from the Kairi line SL 2. Previous Kairi lines have shown only field resistance whereas SL 2 is highly resistant following manual inoculation.

Tomato. Pilot studies with soil solarization, a new technique for the control of soil borne diseases, have been carried out in tomatoes at Bowen and Redlands Horticultural Research Stations.

Rating a tomato trial for bacterial wilt.

Results so far indicate inadequate control of Fusarium wilt (*Fusarium oxysporum* f.sp. *lycopersici*) but possible reduction in the severity of *Verticillium* wilt (*Verticillium dahliae*).

In glasshouse tests, a source of resistance to bacterial speck (*Pseudomonae tomato*) was identified.

New diseases

An important disease identified for the first time in Queensland was boil smut of maize (*Ustilago maydis*). Following its discovery in northern New South Wales, maize plantings, particularly seed crops, were surveyed throughout Queensland. The disease has now been found in 12 plantings in the Beaudesert Shire and four in the Lockyer Valley, but not in the Burdekin area or the Atherton Tablelands.

Boil smut is difficult to control because spores are seed borne, resistant to fungicides, and remain viable in soil for 16 years or longer.

Measures have been taken to contain the spread of the disease while the resistance of current hybrids is assessed and seed treatments to reduce the distribution of spores with seed are evaluated.

A large collection of fungi was made during a plant quarantine survey of Cape York–Torres Strait. These specimens are still being examined but it is clear from those processed to date that there are many new records. They include *Pseudocercospora timorensis* on sweet potato. Bacterial diseases recorded in Queensland for the first time were a leaf spot of pigeon pea caused by *Pseudomonas syringae* pv. *phaseolicola* at Redland Bay, a leaf spot of *Tagetes* sp. at Gatton caused by *Pseudomonas syringae* pv. *tagetis* and a leaf spot of Bouganvillea caused by *Pseudomonas andropogonis.*

Diagnostic services

More than 2 000 inquiries requiring disease diagnosis were handled through Indooroopilly and the seven country centres where Plant Pathologists are stationed.

The specialist bacteriologist handled 150 samples which required detailed laboratory checking. The nematologists examined 1 000 plant and soil samples. In the virology section, more than 600 specimens were examined with the electron microscope and 300 were indexed in the glasshouse.

Microbiology

Studies of the survival in soil of the bacterium *Pseudomonas solanacearum,* which causes a severe wilt of several crops including potato and tomato, continued.

Previous investigations showed that, in sand culture, the bacterium multiplied in the rhizosphere of oats and a hybrid forage sorghum (cv. Zulu). This work is continuing to determine whether such stimulation occurs in Redland Bay light-medium clays and Maroochy clay loams. Four weeks after planting in the Maroochy clay loam, numbers of *P. solanacearum* in the rhizosphere of oats and sorghum increased and the mean rhizosphere-soil ratios were above 10:1. There was a decline in numbers 6 weeks after planting.

In studies at the Queensland Wheat Research Institute, it was shown that endotrophic mycorrhizae may improve the growth of wheat, sorghum and sunflower on a range of soil types.

Crops grown after a long fallow and which are prone to show deficiencies of phosphorus and zinc were more poorly infected with mycorrhizae than crops grown after a short fallow. In a pot experiment with soil from Emerald which was deficient in phosphorus, addition of soil containing mycorrhizae tripled leaf area and head weight of sunflowers. In another experiment, sunflowers grown in soil from short fallow which was irradiated to kill mycorrhizae made only poor growth.

Legume bacteriology

Favourable climatic conditions in the main grain growing areas have maintained the area planted to soybean, mung bean and navy bean at the previous year's level. There was little interest in chick pea and only minor plantings of pasture legumes were made. Inoculant suppliers reported little change in the demand for legume inoculants.

The quality of commercial inoculants offered for sale at retail outlets continued to be good. Despite these high quality inoculants, difficulties still occurred and nodulation problems with *Leucaena,* cluster clover, soybean and peanuts were investigated.

During the year, 258 rhizobium cultures were supplied to agrostologists and farmers for 12 different legumes for which there are no commercial cultures. This indicated renewed experimental interest in such legumes as *Astralagus hamosus, Lotus pedur-anulatus, Psophocarpus tetragonolobus* and *Trifolium burchellianum.*

Following a recent overseas report of nitrogen fixation by *Opuntia* spp. in India, the local prickly pears *O. stricta* and *O. inermis* from Redbank and Dinmore respectively were examined for N fixing activity. None was detected.

Virology

Tomato yellow top virus (TYTV) was purified using methods designed to release the virus particles from thick walled phloem cells. Virus yields were generally in the order of 100 µg per kg. The virions of TYTV have a diameter of *ca.* 24 nm and a single coat protein of MW 26 000.

An enzyme-linked immunosorbent assay (ELISA) was developed for TYTV and was successfully used to detect TYTV in field-infected tomatoes. The ELISA test takes 1 to 2 days and can be used to replace infectivity assays with aphids which take 10 to 14 days. This technique, using antisera to TYTV, also detected potato leafroll virus (PLRV) in field-infected potato leaves indicating a close serological relationship between the two viruses.

Both TYTV and PLRV cause similar yellow top symptoms in tomatoes but whether TYTV may also cause leaf rolling in potatoes has not yet been shown. These studies indicate that TYTV is a new member of the luteovirus group.

In studies of potato virus Y (PVY) in tomato and tobacco, a third strain of the virus was detected. The isolate was from a dried leaf culture of a sample collected in 1974 from tobacco at Bundaberg. The isolate causes veinal necrosis in 'Turkish' and 'Xanthi' tobacco. The three strains of PVY known to occur in Queensland can be differentiated by their reactions on Turkish tobacco and the cultivar NC 95.

A field trial was conducted to assess the reaction of some *Lycopersicon* lines to PVY. Two lines of *L. peruvianum* and *L. hirsutum* were selected for further studies on the inheritance of resistance to PVY.

Work on the use of c-DNA probes, first used for detecting avocado sunblotch viroid, is being expanded. Complementary DNA has been produced to the nucleic acid components of some viruses currently being characterized, and will be used for assessment of their value as diagnostic tools and also in determining relationships between viruses.

Mycology

An additional correlation with a *Cochliobolus* telemorph was identified. The ascal state of *Drechslera ellisii* was produced in culture using isolates from Torres Strait and Pakistan. The anamorph is incorrectly assigned in *Dreschslera* and the appropriate transfer to *Bipolaris* will be made when the teleomorph is described. This is the tenth new correlation discovered in the course of this investigation. Other *Cochliobolus* spp. recently induced to form teleomorphs are *C. lunatus, C. setariae* and a fungus tentatively identified as *C. bicolor.*

Parasympodiella laxa was found associated with a dieback condition in *Brachychiton acerifolium.* In culture, the fungus formed a synanomorph, producing masses of acicular conidia from phialides in dense aspergilloid heads. The fungus has also been collected on *Mangifera indica.*

A large collection of microfungi was made during a plant quarantine survey of Cape York and Torres Strait islands. It is clear from those processed to date that there are many new records.

Nematology

A new project has been started to investigate the distribution, importance and control of root-lesion nematodes (*Pratylenchus* spp.) on crops grown in the South Burnett region.

The effect of nematodes on maize, soybean, and peanuts was not visually obvious except in two soybean crops, but data from a peanut trial where some plots were treated with a nematicide indicate that yields may be correlated with root lesion nematode populations. The relative ability of different cultivars of soybean, navy bean, peanut, maize and sorghum to act as hosts of *Pratylenchus brachyurus* and *P. thornei,* the two most common root lesion nematodes, was assessed in glasshouse trials.

The distribution of needle nematode (*Paralongidorus* sp.) in rice in the Burdekin area was further assessed but this species still seems to be very limited in extent. Sampling of native vegetation as well as rice is being done to determine whether the restricted occurrence is associated with previous vegetation pattern. A description of this new species of *Paralongidorus* will be published shortly.

Two workshops on practical nematology and control of nematodes were held for Agriculture and Horticulture Branch extension staff.

Quarantine

A survey of plant diseases in the Torres Strait region was undertaken for Plant Quarantine, Department of Health, Canberra. The aim of the survey was to determine whether any disease in this remote area of Queensland posed a threat to commercial crops farther south.

The most significant discovery was that of *Mycosphaerella fijiensis* var. *difformis*, the cause of black sigatoka disease of banana. Banana freckle (*Guignardia musae*) was found at a number of sites.

The detection of these serious diseases at Bamaga on mainland Australia prompted additional surveys to determine their exact distribution on Cape York Peninsula and the islands of the Torres Strait. Black sigatoka was not detected south of Bamaga, but freckle disease was identified at Lockhart River. An eradication campaign was initiated to contain further spread of both diseases.

It is planned to continue such surveys for plant diseases in remote areas of Far North Queensland in conjunction with other Plant Quarantine and Departmental activities in the area.

Botany Branch

THE responsibilities and functions of Botany Branch are—

- To study, describe and classify plants of Queensland so that they can be identified and named accurately.
- To study and record the distribution of native and naturalized plants in the State.
- To prepare descriptive accounts of plants in the State.
- To identify plants submitted by primary producers, officers of State and Commonwealth Government organizations, Universities, and other interested people and groups and to report on the properties of these plants.
- To carry out field studies of plant communities within the State, including their structure, relationships and response to change in environmental factors, and to prepare vegetation maps.
- To pursue research in the fields of economic botany, such as the investigation of poisonous plants and native herbage and fodder plants.
- To maintain the Queensland Herbarium as a reference collection of plant materials of international standing, and to use these materials in studies in plant taxonomy, plant geography, ecology and economic botany.

The organization of Branch officers into three groups continued as in previous years, though changes in demand for some services resulted in some movement of officers between groups.

The Taxonomy group maintains identification and advisory services to meet demands, prepares check-lists and regional handbooks to the Queensland flora, and continues taxonomic research. The Ecology Group studies and maps vegetation within the State, and advises on ecological matters. The Services Group maintains the Queensland Herbarium and provides assistance to the other groups.

Services and extension

Taxonomy group's activities

About 22 100 specimens were identified by botanists of the Taxonomy group, an increase of 5% from the previous year. Most of the identifications were the result of almost 2 000 inquiries.

The public accounted for 44% of the specimens submitted, a considerable increase over the 27% of the previous year. Consequently there was a slight decrease in the proportions of specimens from other sources. The number of specimens identified for consultants fell from 1 300 to 300. A small proportion of the identifications was carried out by the botanist stationed at Mareeba.

The time taken up in forensic botany increased once again during the year. Certificates of Identification were issued to State Police officers in connection with 1 685 samples of *Cannabis sativa* or occasionally to Commonwealth Customs officers. This is an increase of more than 37.5% on the 1980–81 total and continues the trend of recent years. If the trend continues, it is likely that the total for next financial year will reach 2 000. The rate of increase in this work can be gauged from the following statistics: 1975–76, 561; 1976–77, 844; 1977–78, 879; 1978–79, 941; 1979–80, 1 283; 1980–81, 1 225; 1981–82, 1 685.

In connection with Commonwealth Quarantine Regulations, 48 statements were issued relative to seizures by quarantine officers. This is also a significant increase over the 1980–81 period (28). Time taken in identifying quarantine material is much greater than that involved in *Cannabis* identification. Forensic botanists also spent more time in court appearances (134 hours) than in the previous year.

Material submitted by the Animal Research Institute, Yeerongpilly, in connection with suspected plant poisoning of stock consisted of several plant specimens and 40 samples of rumen contents from post-mortem of stock.

Ecology group's activities

The Ecology group advised responsible authorities on botanical aspects, including the establishment of native plants, of developments in Queensland likely to have major environmental effects.

Comments were prepared on impact assessment reports or other environmental studies on the following projects: Theodore Coal Project, Kidston (Goldmining) Project, Wolfang Coal Mining Project, Theresa Creek Dam, Callide Pipeline Investigation, Callide 'B' Power Station and the Queensland Electricity Generating Board (33kV substation at North Mackay).

The leader of the group continued as a member of the inter-departmental committee advising on rehabilitation following sand mining. Two week-long inspections were carried out during the year, and two special visits were made to North Stradbroke Island in connection with a serious slump of sand which moved across a swamp into Moreton Bay. In addition, two visits were made to Moreton Island to inspect proposed leases and to discuss possible lease conditions.

Officers of the group were involved in surveys of areas considered as reserves for environmental or scientific purposes. Notes on the botanical features of a section of State Forest 444 Palgrave (near Warwick) proposed as a Scientific Area were prepared.

Information on the proposed Kroombit Tops National Park was provided to National Parks and Wildlife Service. Checklists of species in the Carnarvon and Burleigh Heads National Parks were compiled, and a checklist of the vascular plant flora of the Lamington National Park was published.

Educational activities

The educational and public relations activities of the Branch increased during the year. Thirteen groups visited the herbarium and were given talks on the functions of Botany Branch. Lectures were given in Brisbane and in north Queensland to interested groups on poisonous plants, native plants in cultivation, and on vegetation mapping.

A comprehensive display of recent Queensland maps of vegetation was staged at the XIII International Botanical Congress in Sydney. The display was later presented at the Queensland Institute of Technology and formed the basis for a lecture on vegetation mapping to students.

A selection of poisonous plants was displayed as part of the Departmental display at the RNA Show in Brisbane. Veterinary Science students were shown poisonous plants in three local field trips and their collections of poisonous plants were critically examined.

A display of photographs on mangroves planted along the canal at the new Brisbane airport was staged in King George Square for the United Nations World Environment Day.

Publications. There has been a great delay in publications and some large works reported to be in press at the end of last financial year are still in press, though all have progressed to some extent. Proofs of the fifth part of *Austrobaileya,* a technical journal published by the Branch, have been received and publication is expected in the latter part of 1982. Publication of the following is also expected in the 1982–83 financial year: *Ferns and Fern-allies of Queensland, Flora of South Eastern Queensland* Volume 1, *Wildflowers of South-eastern Queensland (Acacia), Flowering Plants in Australia* and *Sydney Parkinson: Artist of Cook's Endeavour.* Branch officers contributed to the last two books which are to be published by other organizations.

Officers also contributed to the *Flora of Central Australia* which was published during the year. The sixth part of a series on aquatic plants of Queensland appeared in the *Queensland Agricultural Journal* during the year.

A booklet on suburban weeds is being prepared and preliminary work has been carried out, in conjunction with officers of Entomology Branch on a new *Honey Flora of Queensland.* The previous *Honey Flora,* which sold well, has been out of print since 1978. *Queensland Botany Bulletin* No. 1 (Coastal Vegetation of Mulgrave Shire) is in press and the manuscript of No. 2 (The Naturalized *Lantana camara* complex in eastern Australia) has been completed.

In the rationalizing of titles of Departmental publications, *Queensland Botany Bulletin* will, in future, be the title of technical bulletins produced by the Branch.

Research

Ecology

Field work for the Western Arid Region Land Use Survey (WARLUS) was completed several years ago and the reports are in various stages of preparation. WARLUS is a project co-ordinated by Development Planning Branch, Division of Land Utilisation. The land systems map for part 3 (Charleville area) has been printed. The botanical sections of the report were completed several years ago.

The land systems map for part 5 (Longreach–Winton–Muttaburra) has also been printed and the vegetation map is being printed. A checklist of more than 680 species (with common names and poisonous properties) of the area has been prepared. The land systems map of part 6 (Birdsville-Boulia) is ready to be printed.

The project, Vegetation Mapping of Queensland (1:1 000 000 scale) continued. The project, which is partly funded by the Commonwealth Bureau of Flora and Fauna, consists of the preparation of nine maps which will cover the whole State. Three sheets are being worked on. The South-western Sheet was printed in 1979 and the explanatory booklet to accompany it is expected to be published in the 1982–83 financial year.

Considerable progress was made on the South-central Sheet during the year. Two field trips were made to the area, aerial photographs were marked up, and boundaries of vegetation units checked on the ground. Map and booklet are expected to be published in the 1982–83 financial year.

Preliminary field work has been carried out over about one-third of the area of the Far Northern Sheet which covers much of Cape York Peninsula. Field work has been concentrated on the Aurukun and Weipa 1:250 000 map sheets as the Branch has been contracted to produce for a pre-mining feasibility study, a vegetation map and accompanying report of a special bauxite mining lease between Aurukun and Weipa. Aerial photographs have been marked up, two extended field trips undertaken and a 1:250 000 vegetation map of the 2 154 km^2 lease prepared. The actual mine site has been mapped at 1:50 000. The project is to be completed by September 1982.

The Moreton Region Vegetation Mapping-Project, which is partly funded by grants from the National Estate Programme of the Commonwealth Government, continued. A summary report of the Caloundra, Brisbane, Beenleigh and Murwillumbah map areas is being prepared. Information on 1 800 indigenous species is included. There has been some preliminary field work for 1:250 000 Ipswich and Gympie maps.

Surveys of beach dune vegetation are undertaken for the Beach Protection Authority. Maps and descriptions of vegetation are used by the BPA, as source material on which to base their dune management reports. The report on the coastal vegetation of Mulgrave Shire is being printed. The maps of the area will be published by the BPA.

Preparation of the report on the vegetation of the Sunshine Coast and the associated cartographic work are well advanced. Data from a detailed survey of the vegetation of Mount Coolum will be used in the report and will also be published in full as a separate report.

A report is being prepared on the plantings of mangroves along the canal at the new Brisbane Airport constructed by the Department of Housing and Construction. Trials indicate that nursery-grown seedlings of *Avicennia marina* var. *australasica* grow faster than seedlings transplanted in the field. Survival of transplanted seedlings along the canal varies from 29% at the mouth where severe bank erosion occurred to 99% in the upper reaches.

Taxonomy

Much botanical research, pure and applied, depends on correct identification of plants which, in turn, sometimes requires competent taxonomic research. Consequently the identification and advisory services of the Taxonomy group are supported by such research. The increase in requests for identification in recent years, however, has made it difficult to maintain a satisfactory level of research within the Branch.

Good progress was made towards the production of a series of keys to all native and naturalized species of grass in Australia. Keys to almost two-thirds of the 1 300 recognized taxa have been constructed. Considerable progress was made with the revision of wire grasses (*Aristida* spp.) in Australia. This has been facilitated by grants from the Commonwealth Government through the Bureau of Flora and Fauna. A manuscript describing new taxa of *Aristida* has been submitted for publication.

Preparation of an account of the taxa of wild oats (*Avena* spp.) mainly in Queensland has begun. This results from a joint project with Dr B. Wilson, Queensland Wheat Research Institute. A paper on research techniques used in the study was published. A paper proposing the conservation of the widely used but technically unacceptable name *Rottboellia exaltata* was submitted for publication in *Taxon* and will appear in the issue of August 1982.

Manuscripts on species of *Sporobolus, Sorghum, Enteropogon* and *Dichelachne* have been submitted to various journals for publication. Some progress was made towards the analysis of the distribution of grass genera throughout the world.

Studies on *Acacia* continued. A review of section *Lycopodiifoliae* was begun, with one undescribed species recognized from Western Australia. A manuscript on *A. deltoidea* and its near relatives has been prepared for publication. Data on distribution of *Acacia* in Australia were being analysed as a preliminary to the preparation of a paper.

In collaboration with Professor E. E. Conn, University of California, screening of *Acacia* for cyanogenic species began. Cyanogenic species were found in one well marked group of *Jubflorae* and in the unrelated section *Botrycephalae.*

Work on the family Myrtaceae continued. The first part of a revision of *Melaleuca* in eastern and northern Australia has been submitted for publication. Progress on the revision of *Austromyrtus* has slowed because of the emphasis on *Melaleuca.* A manuscript describing a new species of *Darwinia,* however, has been prepared for publication. Critical study of *Rhodamnia* has revealed new taxa which will be described.

Revisions of *Cupaniopsis* (11 species), *Distichostemon* (8 species), *Sarcopteryx* (5 species), all Sapindaceae, *Xylosma* (4 species), and *Flacourtiaceae,* were completed and will be published in the 1982–83 financial year. The taxonomy and nomenclature of the predominantly rainforest family Sapotaceae were examined in detail and material is being prepared for publication.

Revisions of *Commersonia* and *Argyrodendron* (both Steruliaceae) were begun. A critical study was made of *Elacocarpus* (Elacocarpaceae). Steady progress was made with *Ipomoea* (Convolvulaceae). Descriptions of most taxa have now been prepared. At least four undescribed species have been recognized. More species were added to the living collection in the glasshouse.

Revisionary studies in *Tephrosia* (Fabaceae) continued. About 60 species are currently recognized, and critical study of Western Australian material will probably reveal more. Good herbarium material of an undescribed genus of Thymelaeaceae from Cape York Peninsula has been collected. *Spermacoce* has been extensively collected in north Queensland in the past 3 years. It is proposed that revisionary studies on the genus be commenced in the coming year.

A paper recording the genus *Romnalda* (Xanthorrhoeaceae) for Australia and describing new species is in press in *Kew Bulletin.* Some progress was made with a revision of *Dianella* and *Stypandra* (Liliaceae), but little progress was made with *Macarthuria* (Aizoaceae).

The flora inventory of Cook Pastoral District continued, though field work was more restricted than in the previous year. During the year, 2 556 specimens were forwarded to Brisbane and 407 retained for the Mareeba reference collection. Three officers have prepared accounts of families for volume 8 of the *Flora of Australia,* which is expected to be published in July 1982. Families are also being written up for volumes to be published in 1983.

Queensland Herbarium

A significant reduction was made in the backlog of material waiting to be incorporated into the herbarium. This was achieved despite large increases in the number of specimens lent to other institutions, the number sent and received on exchange from other institutions and the number of new specimens incorporated into the herbarium.

During the year, 17 100 specimens were incorporated, 9 400 were lent, 2 400 were returned, 3 300 were sent on exchange and 4 000 received on exchange. The complete Brass, Kajewski and part of Hunt collections (2 050) were added to the herbarium.

Special project

HERBRECS

HERBRECS (Herbarium Data Storage Project). This project is funded largely by the Commonwealth Government through the Bureau of Flora and Fauna. Permission has been granted to proceed with conversion of the HERBRECS system, at present operated through the State Government Computer Centre, to an in-house system at Indooroopilly.

An input terminal and output letter quality printer will be installed in the herbarium and will be connected to a mini-computer in the hydrology building. It is expected that, when the conversion has been completed, retrievals will be readily available at a reasonable cost.

A total of 4 500 place name qualifiers was added to the master file and a further 124 100 were coded and are awaiting entry to the file. About 37 000 specimens have to be coded before the project is completed in September 1982. Additions to the master file totalled 76 900, and 7 200 alterations were made.

Miscellaneous

The Director attended the annual meeting of the Council of Heads of Australian Herbaria in Canberra and on 1 January 1982 became chairman of the Council for 1982. He continued to represent the Department on a number of inter-departmental committees and is on the committee organizing an International Savanna Symposium to be held in Brisbane in 1984.

The Assistant Director continued to act on the editorial committee of the *Flora of Australia.* The first volume of the *Flora* was published in August 1981. He also spent a month in Sabah as a consultant to FAO. A study of herbarium material and atypical individuals that occurred in forestry plantings of *Acacia mangium* was carried out.

XIII International Botanical Conference

Five pre and post-conference field trips, organized by the Excursions Committee under the chairmanship of the Director, were held in conjunction with the Conference. All tours were successful and extremely favourable comments were received from participants. Four members of staff were involved in planning and guiding some of the excursions. A number of staff members attended the Conference in Sydney.

Division of Dairying and Fisheries

BOTH the dairying and fishing industries are undergoing organizational changes which have affected Divisional activities in the past year. The activities of the Divisional Branches and Sections are summarized under the following headings.

Dairying

Trends and production

The downward trend in dairy farm numbers which has been evident for many years has continued. The number and types of suppliers from registered dairies in the State are set out in the following table–

Type of supply	1979–80	1980–81	1981–82
Cream	579	390	243
Milk	2 750	2 524	2 443
Raw milk	26	26	25
Total	3 355	2 940	2 711
Goat	24	21	34

In spite of reduced numbers, the economic performance of dairy farmers in 1981–82 was very good. An increase in milk production of approximately 8% was noted. This indicated a substantial increase in production per farm. Farm gate returns have improved by approximately 18% over the previous year and this is well in excess of increases in costs.

The domestic market for dairy products remains strong. There has been an increase in market milk sales of 4.6% across the State. Increasing demand for products such as yoghurt and cheese has also been noted. Table cream sales have increased by approximately 8%.

Queensland still required to import large quantities of butter to meet market requirements. Almost all of the butter was brought in from Victoria with a small quantity from New South Wales. Some degree of uncertainty exists over the effect of the Closer Economic Relationship Programme with New Zealand on access of New Zealand products to the Australian domestic market. In the short term, however, it is not expected to affect Queensland dairy farmers greatly, but there may be some disruption of domestic markets in the long term.

Legislation and policy changes

During the year, the following legislative changes were made—

- Artificial Breeding of Stock Act was proclaimed.
- *Margarine Act* 1958–1982 was amended.
- *Filled Milk Act* 1958–1982 was amended.
- Dairy Produce Regulations 1980 were amended.

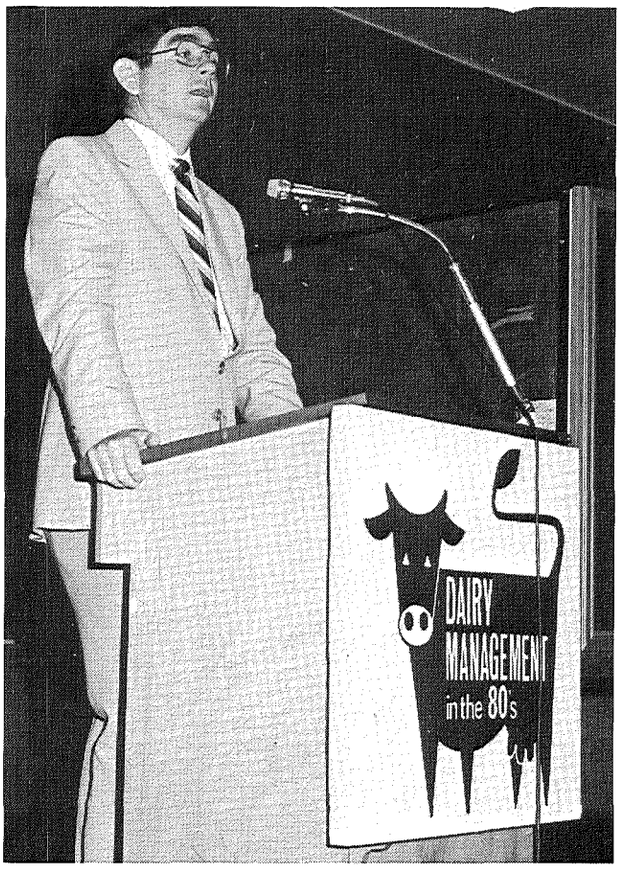
A significant change in industry policy during the year was the announcement of the reopening of the dairy industry to new suppliers in the south east Queensland area, under certain conditions, by the Minister in February 1982. At this stage, 25 new suppliers have been accepted into the industry by associations in south east Queensland. In central Queensland, the registration of eight new suppliers has been approved. No new registrations have been issued in north Queensland.

Approval was also announced for suppliers to transfer from one supply group to another while retaining a portion of their market milk entitlement. Only a few transfers have occurred in recent months but it is expected that more will occur in 1982–83.

Extension activities

A most significant extension event held during the year was a joint Queensland Dairymen's Organisation and DPI seminar —'Dairy management in the 80s'. This was held in Toowoomba and attracted wide support from all sections of the industry. More than 400 farmers and other industry personnel attended the seminar, the discussion groups and the associated trade display. There is now clear evidence that dairy farmers are accepting improved production technology. This is evident in the interest in new dairy sheds, in better pasture production and in herd improvement techniques.

During the year, 11 Dairy Industry Liaison Groups were set up to improve the consultative process between industry and the Department in both the extension and research areas.



The Minister for Primary Industries (Hon. Mike Ahern, M.L.A.) opened the seminar, 'Dairy Management in the 80s' in Toowoomba in September 1981.

Service and advisory activities

Artificial breeding. Seven bulls from the first importation through the Cocos Island Quarantine Centre were delivered directly to the Department's A.I. Export Centre. This action was taken by owners to ensure that supplies of semen were placed in storage before further movement of the animals to their properties or other locations.

Negotiations are in progress for the direct entry of nine additional sires which are due to enter Australia in late 1982 and early 1983.

Interest in the imported bulls was extensive as more than 100 cattle breeders visited the Centre to inspect them during the 2 days following their arrival.

The first nationally proven beef sire is entering the Wacol A.I. Centre for semen collection and distribution to owners of Poll Hereford cattle throughout Australia.

This sire, 'Moorlands Miles', was identified as the leading sire of the breed through the Sire Reference Scheme which is organized by the Poll Hereford Society.

Herd production services. Herd recording registrations increased by 17% this year. There are now 782 herd owners (approximately 30% of all dairymen) making use of this service.

The Mastitis Cell Count Service, which commenced in July 1981, is being used regularly by more than 400 dairymen. This early popularity of the service indicates the importance placed on mastitis detection and control in the management of dairy herds.

The bulk herd cell count service continued and results indicate that generally good control is being maintained over mastitis.

Quality control. Divisional staff continued to maintain control over dairy produce quality during the year at all levels from the farm through to the vendor. Good co-operation was experienced with Queensland Milk Board staff in this activity.

Research activities (farm)

Feeding systems. Trials conducted on several farms in southern Queensland have shown that irrigated annual clover systems have several advantages over irrigated 'high N' ryegrass. The clovers are capable of higher milk production (approximately 3 L per cow per day) than with ryegrass, have a lower requirement for nitrogen fertilizer and a longer growing season. Disadvantages are slower establishment of clover swards and occurrence of bloat.

Breed development. Work has continued on the development of the tick resistant Australian Friesian Sahiwal breed.

Herd health. Work has continued on automated procedures for detecting mastitis and world-wide interest has been shown in the NAGase procedure developed at the Otto Madsen Research Laboratory.

Research activities (products)

Work into a diverse range of dairy product manufacturing is continuing. Much of this work is supported by industry funds through the Australian Dairy Research Committee.

The Otto Madsen Dairy Research Laboratory now has a complement of experienced and dedicated research scientists and is achieving Australia-wide recognition for the quality of research carried out.

Fisheries

The Fishing Industry Organization and Marketing Bill was passed on 25 March 1982 setting the stage for the establishment of the Queensland Fish Management Authority which will have the responsibility and power to manage the catching, processing and marketing of seafoods. Fisheries management in the future will be achieved by the exercise of the licensing powers of the Authority.

Industry review

Improved prawn prices during 1981–82 have alleviated some of the economic problems being experienced by fishermen but continued high interest rates remain a significant factor affecting the viability of units employed in prawn trawling.

The number of vessels engaged in prawning increased to 1 412 at 31 December 1981. It has become clear that prawn stocks along the Queensland coast are fully exploited and further capital investment in the catching sector is undesirable. Efforts are being made to locate stocks of royal-red prawns in deep water off southern Queensland. A deep water trawl survey is to commence on the continental shelf east of the Great Barrier Reef in 1982–83.

During October–November 1981, nine converted prawn trawlers operating 80 miles offshore from Cairns demonstrated that it would be possible to take yellow-fin and big-eye tuna in commercial quantities using hand-lines and poles. Fisheries officers were placed on Japanese fishing vessels during the same period to compare their operations with the Queensland boats. One of the problems which will affect this embryonic fishery is the marketing and handling of the catch. At present the tuna is being transported to southern canneries. It is hoped, however, that an increasing proportion of the tuna catch in north Queensland will be destined for the Japanese 'sashimi' market. Fisheries Research Branch is planning to examine bait-fish resources in the Cairns area to assist poling operations in the 1982 season.

The pearling industry continues to be one of the most valuable sections of the fishing industry apart from prawning. Pearl culture farms in the Torres Strait and Escape River areas use wild stock pearl oysters collected by islanders using diving apparatus. The industry is currently being investigated to ascertain whether it needs any form of assistance.

Fisheries production

During 1980–81, total Queensland fisheries production was estimated to be worth $86.3m, an increase of $23.5m on the 1979–80 catch. The value of fisheries production in 1981–82 is expected to exceed $95m, this being a direct result of good overseas prawn prices; these have improved dramatically during this financial year.

Prawn catches have remained reasonably stable, although total prawn catch for 1981–82 should be less than previous years. Production of banana prawns from the Gulf of Carpentaria failed to meet expectations, presumably because of relatively low rainfall in the Gulf region during the summer months. Tiger prawn catches in the Gulf of Carpentaria have been also down, compared with those of previous years. Production of tiger prawns improved in the Torres Strait region, however. Higher prawn prices ($10 per kg for bulk packed export prawns) have helped alleviate some of the present economic difficulties of the prawning fleet.

Good catches of scallops were made during the latter half of 1981, reflecting the increased effort in this fishery resulting from lower prawn prices. Of the product of the estuary and inshore net fisheries, there are indications that mullet catches will be less than expected, principally because of natural fluctuations in the available stock. Catches of bream, whiting, barramundi and salmon and mud crabs have remained steady.

Native fish stocking programme

The Freshwater Fisheries Research Station at Walkamin on the Atherton Tableland has been developed to the stage where mass production of fingerlings is possible. Improvement of pond and hatchery facilities has allowed a massive 1 100% increase in fingerling production over that of the previous year.

The principal species bred for stock were sooty grunter (*Hephaestus fuliginosus*), sleepy cod (*Oxyeleotris lineolatus*) and silver perch (*Bidyanus bidyanus*). Most of this year's production has been released in the Tinaroo Dam (Atherton), Awoonga Dam (Gladstone) and Monduran Dam (Gin Gin) bringing to 15 the number of rivers and storages stocked with fish bred at Walkamin.

Fingerling production is expected to increase over the next few years and is expected to exceed 250 000 a year, as additional improvements at Walkamin are carried out.

Fisheries research vessels

The 18 metre trawler 'Iron Humphrey', one of the top producing fishing vessels in the southern Queensland prawning fleet, was acquired in June 1981. During 1981–82 the vessel was refitted and converted to a research trawler. She has since been relocated at the Northern Fisheries Research Centre, Cairns, which has jetty facilities to accommodate vessels of this size.

This vessel will be used for research and exploratory fishing in the Gulf of Carpentaria and a deep-water trawl survey on the continental shelf east of the Great Barrier Reef. The trawler will be renamed 'Gwendoline May' and commissioned on 14 July 1982.

The 12 metre trawler 'Bar-ea-mul' was previously based at Burnett Heads and moved to Moreton Bay in December. It is presently attached to the Southern Fisheries Research Centre at Deception Bay and is being employed to support studies on the effect of beam trawling on the bay prawn fishery as well as exploratory trawling for squid.

Beam trawl programme

The extent to which beam trawling should be permitted in the lower reaches of Queensland rivers has been questioned by otter trawlermen fishing the same prawn species and by recreational fishermen who are concerned at the effects of this activity on the juvenile stages of fish species of angling importance.

Research staff at the Southern Fisheries Research Centre (Deception Bay) and the Burnett Heads Fisheries Laboratory have set up programmes to investigate these questions. The data resulting from these projects will lead to a better understanding of distribution patterns of those species of fish and prawns which utilize estuarine systems at some stage of their life cycle and provide a solid information base upon which to assess the validity of claims and allegations concerning the beam trawl fishery in southern Queensland.

Introduction of Nile perch

Funds have been allocated to assess the suitability of introducing Nile perch (*Lates niloticus*) into Queensland. Nile perch, a native freshwater fish endemic in some rivers and lakes in Africa, is very much like barramundi in appearance. Fingerlings of Nile perch are to be imported into Queensland after they undergo stringent quarantine and examination for exotic diseases. It is planned that special ponds in a quarantine area will be constructed during the 1982 dry season.

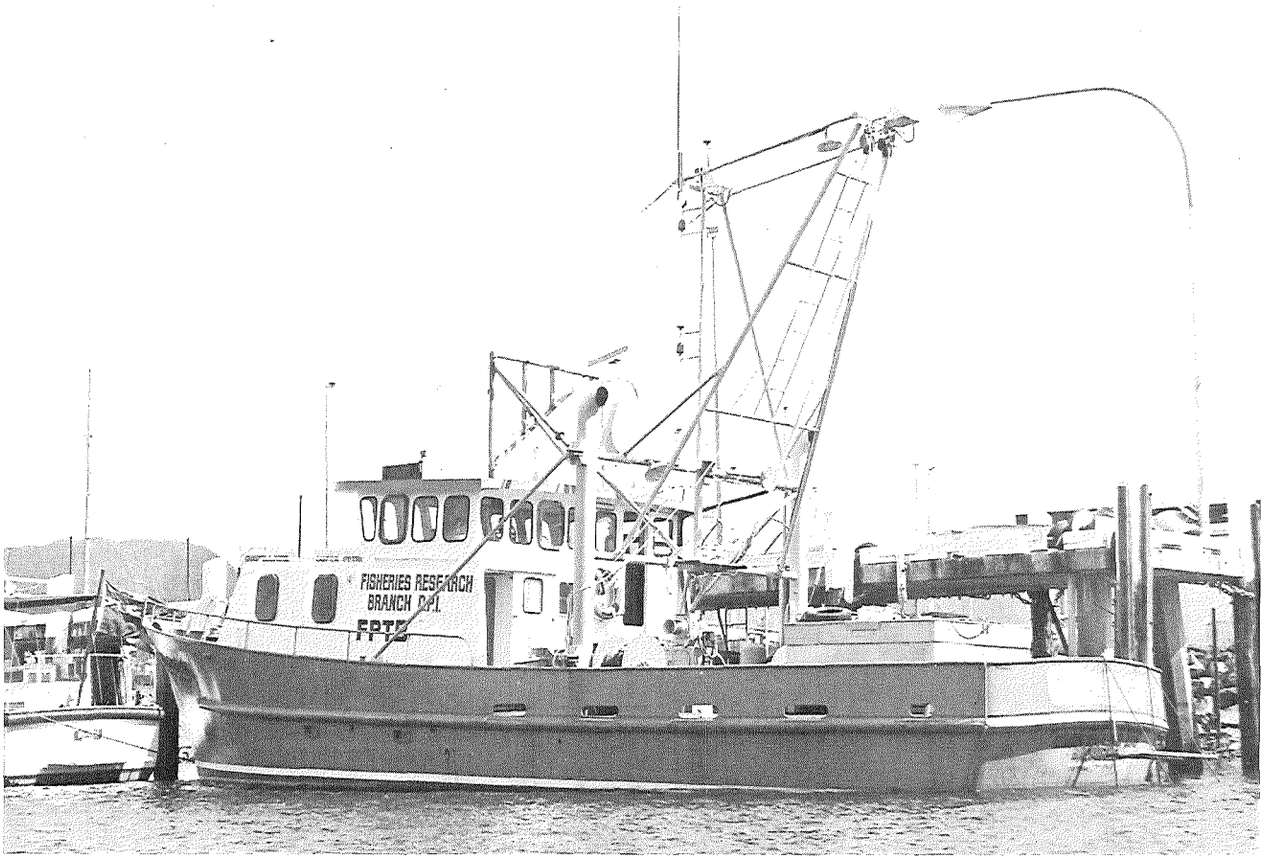
Licensing activities

Licences were issued under the provisions of the *Fisheries Act* 1976–1981 to encompass all commercial fishing operations conducted in Queensland waters. Fees payable for such licences were reviewed during the past financial year and were increased for most commonly issued licences.

Master Fisherman's licences

As in previous years, a minimum catch quota was applied to all fishermen seeking to renew their licences. Because of the wide varieties in production values of different fisheries and the poor season experienced in many of the fisheries, the principle of tying the quota to the minimum wage standard was abandoned and the $5 000 quota level of 1980–81 was retained.

Licensing Advisory Panels, introduced in 1979 and made up of Queensland Boating and Fisheries Patrol officers and locally nominated Master Fishermen, were continued in an expanded role over the past year.



The trawler 'Gwendoline May' at the Northern Fisheries Research Centre, Cairns.

Limitations were placed on the Gulf of Carpentaria and East Coast Barramundi/Set Gill Net fisheries in the previous year and this was continued with only 159 and 403 fishermen having their licences endorsed for the respective fisheries. Additional limitations were imposed on beam trawling and the issuing of any additional Master Fishermen licences thus fixing the number of licensed Master Fishermen at approximately 2 600.

Commercial fishing vessel licences

All vessels used in commercial fishing operations are required by the *Fisheries Act* 1976–1981 to be licensed. Specific policies with respect to vessels engaged in certain types of operations were introduced or updated.

Other trawlers not operating from a Queensland port on a year round basis and those vessels over 14 m holding endorsements to operate in the Moreton Bay prawn fishery had their operations restricted north from the New South Wales border to Sandy Cape (Fraser Island).

Vessels licensed to operate in the Northern (Gulf of Carpentaria) prawn fishery were subjected to conditions applied to that fishery by joint Commonwealth, Northern Territory and Queensland limited licence policy constraints.

The 'freeze' on licences was extended to offshore beam trawlers on 30 September 1980.

This policy was re-stated and further restrictions on otter trawlers being constructed were introduced. As a result the number of otter trawlers has been limited at approximately 1 400.

The Department continued to issue licences on behalf of the Commonwealth pursuant to the *Fisheries Act* 1952–1980 to Queensland commercial fishermen engaged in operations in Commonwealth waters.

Numbers of licences issued reflect a decline in the number of Master Fishermen controlling commercial operations in recent years.

Oystering and shell grit

Periodic inspection of oyster banks was carried out in Moreton Bay and State waters generally to ensure that oystering is undertaken in accordance with prescribed conditions.

Traditional methods of oystering either by ground cultivation or harvesting of wild stocks in areas best suited for this form of activity continued during the year. This type of operation provides a livelihood for about 100 operators throughout many parts of the State.

Shell grit operations remained at a relatively steady level through the year as a localized industry.

Field Services Branch

TOTAL milk production in Australia has continued on a downward trend, falling from 5 671 ML in 1979 to 5 398 ML in 1980 and 5 181 ML in 1981. Total market milk consumption was expected to rise 1.1% in 1981–82, while milk available for manufacturing purposes was expected to fall by 2.4%.

These factors, coupled with higher domestic prices and favourable export markets, were expected to result in average farm gate prices for whole milk increasing by 16% in 1981–82. Average prices throughout Australia were expected to be 27c per L for market milk and $3.45 per kg of butterfat for manufacturing milk.

Of the various commodity groups within the rural sector, dairying held a relatively favourable position in 1981–82. According to the Bureau of Agricultural Economics, dairying was expected to give the second highest rate of return, after wheat.

Against the background of declining national dairy production, it is notable that an increase in production was recorded in Queensland during 1981–82 compared with the previous year.

Queensland dairy industry

Dairy farm numbers in Queensland continued to decline, though at a much slower rate than in previous years. The number and types of supply of registered dairies in the State in 1981–82 and the three preceding years are set out in the following table—

Type and supply	1978–79	1979–80	1980–81	1981–82
Cream	643	579	390	243
Milk	2 889	2 750	2 524	2 443
Milk raw	15	26	26	25
Total	3 547	3 355	2 940	2 711
Goat	18	24	21	34

From the table above, it is clear that the greatest adjustment occurred in the cream supply segment of the industry. Apart from economic pressures on cream producers, the trend for factories to cease butter manufacture has continued.

In response to a change in Government policy, five new producers began supplying milk in central Queensland during the year in accordance with the established guidelines. Other applications for new registrations, in both central Queensland and the Darling Downs regions, were under consideration.

Interest in goat milk production has continued to increase, with 13 new goat dairies registered during the year.

Seasonal conditions in most dairying regions were excellent. An exception was the central Queensland region, where summer rainfall was well below average.

Total milk production in Queensland in 1981–82 increased by 7.1% compared with that of the previous year. This trend can be attributed in part to good seasonal conditions, and in part to improved economic circumstances and renewed confidence within the dairy farming community. Production trends are set out in the following table—

Year	Milk production (ML)
1979–80	538
1980–81	506
1981–82	542

The trend of increasing demand for market milk and cream products in Queensland continued during 1981–82. As in the previous year, trends in consumption patterns were not uniform throughout the State. Demographic factors were a big influence in this regard. Production of product by type is set out below for 1981–82, together with changes in production relative to 1980–81—

Product	Production 1981–82	% change on 1980–81
Pasteurized milk *(ML)	246.5	+3.8
Pasteurized cream (ML of milk equivalent)	41.3	+8.7
Flavoured milks (ML)	5.8	+11.5
Modified milks (white and flavoured) (ML)	25.9	+4.4
Total Market Milk	319.5	+4.6
Butter (t)	3 204	+12.2
Cheese (t)	12 708	+20.2
Casein (t)	558	+21.0
Powders (t)	9 347	+13.4

* Includes UHT milk.

Attention is drawn to the fact that included in the 4.6% increase in total market milk production during the year was an 8.7% increase in market cream production by Queensland factories. Of the total Queensland milk production in 1981–82, 58.9% was required for market milk purposes.

Financial rates payable to producers for both market and manufacture milk increased during the year. Gross return for manufacture milk, but excluding deferred pay, increased from an average rate in 1980–81 of $2.61 per kg of butterfat to an average rate in 1981–82 of $3.23 per kg. Gross rate for market milk increased during the year from 30.65c per L to 33.53c per L. Average net rate including deferred pays paid to producers for all milk increased from 18.2c per L in 1980–81 to 21.3c per L in 1981–82. The rate of increase in pay rates was slightly greater than the rate of increase in costs of production.

It is clear that many farmers are now seeking increased farm production to take advantage of the favourable financial returns applying at the present time. The increased confidence by producers in the future of the dairy industry has resulted in increased demand for extension services offered by the Branch, particularly in areas of herd improvement, feeding programmes and milking management.

Branch activities

The programmes and activities of Branch staff during the year were directed towards the achievement of the overall role of the Branch.

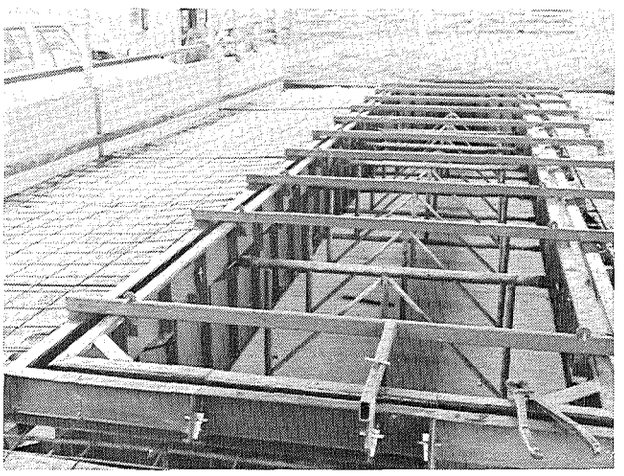
This is to promote productivity and efficiency on farms and in the processing and distribution of milk and milk products and to maintain adequate product quality consistent with market needs and extension constraints.

In order to achieve this role, the Branch is organized in two sections: the Farm Production Section and the Dairy Products Section.

Farm Production Section

Extension activities

The farm production sections carried out the main part of their work as planned extension activities. The objective of the Branch is to raise production per cow and per farm. The main areas of activity were milking systems and dairy sheds, dairy cattle nutrition and heifer management, herd improvement, farm management accounting, and advice on herd health programmes including mastitis and reproductive efficiency. A major activity during the year was the 'Dairy Management in the 80s' seminar organized in conjunction with the Queensland Dairymen's Organisation and staged in Toowoomba in September 1981.



DPI herringbone dairy pit moulds in position ready for the concrete pour.

Milking systems and dairy sheds. The Branch capitalized on interest created by the 'Dairy Management in the 80s' seminar and the associated Dairy Shed Competition. Officers have been closely involved with a greatly increased number of new sheds being built and with old sheds being converted to herringbone design.

A set of herringbone pit moulds was constructed under supervision of officers with the Dairy Shed Resource Group based at Wacol. These moulds are used to construct the pit of a herringbone milking shed and have been used in the construction of at least six new herringbone sheds under officer supervision. The moulds are heavily booked for use by producers during the coming year.

The milking system display used at the Toowoomba seminar was also displayed at the 'Better Lifestyle and Milking' seminar held at Lismore. Part of this display was photographs taken during the Dairy Shed Competition of all the sheds and design features. These photographs and transparencies have proved invaluable when talking to individual farmers about sheds and milking systems and at farmer discussion groups also.

A yard cleaning demonstration system has been used to demonstrate fast yard cleaning throughout the State and has led to farmers upgrading their cleaning systems.

Overall, the Dairy Shed Resource Group has proved a valuable addition to the Branch and has been used extensively by individual farmers and field officers. Individual farmers have sought their advice on all aspects of shed and yard design and milking machine installations. District officers have used the Resource Group at farmer meetings and to upgrade their own knowledge in this subject area.

Dairy cattle nutrition and heifer management. In contrast to previous years, all regions made greater efforts to give advice to farmers who have no irrigation facilities. Feed planning on these farms is vital. Dryland farms account for a significant part of the total milk supply.

Planning of extension programmes in all regions has included the increased use of fertilizer, especially nitrogen, on dryland pastures to increase milk production. Also, in most regions, some emphasis has been placed on fodder conservation through a variety of methods to help provide quality feed year round on dryland farms.

Continuing activities through demonstration and extension have resulted in the increased use of clover based pastures in all regions except East Moreton. Straight clover mixtures or ryegrass and clovers have resulted in good milk production. These strategies are economically sound in the irrigated situation.

Trials conducted in association with Dairy Cattle Husbandry Branch again emphasized the role of clover in the winter feed programme and showed levels of production per hectare during 6 months equivalent to yearly production per hectare in Victoria and New Zealand. The practice of standing clover pastures over into a second season has been successfully achieved by a number of farmers.

Feeding dairy cattle for milk production was one of the main themes at the Toowoomba seminar with the emphasis placed on pastures and their efficient use both under irrigation and dryland systems.

Heifer management and calf rearing are becoming increasingly important in a buoyant dairy industry. Improved methods of rearing and managing were featured as a discussion topic at the seminar. Replacement dairy stock have been in demand, indicating a need for more heifers to be reared as replacements and for farm build up.

Herd improvement. The increase in the number of farmers using artificial insemination (A.I.) and herd recording continued during the year. Most of this increase was due to farmers doing their own A.I. Thirty-four Do-It-Yourself (DIY) schools (328 farmers) were conducted during the year. Most of these farmers were new A.I. users.

The importance of DIY schools in overall herd improvement throughout the State cannot be overstressed. These schools provide important extension platforms for many other activities. Once a farmer has been taught A.I., he realizes he has the sole responsibility for getting cows in calf. He becomes more aware of nutrition, reproductive performance and production performance of his cows. As a flow-on, interest is shown in the breeding management services and herd recording services offered by the Department.

Once a course has been conducted, it is easy to get the group of farmers concerned together again for further extension exercises.

During the year, six A.I. co-operatives became Wacol A.I. Centre agents. In this capacity, they have agreed to support DIY farmers in their service areas. The demand for DIY courses is such that bookings have been running 12 months in advance. Once further co-operatives actively support DIY, the demand for courses will increase further.

The main extension effort in herd improvement continued to be in discussion groups and refresher courses. Thirty-eight refresher courses and discussion group meetings were conducted during the year. The main theme at these activities is to promote herd improvement by getting participation in herd recording and bull proving. These meetings are usually follow-up, 6 months after the A.I. courses.

Bull proving use is increasing. More than 7 900 Friesian cows in 177 herds have been nominated for mating. This should enable at least 60 daughters from each of the 12 bulls in the team to be used in calculating bull proofs, about double the number required for reliable proofs.

Promotional displays on herd improvement aspects have been erected at some rural shows.

A herd improvement session was held at the Toowoomba 'Dairy Management in the 80s' Seminar. A private veterinary practitioner specializing in herd health and a farmer with good herd reproductive performance addressed the session.

Farm management accounting. Modern dairying relies on good cost control and this trend is reflected in the number of farmers in various farm management accounting schemes.

Each region has a system which has been tailored to that region's needs. The Wide Bay scheme is run in conjunction with the Wide Bay Co-operative Dairy Association's computing facility and an economist from Economic Services Branch. There are currently 40 farmers using this particular scheme in its first year with others waiting to take part.

There are still more than 60 farmers using the Dairy Farm Management Scheme (DFMS), a computer based system operated through Economic Services Branch. In some regions, systems have been developed which can be used without central computing facilities. There are 40 farmers using these latter schemes on a regular basis (annually, 6 monthly or quarterly).

A few farmers are now using their DFMS figures for cash flow analysis.

The table below contrasts returns and costs for 1980 and 1981 on 15 farms in the East Moreton North.

Comparison of returns and costs for 15 East Moreton dairy farmers

—	1980	1981
Average return (c/L)	22.68	24.83
Range (c/L)	18.67–25.00	20.84–28.97
Total variable costs (c/L)	11.86	13.68
Range (c/L)	1.83–16.66	7.46–17.43
Average gross margin (c/L)	10.82	11.15
Range (c/L)	N/A	5.44–17.92

Herd health programmes. Herd health programmes which are conducted by the local private veterinarian based on the Werribee Herd Health System have been actively promoted during the year. Various discussion groups and meetings have had herd health as a meeting topic. As a result, there has been an increase in numbers of farmers undertaking a full herd health programme.

Dr W. Tranter, who gave an excellent talk at the Dairy Management Seminar, has around 50 Atherton Tableland farmers on his herd health scheme. Other veterinarians are becoming interested and officers in this section are encouraging farmers to use this option.

Other facets of herd health are also being promoted. The individual cow cell count service, introduced in July 1981, has attracted 350 farmers to date and is seen as an important aid in management of herd health principally in the area of mastitis control.

Help is still being sought by farmers on mastitis prevention and control. This renewed interest is reflected in the bulk milk somatic cell count results which showed a reduction during 1981–82 compared with rises during the previous 2 years. This trend is illustrated in the following table—

Monthly somatic cell count results for all Queensland bulk herd milks May 1980–April 1981 compared with May 1981–April 1982

Month	No. of tests		Mean cell count	
	1980–81	1981–82	1980–81	1981–82
May	2 417	2 214	509	485
June	2 290	2 249	546	461
July	2 558	1 947	528	406
August	2 435	2 105	557	421
September	2 019	2 086	506	403
October	2 452	2 231	536	357
November	2 218	2 212	521	435
December	2 250	2 279	542	357
January	2 275	N/A	396	N/A
February	2 318	2 314	383	386
March	2 344	2 122	440	410
April	1 650	2 383	544	386

Extension—general

The trend, reported last year, towards the formation of active liaison groups made up of Departmental officers concerned with dairying and of representatives from dairy industry accelerated during this year. Each of the seven regions now has one or more industry liaison groups, in general based on a factory supply group. These committees have representation from farmers (nominated by the QDO), from the factory, from other branches concerned with dairying (usually Economic Services Branch and Agriculture Branch) and the local Dairy Field Services Advisers. The role of the liaison groups so far formed is to provide constructive advice and criticism on current extension plans and to provide direction to future planning. Importantly, farmers will be in the majority on most of these liaison groups.

A second trend which has accelerated during 1981–82 is the formation of farmer discussion groups, allowing a much wider contact with farmers by field officers and specialist officers. There are, for instance, 11 such groups in the Wide Bay area, operating throughout the region. Other regions which have regular discussion groups are East Moreton seven, South Burnett two, West Moreton four and central Queensland four. All regions use farm walks and meetings on special subjects to pass the messages to farmers in groups.

Farm visits remain a useful and most used way of contacting farmers on the whole range of subject areas dealt with by this section. As noted in the herd improvement section, DIY/A.I. schools and refresher days have been a most useful extension medium.

Another highlight of the year was the successful dairy farmer tours. An extremely successful tour of New Zealand by a group of Mackay farmers and their wives was completed in January. The local dairy officer, Mr. G. Lloyd, was chiefly responsible for its organization. Other tours have taken place between regions with two groups of farmers going to the Atherton Tableland. Tours of sheds have taken place on a smaller scale—the runner-up in the Dairy Shed Competition has been visited by more than 500 people since August.

Newsletters have again played an important role in communicating with farmers. There are now 10 newsletters operating on a regular basis covering most of the dairying areas of the State. The newsletters are well received by farmers.

Advisory and regulatory activities

After the requirements of registering dairies had been completed, the main regulatory activity has been with respect to the distribution of milk. In some centres, supervision of milk vending has been a large part of the officer's duties.

Raw milk has been of satisfactory bacteriological quality and has shown improvement over previous years. The trend in farm milk quality is illustrated in the following table—

Year	Annual percentage compliance of farm milk in Queensland with total count test (< 50 000/ mL)
1977–78	82.2
1978–79	83.1
1979–80	84.1
1980–81	86.8
1981–82	88.0

All Associations have a penalty system for the total count test on farm milk and the officer's quality function has been made easier where meaningful penalties were consistently applied.

As noted previously, the general standard of sheds has been uplifted. With new sheds being built the standard of cleaning and hygiene has also shown improvement.

A problem, which has appeared intermittently and which has been dealt with satisfactorily, is pesticide residues in milk. In all instances these have been traced back and the source identified and eliminated. Some problems were experienced with antibiotic residues in milk supplies during the year.

Officers in all regions reported continuing work with the Lands Administration Commission in processing farm development loans. More activity in this regard is coming from south-east Queensland.

Dairy Products Section

Regulatory activities

Processing centres. As at April 1982, 41 dairy products processing centres were operating throughout the State. Taking into account that some of these are multi-product plants, the following processing units were operational: 9 butter, 3 cheese (Cheddar only), 7 cheese (Cheddar and other varieties), 5 cheese (non Cheddar varieties only), 21 pasteurized milk, 11 powders, 3 casein, 6 yoghurt, 9 other dairy products (ice cream, goat milk), and 9 chilled milk.

A new processing plant at Brisbane, Frosty Boy (Aust.) Pty. Ltd., became operational during the year.

New processing buildings and equipment. During the year ended 30 April 1982, factories in Queensland had applied for and received approval for expenditure of $3,322,167 on new equipment, and $1,272,455 on new buildings and building extensions.

Australian Code of Practice. All plans for new buildings or alterations and for installations of new processing equipment were checked for compliance with Code of Practice requirements before approval. All building works and installations were inspected to ensure a satisfactory standard of materials and workmanship.

Registration of dairy produce laboratories. All laboratories in the State were inspected for renewal of Registrations.

Inspections resulted in 24 laboratories being re-registered for the 1981–82 period. One additional laboratory was registered for the first time, one ceased operation, and registration of one laboratory was deferred pending structural improvements.

Certificates of Competency. During the year, 121 Certificates of Competency were issued under the *Dairy Produce Act* to operatives involved in various aspects of dairy processing.

A total of 98 permits pending examination for Certificate of Competency was issued.

Dairy produce grading. *Butter.* The shortfall of butter in Queensland has continued to be filled by the importation from interstate of bulk butter and more recently by direct importation of pat butter.

All butter imported in bulk or pat form is graded before release to ensure compliance with local grade requirements. Imported butter comprised 5 572 t of bulk butter from Victorian factories for repacking by the Butter Marketing Board, a decrease of 20.7% compared with 1980–81, and 1 813 t of pat butter from Victoria and New South Wales for direct retail sale, an increase of 210%. A further 1 370 t of butter were imported for dehydration.

Overall butter sales in Queensland for 1981–82 were 8 103 t, a 0.5% reduction on 1980–81 figures.

Cheese. A substantial proportion of Queensland Cheddar cheese production is being graded in-factory by State officers. In general, grades have been satisfactory with the exception of one factory where intermittent down grading occurred. A substantial improvement in grades is expected at this particular factory upon installation of new equipment.

Routine grading of most semi-hard and hard varieties manufactured in Queensland other than Cheddar was also introduced.

Production statistics. The Branch continued to supervise collection and processing of milk production and utilization statistics for Queensland.

Milko-tester calibration. As part of an on-going programme, calibration of automatic fat testing equipment used for payment purposes was checked by designated Branch officers. Two factory laboratories installed infrared milk composition testing equipment during the year.

Advisory activities

The Branch offers a range of advisory services to the dairy processing industry. One of the major activities is assisting processors to maintain and improve product quality for all existing and new product lines. This assistance can be in the form of in-factory line surveys, inspection of buildings and equipment, organoleptic grading, and general information and advice.

Much of this work is done in response to routine monitoring of product quality by Dairy Research Branch.

Liaison is maintained with the Queensland Milk Board on matters of milk quality through a joint Milk Board-Departmental Milk Quality Control Committee. This Committee meets monthly and reviews quality trends and action taken to rectify problems.

Special investigations

During the year, work was continued on or was initiated on a number of special projects in dairy processing. Major activities are discussed below.

Shattering of cottage cheese curd. Work on this project, initially funded with Dairying Research Committee funds, continued during 1981–82 under State funding. Comparisons between laboratory scale and pilot plant results were made. The final draft of the report on the project has been submitted for publication.

Selection of suitable mould cultures for blue-vein cheese. Laboratory scale trials were commenced to isolate suitable mould cultures for Blue-vein cheese manufacture. In particular, mould colour in existing cultures has tended towards green rather than the desired 'blue'. Moulds have been isolated from imported cheeses and attributes of colour, weight and growth rate, and methods for propagation examined.

Survey of losses in dairy processing. The survey, began in 1980–81, was continued during 1981–82. Nineteen dairy processing plants which included cheese, market milk and mixed product plants were surveyed.

The survey established that the most significant area in money terms was product losses. These ranged from 0.5% to 11.7% (average 5%) of milk intake.

Water usage was found to vary from 1.0 to 7.0 L per /1 L of milk intake (average 3.0 L). Energy losses were also found to be significant.

The results of the survey will be used to advise Queensland dairy factories on loss reduction methods.

Recovery of whey fines. A study of the effects of screens on whey fines and biochemical oxygen demand (BOD) was completed during 1981–82.

A 20 µm nylon screen was found to be most suitable for whey filtration and product recovery in commercial dairy factories.

The BOD of Cheddar and cottage cheese whey was not found to be significantly reduced by removal of fines by screening. Results for casein whey were inconclusive.

Industry training and information

Dairy Products Bulletin. The Branch continues to publish 'Dairy Products', a bulletin widely distributed throughout the processing industry in Queensland. It also attracts interest from interstate and overseas. The bulletin is produced three times per year, with in excess of 300 copies distributed. A wide variety of material is included in the Bulletin ranging from local and overseas technical developments to general industry news and information.

Technical reports. Work continued on a series of technical reports for the processing industry designed to serve as operative handbooks. During the 1981–82 period, five booklets in the Queensland Dairy Products Information Series became available

in the following specific areas of processing: Operation of HTST Pasteurizer, UHT Processing of Dairy Products, Manufacture of Market Cream, Yoghurt Manufacture, Milk Packaging. An earlier publication, Bulk Milk Collection, was updated.

Factory Operative Training Group. This Committee composed of representatives from Dairy Field Services Branch, Dairy Research Branch and the commercial processing industry meets at regular intervals to oversee industry operative training and to plan specific activities.

A major training programme was undertaken in 1981–82 in view of the new Certificate of Competency for dairy produce laboratory technicians. Three schools, two at the Gympie Forestry Training Centre and one at QAC, Lawes, were held during the year. The total number of participants attending all three schools was 47, and all were successful in passing the practical examination.

The Committee was also involved in the planning of a Dairy Technology Workshop 82 held at the Forestry Training Centre in May 1982. Upgrading of Technical Correspondence School courses related to Certificates of Competency was also considered by the Committee.

Regional industry training. Depending on availability of resources and local industry interest, regional or in-factory training exercises were conducted. The Wide Bay-South Burnett region conducted six, half-day programmes on such topics as hygiene, tanker driver operations, factory losses and Milko-testers. Hygiene was the theme of nine training exercises held in central Queensland. The Darling Downs region conducted two seminars on hygiene and Milko-testers during the year.

Local officers continued to provide assistance as required to operatives undertaking Certificate of Competency courses.

Special activities

'Dairy Management in the 80s' Seminar

The Division of Dairying and Fisheries in conjunction with the Queensland Dairymen's Organisation successfully staged the 'Dairy Management in the 80s' Seminar in Toowoomba from 8 to 11 September 1981.

More than 400 people, including 250 Queensland dairy farmers, attended the main sessions. The 4-day programme, officially opened by the Hon. Mike Ahern, M.L.A., Minister for Primary Industries, included seminar sessions on feeding, breeding and milking management, discussion groups, farm tours and various social activities. The trade display featuring 37 firms associated with the dairy industry was attended by 600 people.

Mr Dennis Byrnes, of Yungaburra, won the Dairy Shed Design competition which attracted 70 entries throughout the State.

The Seminar was voted an outstanding success by all who attended. It provided a forum for all sections of the industry—farmers, processors, service industries and extension and research personnel—to discuss the major issues facing the dairy industry in the coming decade.

All regions have reported a renewed interest in upgrading dairy premises and many farmers have adopted innovations presented at the seminar. The practical addresses by farmer speakers (Messrs John Norbury, Upper Barron; Robert Burns, Eungella; and Ken Whieldon, Toogoolawah) were extremely well received.

All those involved in the seminar are to be congratulated on their efforts and the financial support of the Queensland dairy processing companies and other organizations is gratefully acknowledged.

Dairy Technology Workshop 82

This workshop was conducted by the Division of Dairying and Fisheries in conjunction with the Queensland dairy processing industry at the Forestry Training Centre, Gympie, from 24 to 28 May 1982. The objectives of the workshop were to provide a forum for both industry and Departmental technologists to update their technical knowledge, particularly in areas such as processing of laboratory data, analytical methods, cheese starter technology, laboratory management, and information acquisition. Demonstration programs for processing of laboratory data on micro-computers were specially prepared for the workshop.

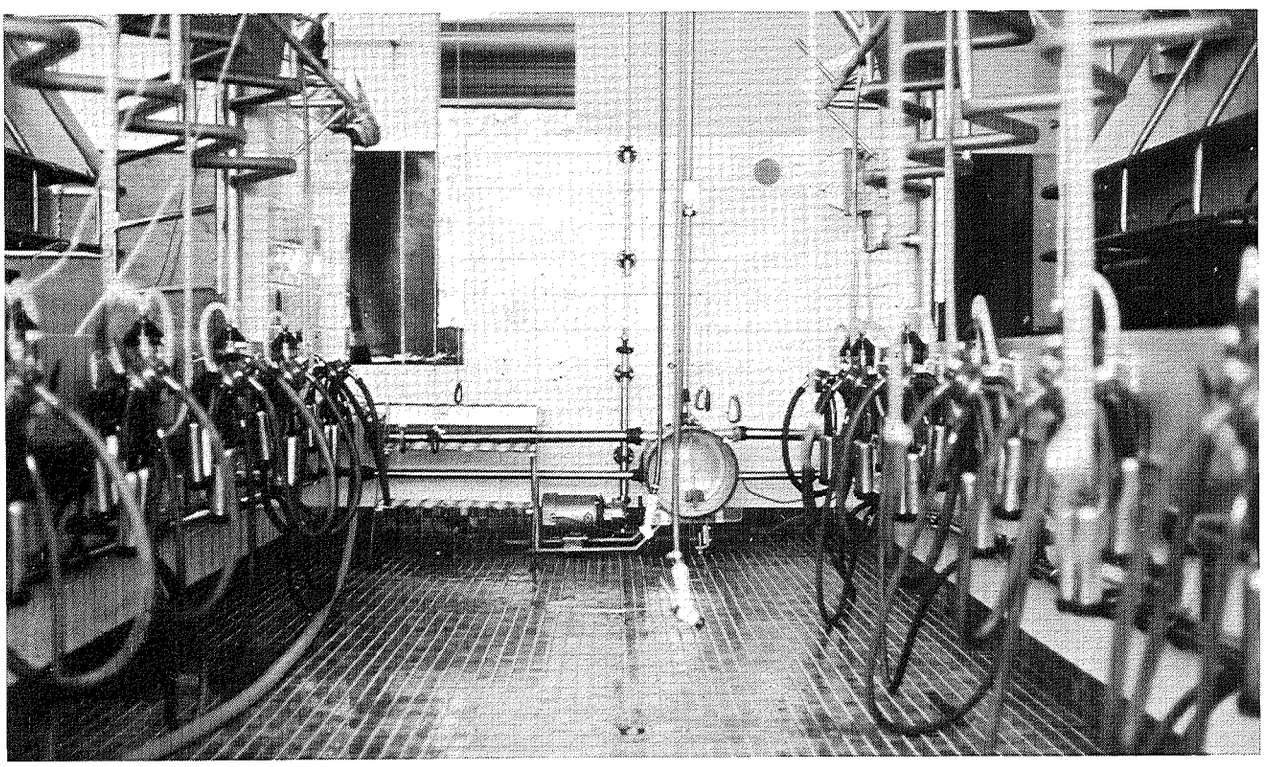
A feature of the workshop which attracted widespread interest was a commercial trade presentation and display. Some 15 firms participated in the display. Most of the equipment on display was for analytical applications. Sixty people were present during this session.

Some 14 industry technologists attended on a full-time basis and 10 on a part-time basis. Attendance by Departmental staff was 10 on a full-time basis and 15 on a part-time basis. Lecturers were drawn from industry, the Department, and several other sources, both local and interstate.

Pesticide residues in dairy products

During 1981, under the National Residue Survey, 223 butter, cheese and powdered milk samples were analysed and no sample was found to be above Maximum Residue Limit (MRL).

Under the Queensland Pesticide Residue in Dairy Produce Monitoring Programme, a sample of pasteurized milk from all pasteurized milk factories was taken each month for pesticide analysis. During 1981, 149 samples were analysed under this programme. Three samples from one factory recorded dieldrin above MRL.



The interior of the winning entry in the 1981 Dairy Shed Competition. The shed, an eight doubled up herringbone with automatic cup removers, is owned by Mr Dennis Byrnes, Yungaburra.

Practical laboratory work during one of the dairy laboratory technicians' schools at the Forestry Centre, Gympie.

Due to limited analytical resources it was not possible to sample all individual farm suppliers to this factory for pesticide analysis until February 1982. However, 165 samples from other sources were analysed on a trace-back basis. Of these, 17 were above MRL. Contamination sources included feeding vegetable waste and spraying and dipping of cattle.

A combined summary of the results from both these surveys for the period 1970–1981 is provided in the table below—

Percentage of butter, cheese, pasteurized milk and powdered milk sample above Maximum Residue Limit

Year	DDT	Dieldrin	Aldrin	Lindane	BHC	HCB
1970.....	5.7	0.4	0.1	0.2	0.8	5.1
1971.....	3.2	3.7	nil	0.1	1.8	6.3
1972.....	0.6	2.4	nil	nil	1.6	3.2
1973.....	1.5	0.9	nil	nil	nil	1.2
1974.....	0.9	2.2	nil	0.1	nil	1.5
1975.....	1.2	0.8	nil	nil	0.4	0.1
1976.....	0.6	2.8	nil	nil	nil	nil
1977.....	nil	1.5	nil	0.2	nil	nil
1978.....	nil	nil	nil	nil	nil	nil
1979.....	nil	0.8	nil	nil	0.5	nil
1980.....	0.5	2.1	nil	nil	1.3	nil
1981.....	nil	0.8	nil	nil	nil	nil

This table indicates that the incidence of pesticide residues in Queensland dairy produce is being maintained at a low level.

International Training Courses

Branch staff provided technical input into two International Training Courses funded by the Australian Development Assistance Bureau.

Dairy technology. A course in dairy technology was conducted by the Branch from 1 September to 19 November 1981. Twenty-one overseas participants representing 13 countries from the regions of Africa, Asia, South-East Asia and the South-West Pacific attended.

The course objective was to meet the needs of technologists involved in processing of dairy products and in the developments of the dairy industry in their home countries. The course appeared to be successful in achieving its objectives.

Cattle production and pasture development. Specific to Malaysia, this course ran from 15 March to 17 June 1982. Officers of the Branch conducted the extension segment and assisted with technical sessions on dairy production as discussion leaders and organizing field visits.

Technical programmes for visitors. The Branch continued to meet a need for *ad hoc* technical programmes arranged in accordance with the requirements of various visitors, mainly farmers, extension officers and scientists.

For example, the north Queensland region reported a major commitment to arranging technical programmes for visitors. Six different groups of overseas visitors, a Victorian Department of Agriculture Officer, three dairy equipment suppliers and one Gympie dairy farmer were assisted through office discussions and/or farm visits.

Extension research

Work continued on the extension research project 'Learning Efforts and Learning Strategies of Dairy Farmers'. This project, being conducted under the supervision of Miss C. A. Underwood, Husbandry Officer, is supported by the Rural Credits Department of the Reserve Bank.

The aim of the project is to identify farmers' learning strategies, focusing on the resources they prefer to use. The information obtained will be used in developing future extension strategies. Basic data are being collected through comprehensive farmer interviews. Most of the 150 planned interviews were completed during the year.

Computing services and development

Computerized processing of milk production and utilization statistics and of monthly bulk herd milk somatic cell counts were continued by the Branch on an on-going basis. Liaison was maintained with other authorities concerned with collection of milk production and utilization statistics with a view to rationalizing data collection.

During the year, a new computerized system for recording and processing of dairy farm registration details was commissioned. This new programme allows registration detail to be collected in a variety of ways.

Microcomputers are now a technical and economic reality for farm and factory use. Following widespread interest among dairy farmers at the 'Dairy Management in the 80s' seminar in on-farm use of microcomputers as an aid to herd management, the Branch has begun to develop programs for on-farm use that are compatible with the centralized herd management data system. A microcomputer was purchased to enable this program development to proceed.

Demonstration programs for processing of analytical data in a dairy factory laboratory were prepared for Dairy Technology Workshop 82.

Overseas consulting

By arrangement with the Australian Development Assistance Bureau, Mr Alan Murray, Husbandry Officer, commenced a 30-day consultancy for the FAO on the dairy industry in Zambia.

Dairy shed trials

Two dairy shed trials were concluded during the year. One trial was concerned with evaluation of a milk pre-cooler on a farm in the Mundubbera district. On a full year basis, the pre-cooler, operated in conjunction with an evaporative cooling tower, gave a net saving in cost of electricity for milk cooling of 32%. This saving amounted to $250 on the trial farm.

The other trial was concerned with the evaluation of a solar water heater for dairy purposes. Use of the conventional solar heater, installed at another dairy in the Mundubbera area, produced savings in cost of electricity for water heating of 30% on a full year basis. This was equivalent to a saving of $30 on the farm concerned.

Trials to compare the effect of various types of farm milk pumps on lipolysis were continued.

Staff training and development

General staff development

The Staff Development and Training programme based on the confidential supervisor-officer interview introduced in 1981 continues to be used by the Branch. A review of the programme will be undertaken in 1983.

Induction training

Training programmes for two cadets, two husbandry officers and two technologists have been conducted during the year. Branch staff in north Queensland devoted 18 weeks to this training programme in conjunction with the basic dairy husbandry training programme at Kairi Research Station.

Training courses and activities attended by Branch staff

External Courses. The Acting Branch Director successfully completed a Graduate Diploma in Business Administration at the QIT. Two graduate officers were also awarded higher degrees during the year: M.Ag.Studies (Extension), full-time; M.Sc. (Environmental Studies), part-time. One officer is undertaking studies towards a post-graduate diploma in computing on a part-time basis.

Information and Extension Training Branch Courses. The following courses were attended: Orientation Course, 1 officer; Management Development Course, 2 officers; Time Management (MPIP24), 1 officer; Training Branch Trainers' Workshop, 1 officer; Group Methods in Extension, 5 officers; Writing Workshop, 1 officer.

Technical training. The Technical training was conducted mainly on a regional basis, as follows—

East Moreton-West Moreton: Nutrition-Milk Composition Seminar, QUF (1 day) 8 officers; Leucaena establishment and management, CSIRO, Samford (1 day) 2 officers; Leucaena Establishment and Management (J. Drynan) (1/2 day) 6 officers; Milking Machine-Dairy Premises Workshop (1 day) 10 officers; Irrigated clover pastures farm walk (1/2 day) 5 officers; Research-extension liaison workshop (1 day) 2 officers.

Central Queensland: Milking machines-dairy premises workshop (1 day) 4 officers.

Darling Downs: Feeding systems study tour of northern New South Wales (4 days) 4 officers; Feeding systems study tour of south east Queensland (3 days) 3 officers; Feeding systems and successful extension programmes study tour, NSW (2 days) 1 officer; Redcliffe extension planning workshop (3 days) 9 officers; Mutdapilly Research Station (1 day) 9 officers; Wacol A.I. Centre (1 day) 9 officers.

South Burnett: Bull proving workshop (4 days) 1 officer; Bull proving workshop (1 day) 3 officers; Administration (1 day) 1 officer.

Wide Bay: Bull proving workshop (4 days) 3 officers; Workshop on industry problems and strategies to overcome them (4 days) 8 officers; Study tour to north Queensland (5 days) 3 officers.

'Dairy Management in the 80s' Seminar. Most Branch officers in the Farm Section attended this Seminar which was conducted by the Branch at Toowoomba from 8 to 11 September 1981. The range of interstate and local speakers discussing the latest technical innovations in the dairy industry provided a valuable refresher course for Branch staff. Most officers were also involved in some aspect of the seminar through organization and planning, working parties, arranging and accompanying farmer groups or presenting papers and running discussion groups, displays and competitions.

Interstate and overseas study tours and conferences. Mr John Bywater attended a 4-day seminar in Launceston dealing with farm applications of computers, and a 2-day dairy management seminar at Camden, New South Wales.

Mr Jeff Andrews attended a 3-day Mastitis Research Workers' Conference conducted by the NSW Department of Agriculture at Glenfield.

Mr Michael Moller attended two seminars in Victoria, one dealing with UHT Processing of Milk Products, the other with Loss Monitoring in Dairy Processing.

Dr Harley Juffs undertook a study to investigate organization of Department of Agriculture dairy industry services in Tasmania and Victoria, in conjunction with the Australian Society of Dairy Technology Federal Conference.

Mr Richard Fell attended the joint New Zealand and Australia Societies of Animal Production Conference in New Zealand and also undertook a study tour of New Zealand dairy farms. Mr Alan Murray was recalled from leave in New Zealand to attend this Conference also.

Dairy Cattle Husbandry Branch

THE work of Dairy Cattle Husbandry Branch is in the categories of production research, dairy herd management information services, dairy breed improvement, and artificial breeding services.

To achieve its objectives and discharge its responsibilities, the Branch operates the sub-programmes: Dairy Cattle Research, Dairy Herd Production Services and Artificial Breeding Services, together with Branch administration.

Dairy cattle research

The aim of the Dairy Cattle Research sub-programme is to conduct applied research in dairy cattle production technology and provide information for direct application by Queensland dairy farmers. The experimental work is carried out on the Kairi and Mutdapilly Research Stations, while farm trials are in progress in southern and central Queensland districts.

Substantial improvements in dairy farm production techniques have occurred during recent years with the adoption of the results of local research. Two occasions during the year highlighted the contribution of officers in this sub-programme. The first was the seminar 'Dairy Farming in the 80s' in which most of the technical data had been developed by the research group in the last decade.

The second occasion was the recent Australian Society of Animal Production Biennial Conference held in Brisbane where some 15 papers were presented.

Mutdapilly Research Station

Milking through the 28-unit rotary turnstyle (transferred from Ayr Research Station) began in July 1981. After some initial problems, the facility is now working well and 120 cows an hour are being milked and sampled.

Technical staff have been removed from routine milking duties and now have more time and opportunity to develop skills associated with the research programmes. It is also appropriate to note that the technical staff at Mutdapilly and Kairi Research Stations spend a large portion of their time with the Australian Friesian Sahiwal (AFS) breed development programme.

Throughout the year, some 450 to 500 head have been held at Mutdapilly. This large number of cattle has required many resources to manage. There have been major difficulties in feeding the milking herd throughout the year. Development work, namely, drainage, levelling, fencing and the installation of irrigation facilities, have all taken much longer than expected and it is only now that reasonable quantities of irrigated green feed are available.

Because of the lack of paddock feed, much of the labour has been diverted to intensive systems of cattle feeding thus slowing the development programme. Another problem in this regard is the very limited high ground available when wet weather forces the removal of the cattle from the black soil flats.

Several projects involving grazing studies have been designed. The first began in May 1982 and it is intended to initiate others as facilities become available.

Kairi Research Station

Approval has been given for the construction of a new dairy and yards at Kairi. When completed, this new facility should greatly speed up the milking operation and permit the more effective use of technical officers' time.

The other major proposal for the Station is the upgrading of irrigation facilities. Irrigation has assumed greater significance in the dairy industry on the Atherton Tableland and local farmers have requested that irrigation production studies be commenced.

The deep red basaltic loams of the Atherton Tableland are of high fertility and soil phosphorus status is relatively high. It has generally been considered that animals grazing pasture on these soils would not respond to additional phosphorus supplementation. However, recent farmer experience suggests that phosphorus supplementation of milking cows may be beneficial.

Molasses is a cheaper energy supplement than grain and is being used in increasing quantities on the Atherton Tableland. Unlike grain, the phosphorus level of molasses is extremely low, and thus available phosphorus may limit animal production, particularly when higher levels of molasses are fed.

An experiment is investigating whether a milk yield response occurs from supplementing Friesian cows with phosphorus. Cows are given high or low levels of molasses intake. The treatments are as follows—

Treatment	Molasses fed	Phosphorus fed
1	3.5 kg/cow/d	. .
2	3.5 kg/cow/d	96 g Christmas Is. P/cow/d
3	0.5 kg/cow/d	. .
4	0.5 kg/cow/d	96 g Christmas Is. P/cow/d

Mean milk yields over a period of 4 months are shown below—

Treatment	Milk yield (kg/cow/d)
1	15.8
2	16.9
3	13.1
4	14.6

Responses in milk yield have occurred at both levels of molasses feeding. During the experiment, pasture yields were about 4 500 kg DM per ha, with 27% legumes. Initial blood samples suggest there are no differences between treatments in inorganic phosphorus concentration in blood plasma.

Soil analyses taken from the areas grazed show that phosphorus levels ranged from 26 to 140 ppm (BSES) with pH in the range 6.5 to 6.7.

A further experiment has been designed to examine the influence of superphosphate fertilizer level on milk yield from nitrogen fertilized pastures. Radioactive studies are being made so that the source of milk phosphorus may be determined accurately.

This is one of three new experiments for 1982. It is designed to look at the influence of superphosphate level on milk yield at 100 and 300 kg N per ha yr^{-1}. Three levels of super are being used 0, 250 and 500 kg per ha yr^{-1}. Gypsum is applied to low super treatments to equalize calcium and sulphur inputs. Sodium molybdate was also applied to all paddocks. Grass species is Gatton panic.

Cows calved November–December and entered treatments after a covariate period on pasture. Cows are stocked at 2.6 cows per ha, in a two paddock rotation 3½ days in, 3½ days out. Coarse salt is the only supplement.

Milk yields (kg per cow d^{-1}) for January–February 1982 are presented below for the major treatments—

Treatment	Week ending							
	13/1	20/1	27/1	3/2	10/2	17/2	24/2	3/3
100 N	14.4	13.5	13.1	12.6	13.7	13.8	12.9	12.2
300 N	14.5	13.3	13.7	13.4	14.7	14.5	13.4	13.2
0 P	14.7	13.7	13.9	13.4	14.6	14.5	13.5	12.6
250 P	14.1	12.8	12.7	12.5	13.6	14.1	12.8	12.8
500 P	14.6	13.7	13.6	13.2	14.3	13.9	13.0	12.6
Av. max. Temp. °C	27.4	28.3	29.2	27.6	25.7	26.9	28.3	28.6

A strong and consistent effect of nitrogen fertilizer level on milk yield has been apparent since mid January. From then on, visual differences between 100 and 300 N treatments were obvious in terms of yield and quality.

No consistent phosphorus fertilizer effect has shown up. Cows in 250 P were affected by mastitis early in lactation which reduced the group average. Milk yield was negatively correlated with maximum temperature in these unshaded paddocks.

Pasture sampling was carried out in January; yields and composition are presented below. Total yield was increased by nitrogen level while total yield showed a trend towards increased yield with increasing level of superphosphate.

Treatment	Yield (kg DM/ha)			
	Total	Leaf	Stem	Dead
100 N/0 P	6 967	1 056	5 367	544
100 N/250 P	7 623	1 099	6 047	477
100 N/500 P	7 481	1 129	5 839	513
300 N/0 P	8 018	1 319	6 319	380
300 N/250 P	8 000	1 179	6 361	460
300 N/500 P	8 241	1 191	6 479	571

Phosphorus concentration of the diet was determined in late January using radioisotype P33 injected into oesophageally fistulated (OF) cows. Phosphorus concentration of the diet of OF cows can be determined once the level of phosphorus in the saliva is determined using P33.

Treatment values were as follows—

—	Dietary P concentration %
100 N/0 P	0.19
100 N/250 P	0.19
100 N/500 P	0.21
300 N/0 P	0.17
300 N/250 P	0.19
300 N/500 P	0.20

The important points to note are the very low dietary phosphorus levels compared with the recommended levels of 0.30 to 0.35% (NRC 1978). We know from our previous work that leaf and stem phosphorus levels decline at higher levels of nitrogen fertilizer use. This appears to have carried over into the diet. Diet phosphorus concentration also appears to increase with level of superphosphate although the changes are not marked.

The second experiment, commenced this year, deals with milk yield response to meatmeal supplementation. Treatments in this experiment are four levels of meatmeal feeding 0, 250, 500, 750 g DM per cow d^{-1} mixed with molasses up to a standard supplement intake of 2.5 kg DM per cow d^{-1}. Cows graze in two groups either grass-nitrogen or grass-legume pastures.

In the third new experiment which is concerned with growth rate response in weaners to meatmeal supplementation, a study is being done on the response in liveweight of weaner heifers to four levels of meatmeal supplementation (0, 80, 160, 240 g DM per heifer d^{-1}). Meatmeal is mixed with grain to give a supplement intake of 1 kg DM per heifer d^{-1}.

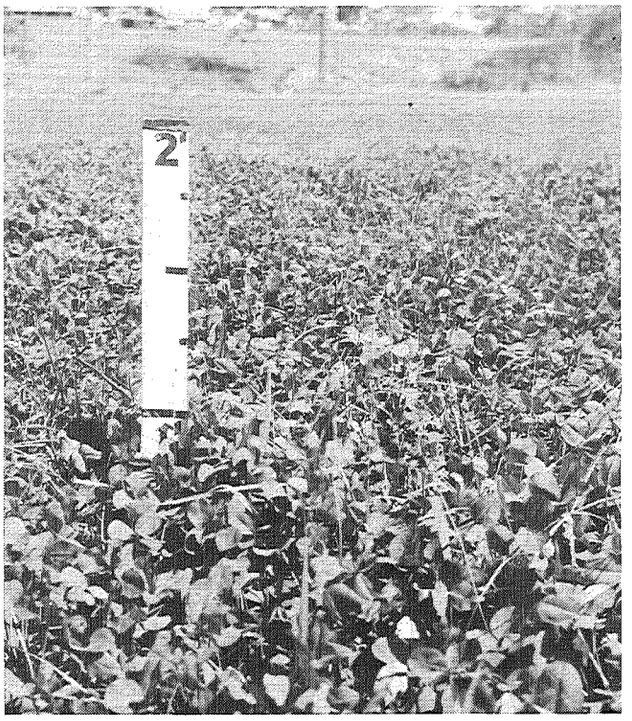
Heifers are weaned at 8 to 10 weeks and enter the experiment at 10 to 14 weeks of age. They are then weighed at fortnightly intervals.

Farm trials

A comparison of annual ryegrass and clovers as sources of winter-spring feed on dairy farms began with plantings of small areas in April–May 1981.

Research over the last 6 years has shown that annual high density ryegrass and/or clover pastures can dramatically increase milk production over the cool dry season—traditionally the problem period for milk production on Queensland dairy farms. Considering the ever increasing reliance of the Queensland industry on the supply of 'liquid milk' the need to increase dry season production is becoming critical.

To date, ryegrass has been used more extensively than clovers on Queensland farms, mainly because of the fear of bloat with clovers and the superior early winter performance of ryegrass pastures. However, experiments over the last 3 years have shown that, while both species have advantages which warrant their continued use in farming systems, clovers consistently produce more milk at lower cost over the combined winter–spring period.



Irrigated ryegrass-clover pasture ready for grazing.

Undoubtedly clovers have a higher quality for milk production and are capable of producing higher per cow yields compared with ryegrass. Their use is expanding.

During the year, three farm trials were conducted to define more clearly the place and relative merits of high density annual clover based pasture and high density ryegrass pasture. Co-operating farmers were Mr A. Stegeman, Boonah; Messrs P. and R. Yarrow, Kalbar; and Mr P. McDonald, Monto.

Results have largely confirmed previous trends which showed that clover pastures establish more slowly and produce slightly less milk to the end of winter, but produce significantly more milk than ryegrass in spring. This is shown in the following table—

Comparative milk production from ryegrass and clover pastures in winter and spring at Monto (planted early April and mid May).

Season	Milk production (L/ha)	
	Ryegrass	Clovers
Winter	4 570	4 375
Spring	5 290	6 260

The yields per cow from clovers were 1 to 3 L per d higher where pasture yields were similar.

Early planting dates improved the winter performance of clovers relative to ryegrass. It is now recommended that planting of high density clovers should begin in mid March, but more work is necessary to determine fully the influence of planting date on winter milk yields.

Low seeding rates of ryegrass in high density clover pastures significantly increased the winter dry matter yields without interfering with successful clover establishment. It is now considered that high density clover mixtures should contain 5 to 10 kg ryegrass or 20 to 30 kg oats per hectare.

Nitrogen applications to clover pastures at planting and in June and July appeared to substantially improve dry matter clover yields in winter. This is supported by research station results.

High density clover pastures on two farms continued to provide feed through summer and autumn and have been kept as intensive pastures for a second year. This is another important advantage clovers have compared with ryegrass pastures.

Other field studies have involved co-operative work with Biochemistry and Veterinary Services Branch to investigate the selenium status of dairy cattle in south east Queensland. A great deal of effort has been expended on blood analyses and extracting intercalving interval data from herd recording records for this project.

More than 400 cows in four herds are being paired to study the effect of selenium supplementation on reproduction and production. A supplementary trial to investigate the response to selenium in calf growth rates on three commercial properties will also be undertaken.

Dairy herd production services

The aim of the Dairy Herd Production Services sub-programme is to make facilities available to dairymen to participate in production recording systems, herd management information services, genetic improvement of herds and dairy breed development.

Three major activities are being undertaken within this sub-programme. They are herd recording (farm, laboratory and processing of records); proving and selection of bulls; and development of the AFS breed.

Herd recording

During the year ending 30 June 1981, 43 279 cows completed recorded lactations. Their average production of 3 003 L milk and 113 kg butterfat is the highest recorded since the commencement of group herd recording in 1948. During the 1981–82 year, herd registrations for recording services increased by 17%, and in May 1982 there were 782 herds participating.

The recording of goat herds has also become more popular with 119 does completing recorded lactations in 14 herds during 1980–81.

In addition to the farm recording services which are supervised by herd recorders or contractors, a farmers-own-sampling scheme and recording of milk measurements only by farmers are available. Although both these recording systems have been introduced recently, they were used by 15% of recording members this year.

As the cost of providing supervised on-farm services increases further, it is expected that greater use will be made of alternatives. In this regard, a project seeking to determine the loss in accuracy of predicting lactation performance which would occur if either morning or afternoon or alternate morning/afternoon yields were measured instead of carrying out the current procedure of measuring yields for both morning and afternoon milkings has been initiated.

The pilot project dealing with mastitis cell counting in 84 herds terminated in July 1981. A bi-monthly cell counting service involving milk samples from individual cows was offered immediately, and it is now being used by 407 herd recording members. A fee of 10c for each sample tested is charged for this service.

Each year, steps are being taken to provide more herd management information to herd recording members. Records of cow reproductive performance were examined in more than 200 herds in an effort to develop an information service on breeding management. Farmers co-operating in the bull proving schemes are receiving breeding management information now, and it is intended to develop a more extensive scheme which will be available as a routine service.

Recording fees were increased by 40% from 1 July 1981 and will be increased by a further 40% in July 1982. The increases are in accordance with current policy for dairy farmers to pay the total cost of farm recording service operations. It was expected that this target would be reached in 1982, but this has been delayed until June 1983 because of the steep increases in cost to provide services which are supervised by contractors.

An operator inputs dairy herd production information to computer files.

The procedure of forwarding all milk samples to a central laboratory for testing has continued. This year 546 184 samples were tested—20% more than in 1980–81. Cell counts were carried out on 117 274 of these samples.

By using automated procedures in the laboratory, approximately 400 milk samples per hour can be analysed for butterfat and protein composition. Cell counts are made on 200 samples per hour. At present, the data derived from the laboratory are manually transferred to a computer through a terminal. Equipment which will provide an interface between the testing apparatus and a microcomputer has been installed and tested. It is expected to be fully operative in July 1983.

The organization of transporting milk samples from depots in all dairying districts to the Wacol laboratory is a major task, as the samples must be kept cool during transport to prevent spoilage. Apart from the normal services, a regular transport service is provided for the south eastern and Darling Downs areas. Approximately 40 000 samples each month are being transported by this service.

Proving dairy bulls

One of the chief features of bull proving operations has been the continued consolidation and refinement of monitoring procedures which were introduced over the previous 2 years.

The manual system involving the compilation of reports on inseminations, births and calvings has been replaced by using standard procedures for the analysis of herd recording information.

This is the first year that automatic extraction of bull proving data from computer files has been undertaken, with the result that a large amount of manual work has been eliminated. The change was made by transferring data to the CSIRONET system and using the available computer programs for its analysis.

Additional computer programs are being developed to improve further the monitoring and reporting of cow nominations, semen supply and details of inseminations, utility characteristics of heifers, daughter recovery rates and stayability assessments.

Collaborative progeny testing with NSW in the Jersey and AIS breeds is continuing. The Jersey programme is in its fourth year with the AIS programme in its third year. Proving of AIS sires was extended to Victorian and South Australian herds during the year.

Currently, 255 Queensland dairymen are participating in bull proving schemes. Most of them (177) are inseminating nominated cows with semen from Friesian bulls, while semen from AIS bulls is used in 47 herds, Jersey in 20 herds and AFS in 11 herds. Semen is being made available from 12 Friesian, 9 AIS, 4 Jersey and 5 AFS bulls.

Dairymen who assist with the proving of bulls have been assessing the utility characters of each sire's daughters during their first lactations. The descriptive method which has been used for a number of years has now been replaced with a linear scoring system in an effort to obtain more objective assessments. The scoring method which has been adopted is similar to that used in USA.

Two sons of the first generation Friesian proven sire 'Coolangatta Airman 38' which were used in the 1976 test group were declared 'A.I. Proven' in 1981. These sires are 'Dasfries Robin Airman' and 'Reynoyle Jewel Master'. The 'A.I. Proven' Friesian sire from the 1977 test group is 'Tocal Destiny Topper'. In addition to this 1982 A.I. Proven sire, the selected bulls 'Mataranka S.P. Benjamin' and 'Wyoming Star Revenue' have been retained on the basis of their good proof results.

The AIS A.I. Proven sires were 'Tabbagong Mayflower's Mascot' (1981) and 'Warroolaba Magnet' (1982). In the Jersey breed the A.I. Proven sire for 1981 was 'Sweet Meadow Flashlight'.

Participating in AFS bull proving continues to expand as more AFS cows become available for mating. However, to date it has not been possible to delineate a bull as 'A.I. Proven'.

AFS breed development

The continued development of the AFS breed depends largely on the efforts of farmer co-operators who are maintaining selected cows and evaluating their daughters. Most of the second and later generation animals are now reared on the farm.

The number of co-operators increased from 14 to 23 during the year. More than 400 cows are on loan to co-operating farmers in southern Queensland, Mackay and Atherton Tableland districts. The 14 cows located on a dairy farm near Darwin continue to perform well. Last year, their average daily production was 10 L per cow.

During the year, 13 young AFS bulls were evaluated for tick resistance before making selections for inclusion in the bull proving group. All these animals had a satisfactory level of resistance and were in the range 98.0 to 99.9%.

Tick resistant dairy herd programme

Although tick control through the use of chemicals is fairly expensive and inconvenient, dairy farmers are reluctant to breed large numbers of tick resistant cattle. It is difficult to persuade them to use Sahiwal bulls over their *Bos taurus* cows to breed herd replacements.

This programme which involves the use of Sahiwal and AFS bulls in Friesian or AIS herds to breed tick resistant replacement animals is being supported by nine co-operators: in the Atherton Tableland (three), Wide Bay (five) and Moreton (one) districts. More than 200 replacements are being reared.

Paddock tick counts have been made in five herds. These indicate that all Sahiwal cross animals are tick resistant.

The selected Friesian sire 'Mataranka S. P. Benjamin', with a proof index of 101 for milk and 107 for butterfat, is being used widely in Queensland herds.

Sahiwal project

A herd of 25 purebred Sahiwals is located at the Mutdapilly Research Station. Reproduction in this herd is satisfactory, with an average of 3.3 inseminations per conception for all matings since 1979.

Each year, a number of young bulls is selected for semen collection. In 1981–82, seven young bulls entered the Ormiston A.I. Centre.

Computer applications

Computer sotfware has been provided for the transfer of herd recording data to other States as part of the development of the Australian Dairy Herd Improvement Scheme. These data are being analysed to produce the first Australia-wide comparison of dairy sires. Breeding indices will be calculated for all recorded cows so that the 'elite' animals may be selected for bull breeding.

A PDP 11/03 microcomputer has been installed at the Herd Improvement Laboratory to automatically capture results from the milk analysis apparatus. This small computer also has the capability to receive routine herd recording data, store it for a limited period, and then transmit the information to a large central unit for processing.

To overcome inflexibility in herd improvement services, a package of herd recording computer software has been obtained and is now being modified for Queensland conditions. Work is continuing in the area of computer hardware for production recording services.

These projects should ensure that sufficient flexibility is available in processing information to satisfy the requirements of herd recording systems for a number of years.

Promotion and publicity

A greater need to promote services and co-ordinate promotional material within the sub-programme has been recognized, and a small group was formed early in 1982 to prepare publications and other promotional material.

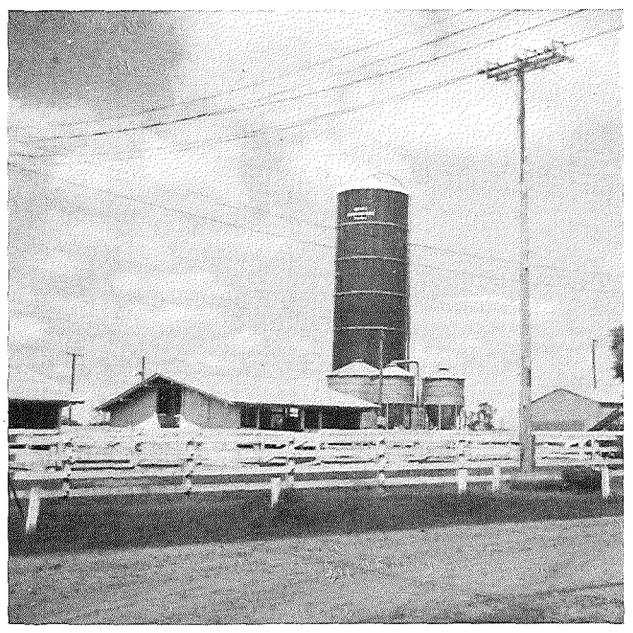
To date, three pamphlets and a booklet publicizing herd recording have been prepared. This activity is additional to the normal preparation of newspaper articles, attendance at field days and courses, radio talks and other extension work.

Artificial breeding services

The aim of the Artificial Breeding Services sub-programme is to provide for the requirements of livestock producers (except insemination services) to undertake artificial breeding programmes in their herds.

To satisfy the requirements of the sub-programme, artificial insemination centres have been established at Wacol and Ormiston. Activities concerned with the collection, processing, storage and marketing of bovine semen for use within Australia are carried out at the Wacol Centre.

The storage of semen from other centres for distribution to Queensland farmers and graziers, marketing of insemination equipment and training in insemination techniques are also handled by the Wacol Centre.



A recent view of part of the Wacol A. I. Centre with the newly erected Harvestore in the background.

The Ormiston Centre is concerned chiefly with the production of bovine semen for export. For this purpose, it is necessary to maintain sires and monitor their health status in accordance with the requirements of importing countries.

Livestock

On the 31 May 1982, 141 Bulls were housed at Wacol and 17 at the Ormiston Centre. Although most of these (132) were owned by the Department, 14 were privately owned and 12 were in the ownership of CSIRO.

Negotiations are under way for the entry to Wacol of the top sire ('Moorlands Miles') identified in the Poll Hereford Society's Reference Sire Scheme. This sire is the first Nationally Proven beef sire, and his standing at Wacol will reflect great credit on the Department's services to the livestock industries.

'Navilloween Potentate', ranked second as Poll Hereford sire of the year, has been leased by the Department for high volume semen sales.

Other Poll Herefords to enter the centres include 'Foxlow Mariner 44th' and 'Warrensville Napoleon'. Both of these sires changed ownership recently for $30,000 each.

A Charbray ('Wheeler View Octavian') was leased following negotiations with the Charbray Society. Significant exports to southern Africa have been arranged by the Society.

The Senior Champion Aberdeen Angus bull at the Sydney show, 'Forres York Y40', has also been leased. This animal is an outstanding representative of the breed and should command sales across Australia.

The majority of bulls to enter A.I. Centres in Australia from the first importation through Cocos Island were delivered to the Ormiston Centre in March 1982. More than 100 visitors inspected the seven bulls over the 2 days following their arrival.

Four of the bulls proved immediately successful as semen donors, and the remainder were forwarded to their owners' properties for return when semen quality improves.

Negotiations are in progress for the entry of nine additional sires due to enter Australia in the second and third shipments through Cocos Island.

Semen production

All semen for unrestricted use is collected and processed at the two licensed centres. Semen for restricted use (that is, for use by the owners of sires from which semen is collected) is either collected and processed at the Herd Improvement Laboratory, or is collected on the property and forwarded to the laboratory for processing.

During the year, 225 600 doses of semen for unrestricted use were placed in storage. This amount included 29 700 doses which were collected from privately owned bulls.

The quantity of semen stored for restricted use increased from 18 630 doses in 1980–81 to 35 960 doses this year.

Semen distribution

It is estimated that 130 800 doses of semen were distributed in Queensland by the Wacol Centre and its agents. In addition, the two A.I. Centres forwarded 39 500 doses to other Australian States or overseas.

Of the semen distributed in Queensland, 82% was collected from dairy bulls and 18% from beef sires. Nearly 70% of dairy semen was from Friesian bulls with 16% from AIS, 8% from Jersey and 6% from other dairy breeds.

Semen exports

With the exception of sales to New Zealand, exports were well down on those of the previous year. The reasons for this probably include the increased value of the Australian dollar, increased semen prices and the capacity of other A.I. Centres to service overseas markets.

The New Zealand market, which took 35 000 doses of Sahiwal semen in the 1981 breeding season, is expected to expand further. Several countries have let contracts for Sahiwal-Friesian crossbred heifers and shipments have already gone to Mexico. The Philippines, Thailand and Indonesia will receive initial consignments in the near future.

In recent negotiations with New Zealand, it was indicated that 100 000 Sahiwal matings would be performed each year for the next 5 years.

Other sales to New Zealand include semen from Poll Hereford, AIS, Friesian, Guernsey, Braford, Santa Gertrudis, AMZ and AFS breeds.

Promotion

The Wacol Centre continued its promotional programme by means of publications, displays, media releases, advertising and Centre activities. Apart from overseas visitors who came from 28 countries, several hundred local graziers and dairymen inspected the Centre.

Training

There was a strong demand for training in artificial insemination techniques again this year and it has been indicated that a similar level of training activity will be required in 1982–83. Courses were conducted for 34 groups of trainees at which 324 persons attended. A further 13 refresher courses were attended by 200 farmers.

The Centre participated in short international training programmes which were under the supervision of Departmental officers. Dr B. Sasikumar, Officer-in-Charge of the Kulathupuza Unit of the Kerala Livestock Development and Milk Marketing Board, India, is undertaking a major training programme of 9 months' duration.

Embryo transfer

Work on embryo transfer was performed in several herds during 1981 to enable staff to develop skills. In these herds, a pregnancy rate of 55% was achieved with an average of 2.5 pregnancies for each donor treatment.

During 1982, transfers have been performed to enhance progress in projects dealing with the development of tick resistant dairy herds and the breeding of Friesian bulls for bull proving.

Dairy Research Branch

Dairy Research Branch, through advisory (and if required, regulatory) product evaluation and research programmes, provides microbiological, chemical and technical support for all sections of the dairying industry, commodity boards and other Departmental officers. By ensuring dairy products are maintained at a high quality standard, the Branch safeguards the consumer.

Tests conducted on dairy produce in the last 2 years are set out below—

—	1981–82		1980–81	
	Samples	Tests	Samples	Tests
Bacteriological	15 892	60 674	17 611	54 491
Chemical.....	23 749	56 568	22 840	56 357

The dairying industry in this State is currently being required to initiate and maintain its own quality control programme. Officers of this Branch have therefore assisted in three ways. Firstly, we have participated in the three practical schools conducted by the Division for students studying for the Dairy Produce Laboratory Technician Certificate. Secondly, we have organized interlaboratory check testing programmes, to enable all laboratory staff (including our own) to check their analytical procedures and, if need be, take corrective action. Thirdly, we have assisted with the training of new technical appointees to factory laboratories.

As the industry assumes greater responsibility for the quality of its products, this Branch will take on the role of referee or reference laboratory and officers of the Branch that of specialist advisers to the industry and other groups. Consequently, officers serve on subcommittees of the Standards Association, groups of experts of the International Dairy Federation, participate in national and international check testing procedures and lecture to maternal and child health sisters and dairy factory operatives as required.

Research findings continue to be transmitted to peers by research publications, presentation of papers at scientific gatherings and to a lesser extent by informal discussions and meetings. As mentioned in the previous report, emphasis is being given to the methods of disseminating research findings to industry and commercial bodies. In particular, mastitis diagnostic methods and methods of controlling the disease have been demonstrated to a small group of farmers. Farmer response has been enthusiastic and milk yield increased. Lack of foaming in Capuccino style coffee is a recurring problem and has been shown to be associated with lipolysis. Our education programmes have recently been adopted by processors in one district affected by this problem.

Officers of the Branch continue to host an increasing number of visits by scientists and technologists, and students from secondary and tertiary institutes. We also accepted four secondary school students, one tertiary level student and three students from an International Training Course for work experience.

Dairy product evaluation

Our long range plan is to automate all product quality evaluation programmes to provide more efficient, less labour intensive services to the dairy industry. Computerization of the liquid milk quality services of this Branch are in an advanced stage. The system should become operational at the end of 1982, rather than 1981 as previously expected, because of modifications to cater for more options among the outputs issued.

Periodic reports have been redesigned to provide alternative formats for the various users within the industry—statutory boards, field advisers and industry personnel. The range of computer programs required in the system has been increased from 11 main and 12 subsidiary programs to 19 main and 17 subsidiary ones. All design stages are completed and documentation is almost complete. Nine of the main programs and all of the subsidiary programs required have been written and tested with multiple sets of typical input data. A printer and terminal capable of handling the system are installed at Hamilton.

Raw milk

—	1981–82	1980–81
Bacteriological analyses		
Farm–to–factory tankers		
Total count—No. of samples	1 868	1 542
% greater than 150 000/mL.....	5.9	7.5
Factory–to–factory tankers		
Total count—No. of samples	1 690	1 780
% greater than 150 000/mL.....	14.4	17.5
Chemical analyses		
All tankers		
No. of samples.....	3 433	3 413
Fat—% unsatisfactory.....	0.09	0.3
Solids–not–fat—% unsatisfactory.....	0.29	8.1
Freezing point—% unsatisfactory	6.6	10.1
% > 1% added water....	5.1	5.1

The results continue to reflect the success of the Divisional programme aimed at reducing bacterial counts at all stages of raw milk handling.

Pasteurized milks and creams

All but 36 samples of cream and flavoured dairy products analysed were of Queensland origin. Generally, quality of pasteurized products was satisfactory but instances of inefficient pasteurization, post-pasteurization contamination (coliforms) and compositional irregularities occurred as listed hereunder.

—	1981–82	1980–81
All products		
Phosphatase test		
No. of samples.....	8 528	8 614
—% fail.....	0.14 (12 samples)	0.33 (29 samples)
Coliform test		
No. of samples.....	8 491	8 410
—% fail.....	14.2	17.2
Whole milks		
Freezing point		
No. of samples.....	3 269	3 236
—% unsatisfactory	12.24	13.50
—% >1% added water...	7.00	6.40
Skim milks		
Composition		
No. of samples.....	547	553
—% substandard solids-not-fat	8.14	7.70
—% substandard fat.....	4.93	11.20
Cream		
Composition		
No. of samples	1 328	1 416
—% substandard fat.....	4.52	2.40

Phosphatase reactivation occurred in the four cream samples (all from one processing plant) that failed the phosphatase test. The presence of coliforms in a significant proportion of samples is the principal area where improvement can be effected.

The Moseley test is still being used as an advisory test for assessing keeping quality of pasteurized milk and cream products. During the year, organoleptic results were also included with the bacteriological results for each sample. Frequently, unacceptable Moseley counts for flavoured milks were associated with acceptable organoleptic results. It appears that high sugar content of flavoured products masked some of the off flavours produced by bacterial activity.

Butter

All work on behalf of the butter industry was performed in Brisbane this year. The numbers of butter samples analysed were considerably greater than for the previous year (1 550 compared with 1 030 in 1980–81). As a consequence of the declining Queensland butter industry, 65% of all samples tested were imported and 48% were imported pat butters. For the first time, pat butters from New South Wales were tested and constituted a considerable portion of the pat butters analysed.

As in previous years, overmoisture butter continues to be a problem with 38% of the interstate samples being overmoisture. Discussions took place between technologists of large interstate manufacturers and chemists within the Branch to ensure analytical methodology for moisture analyses was standardized.

Quality problems caused by elevated copper levels in butter are no longer encountered. Therefore, analyses were reduced to one sample per 6 months from each factory. The results of all analyses were below the standard of 0.07 ppm.

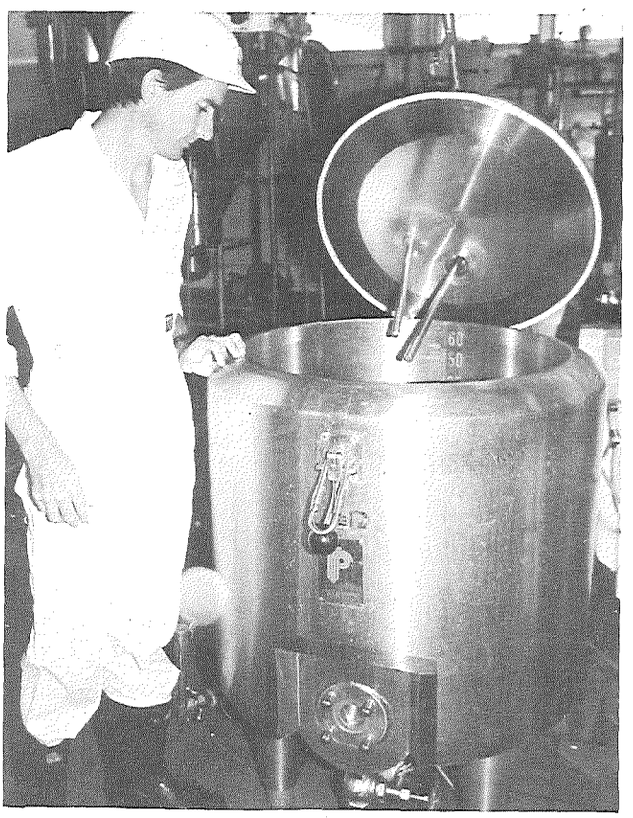
Cheese

Though no cheese was exported during 1980–81, as a result of favourable seasonal conditions this year one factory re-entered the export market. As a consequence, NATA certificates were issued for 85 cheeses sampled and analysed on their behalf.

Officers of the Branch have continued to provide technical assistance for the new ultrafiltration plant at Booval and for other Queensland manufacturers of Cheddar cheese and non-Cheddar cheese. It is noteworthy that two very small Brisbane non-Cheddar cheese manufacturers intermittently produce cheese containing excessive numbers of coliforms and other bacterial contaminants.

Starter cultures

Starter cultures were distributed to industry and individuals. It is of interest that the dairy industry has obtained fewer freeze dried cheese starters, presumably because of newer methods of obtaining bulk starter cultures than the traditional 'scaling up' system.



The fermentation vat for cultured milk at the Otto Madsen Dairy Research Laboratory.

Fewer people have requested cheese starters and yoghurt cultures, probably because of the increased charges levied per culture and the absence of radio and newspaper publicity. Pamphlets (856 sets) were distributed to householders, school children, undergraduates and student nurses either directly or via the various agricultural shows.

Yoghurt and other cultured products

Yoghurts and other cultured dairy products were analysed regularly throughout the year. Intermittent compositional irregularities, as well as yeast and mould contamination occurred in all products.

Milk powders and mixes

These include Junex and Meletone. NATA certificates were issued for milk powders submitted by two dairy co-operatives and one food company. As in previous years, NATA certificates were issued for Junex and Meletone consignments intended for export to the United States of America. All samples conformed to the requirements of the Australian Department of Primary Industry.

Goat milk

Goat milk, raw and pasteurized, is regularly analysed for hygiene quality, composition and adulteration by cow's milk. Though no samples were shown to be adulterated, hygienic and compositional quality was variable.

It is noteworthy that analytical procedures for testing goat milk are still being developed as all the methodology used for testing cow's milk cannot be applied to goat milk. In particular, appropriate methods for assessing pasteurization efficiency and antibiotic residues are being developed.

Residue monitoring

Antibiotics. A total of 5 319 samples was analysed for the presence of antibiotic residues; 27 (0.51%) contained penicillin and one contained inhibitory substances other than penicillin. Despite reports from other countries, penicillin continues to cause most residue problems in Queensland.

Iodine. A total of 4 260 raw and pasteurized milk samples was tested with only 4.5% above the standard of 500 µg/L, indicating iodine residues are not a prime residue in this State and that the Departmental control measures implemented since 1976 have been highly effective (in 1976–77 only 42.8% of the pasteurized milks analysed complied with the standard).

Pesticides. The Branch analysed 405 samples, including pasteurized milk, raw milk and goat milk, for organochlorides and organophosphates.

Sample	Below maximum recommended level	Above MRL				
		Dieldrin	DDT	BHC isomers	Organo-phos-phates	Heptachlor including its Epoxide
Past. milk (192)	179	6	..	1	..	6
Raw milk (206)	180	17	..	4	..	5
Goat milk (7)	5	..	..	..	..	2
Total 405	364	23	..	5	..	13

Dieldrin continues to cause most residue problems.

Legal analyses

Official sampling and analysing of milk and cheese occurred on a limited number of occasions.

Margarine

No margarines were analysed routinely, but one sample was checked to ensure that it was cholesterol free and contained no milk solids (according to label).

Troubleshooting for industry

Apart from a variety of minor problems requiring technical advice or laboratory analyses readily provided by Branch staff, two other industry problems appeared which required considerable work.

1. A taint occurred in the Bundaberg milk supply. Chemical testing showed low levels of hypochlorite were present. No preservative was detected and pesticide levels were below the acceptable level. Organoleptic analysis suggested that the taint could be caused by chlorophenols which can be formed by the action of hypochlorite on phenols which may accidentally have entered the milk.

Scientists in the flavour group of the Dairy Research Laboratory, CSIRO, Highett, have collaborated and are still attempting to confirm the presence of chlorophenols using more sophisticated techniques than are available locally.

2. Thickened cream from one processing plant was tainted on separate occasions (each of which lasted for extended periods). The first disappeared spontaneously without being identified or its cause traced. The second was a bitter taste and was caused by poor hygiene caused by an outlet pipe from the pasteurizer.

Service work

Other Branches. Support was again provided for Dairy Cattle Husbandry Branch and ranged from analyses of milk samples from four projects at the Kairi Research Station to standardization of the Milkoscan at Wacol.

Assistance given to Field Services Branch was more diverse and included analyses of factory survey samples (particularly in the northern part of the State), check testing of various factory laboratory procedures and equipment, provision of freezing point standards to dairy factories, checking the quality of raw milk supplies at Dunk Island, and orientation training for new technical staff.

Regular monitoring of milks from all Atherton Tableland herds, as part of the brucellosis eradication campaign, was carried out for Veterinary Services Branch.

Officers of the Branch have assisted the Overseas Development and Consultancy Section by lecturing to and demonstrating processing procedures to students from the International Training Course in Dairy Technology.

Other organizations. During the year, work was undertaken for a number of organizations. Most of this work was of the 'user pays' type and frequently required use of the evaporator or spray dryer at OMDRL.

Goat milk powder. Approximately 1 000 kg of goat milk powder was dried for Beaudesert Dairy Products.

Pharmaceutical powder. Pilot scale quantities of pharmaceutical powder were dried.

Dairy desserts. A range of fruit flavoured dairy desserts was developed on behalf of a dairy co-operative. The products are now at the stage where factory processing trials are required to adapt the process to the available equipment. We are awaiting further advice as to the direction future trials should take.

Hard milk fat. A large sample of hard milk fat was prepared and forwarded to the Australian Dairy Corporation for promotional discussions with Melbourne firms.

Spray dried milk powders. These were examined for contaminating proteolytic activity. Proteolysis in Australian milk powders apparently has caused bitter taints in milks reconstituted in South-East Asia. All samples analysed were suitable for export.

Research

Contacts with the manufacturing sector of the industry were maintained and, as mentioned earlier, scientists in consultation with Departmental advisory staff are applying the results of their research findings to solve problems of the local industry.

Much of the technologists' work continues to be the result of queries, requests or discussions with members of the State's processing industry. Thus it is evident that though most of the research is funded in part by the Australian Dairy Research Committee (ADRC) the results are immediately applicable to the local industry. One developmental project involving the use of milk products and egg is funded by the Poultry Research Advisory Committee (PRAC).

Milk quality

Mastitis studies. During 1981–82, considerable progress was made regarding the commercialization of the NAGase diagnostic test for detecting mastitis.

Biochemical techniques were developed for the purification and characterization of bovine NAGase in order to obtain further information on the origin of this enzyme in milk. Gel filtration and electrophoresis studies on mammary gland NAGase indicated a pH dependent association-dissociation between the two molecular weight forms of the enzyme.

During the year, a study was made of various colorimetric assay systems for the determination of milk lactate dehydrogenase, as we are aiming at developing a rapid cowside test. Reagent levels were optimized for three suitable systems which gave observable colour changes with mastitic milks in less than 2 min. The test was adapted to a kit form by freeze drying small quantities of a concentrated solution of the required reagents into units of four disposable vials.

However, freeze drying has caused some problems with slow reconstitution of reagents and loss of blue colour in the redox dye dichlorophenol-indophenol. Initial assessment of one assay system in the kit form indicated that the test correctly diagnosed 75% of quarters classified as infected. The cost of reagents in the least expensive system was 3c per test.

Other ancillary mastitis work is summarized below.

1. A rapid paper strip test incorporating the pH indicator bromothymol blue was developed for cowside use and its suitability at sampling improved with a highly absorbent blotting paper. An assessment of the test was made by on-farm examination of quarter milks at a number of commercial farms. The test was only 55% effective in detecting infected quarters and was less sensitive than the detergent based RMT method. However, the test was considered useful for the initial screening of herds and for regular checking of known problem quarters.

2. Monthly sampling of quarter milks was carried out on several commercial farms in the Kilcoy region and milks were subjected to a range of mastitis tests. Computer analysis of the data has enabled problem cows to be identified and a print out summary of results returned to the farmer. This pilot diagnostic scheme has also been used in determining the effectiveness of new and modified mastitis tests. The success of this programme was evident by the marked reduction in mastitis on these farms with a major increase in milk yield. Further work on the development and implementation of this approach to mastitis control needs to be continued.

Lipolytic enzymes in the dairy industry

These enzymes are important in the dairy industry because of their ability to cause rancid off-flavours and to affect the physical stability of some products. A group of scientists is studying the properties and effects of lipolytic enzymes in dairy products.

A survey was carried out to ascertain the types of lipase-producing psychrotrophic micro-organisms which contaminate raw milk. The most frequently encountered organisms in fresh milk were *Pseudomonas* (both fluorescent and non-fluorescent species), *Serratia* and *Acinetobacter.* After the milks were stored for 7 d at 7°C, the fluorescent pseudomonads were by far the most prevalent. Most of the bacteria which produced lipases also produced proteases when grown in milk.

Microbial lipases, particularly those from pseudomonads are often resistant to heating at high temperatures (for example, pasteurization). The effect of low-temperature heating (55°C for 1 h) on these enzymes was investigated. A few of the heat-stable lipases studied were almost destroyed by this treatment. However,

Sampling concentrate from the ultrafiltration pilot plant at the Otto Madsen Dairy Research Laboratory.

the extent of inactivation depended on the pH and nature of the medium in which the heating was performed, that is, water, milk, cream. It was concluded that the low temperature inactivation phenomenon was not sufficiently widespread or efficient to provide a means of eliminating bacterial lipases from dairy products.

An investigation was carried out to determine the factors affecting the extent of foaming in milk when injected with a jet of steam. The work was initiated after several complaints from cafe proprietors that some milks were unsuitable for use in making Capuccino-style coffee. Reports that the lack of foaming was associated with lipolysis were confirmed. Furthermore, for raw milk, small amounts of lipolysed milks were found to suppress foaming in good quality, unlipolysed milks. Heating, homogenizing or addition of milk solids-not-fat improved the foaming capacity. Variations in fat percentages in whole milk, the presence of free or churned-out fat, or added water (up to 15%) had little influence on the steam frothing values.

In relation to lipolysis, some areas of methodology were studied. A GLC method for determining free fatty acids in butter and cheese has been devised and used effectively in free fatty acid analysis of Feta cheese. An HPLC method which complements the above GLC method has also been perfected for the analysis of free fatty acids in butter as the p-bromophenacyl esters. Derivatization has been carried out successfully in the presence of relatively large amounts of triglycerides. The small amount of sample preparation required and the sensitivity of the method for the short-chain, flavoursome fatty acids makes it attractive for laboratories with the necessary apparatus.

In response to industry requests, work has been carried out on a method for assessing the lipolytic potential of butter. The method has been tested on butter spiked with a bacterial lipase and shown to detect in a few days degradation which was not obvious organoleptically until after several weeks' storage at refrigeration temperatures.

The esterases present in milk have been examined and compared with those present in blood serum, mammary tissue and blood leucocytes—three possible sources of the milk enzymes. The enzymes have been separated electrophoretically and differentially stained through the use of different substrates and inhibitors.

Proteolytic enzymes from milk leucocytes

The total potential activity of polymorphonuclear (PMN) leucocytes towards casein was determined and this activity compared with levels of natural milk protease (milk plasmin) in milk. The contribution of psychrotrophic proteases to milk protein breakdown was also examined.

Psychrotroph growth experiments (in both heat-treated and aseptically sampled skim milk) indicated that extracellular bacterial proteases were not produced until cell growth entered the stationary phase. In the mixed flora situation of normal milk bacterial protease was released at a much lower cell density than in the case of a pure culture. On the basis of these experiments, it appeared that very little bacterial protease was released into milk at psychrotroph numbers $<10^6$ cfu s/mL and that proteolytic activity in milk with low bacterial numbers could not be attributed to microbial protease.

The total potential activity of bovine blood somatic cell extracts, towards casein, was determined (at a level of 10^6 cells per mL). Preparations examined included both PMN granulocyte and monocyte extracts. The average activity of the PMN preparations was approximately five times greater than the average activity of the monocyte preparations. Natural milk protease activity, however, of individual quarter, composite and tanker milks was approximately 1.5, 2 and 8 times greater respectively than the potential activity of the PMN leucocytes. Milk protease activity was also three to four times higher when milks were treated with the plasminogen activator, urokinase.

Psychrotrophic spoilage in milk

Research into the development of a sensitive test for the rapid detection of both psychrotrophic bacteria and their extracellular proteolytic enzymes has resulted in several important findings over the last 12 months.

The characterization of purified protease enzymes secreted by these bacteria shows a high degree of heat stability. For example, isolate 82 protease required 190 min of heating at 74°C (pasteurization temperature) to inactivate the enzyme to 10% of the original activity.

A bacteriological survey to determine the number and types of species likely to cause proteolytic psychrotroph spoilage in south east Queensland raw tanker milks has resulted in the isolation of more than 1 200 freeze dried pure cultures. The identification of these isolates will assist in the development of optimal serological conditions for the detection of psychrotrophic spoilage in milk.

Shelf-life tests on both pasteurized and UHT-treated milks have shown that the addition of 300 ng per mL of purified bacterial protease produces unacceptable flavour scores when the products are stored at 7°C for 4 d.

An immunological approach to the problem of psychrotrophic spoilage detection has seen good progress towards the development of an enzyme-linked immuno-sorbent assay (ELISA) procedure. Both rabbit and equine antisera have been successfully raised against one of the isolated psychrotrophs. These antisera were found to be extremely stable and maintained a high concentration both in the crude state and following purification with subsequent storage at −20°C for periods of 3 months or more. Early work with this antiserum to detect the isolate in milk resulted in 10^6 bacteria per mL being readily detected within 8 hours.

Protease-induced antiserum from rabbits appears to lack sensitivity when incorporated into an ELISA system. However, this can be directly attributable to early experimental errors which have been verified by studies with radio isotopes. Attempts to rectify this problem are still in progress.

Milk fat globule membrane

The milk fat globule membrane and the effect of processing, animal and environmental factors on its composition and structure and stability are being studied.

A new method of isolation of MFGM material was developed specifically for commercial milk products and for milks having membranes of reduced stability (for example, mastitic milks and aged or stored milks). This method provided a gentle isolation procedure by eliminating the need to wash the cream to remove skim milk components and also reduced the likelihood of removing loosely-bound membrane material during isolation.

Skim milk components were removed by centrifuging the total extract (that is, buttermilk and butter serum), obtained by churning unwashed cream, through a concentrated sucrose solution. Membrane material collected at the interface and was easily removed. Analysis of membranes isolated by this method showed that membrane material originating from skim milk membranes was also present. However, this level of contamination was low and had little effect on the overall composition..

Membrane material isolated from commercial products showed marked differences in composition, particularly in polypeptide components. Cream and cream-line milk MFGM were similar to raw milk MGFM except B-lactoglobulin (B-LG) was bound to the membrane, probably as a result of heat treatment during processing.

Homogenized milk membranes contained bound skim milk components (that is, caseins and whey proteins) as well as natural MFGM components. Homogenization reduces the size of the fat globules in milk and increases the fat globule surface area. As there is insufficient natural MFGM material to cover this area, skim milk components adsorb onto the fat globule surface and form the new membrane in conjunction with natural MFGM components. UHT milk membrane material contained mainly caseins and whey proteins with only a small amount of natural MFGM components present.

These changes in membrane composition were also reflected in the phospholipid levels with only about 50% of the phospholipid in raw and cream-line milk present in homogenized milk and a very small percentage present in UHT milks.

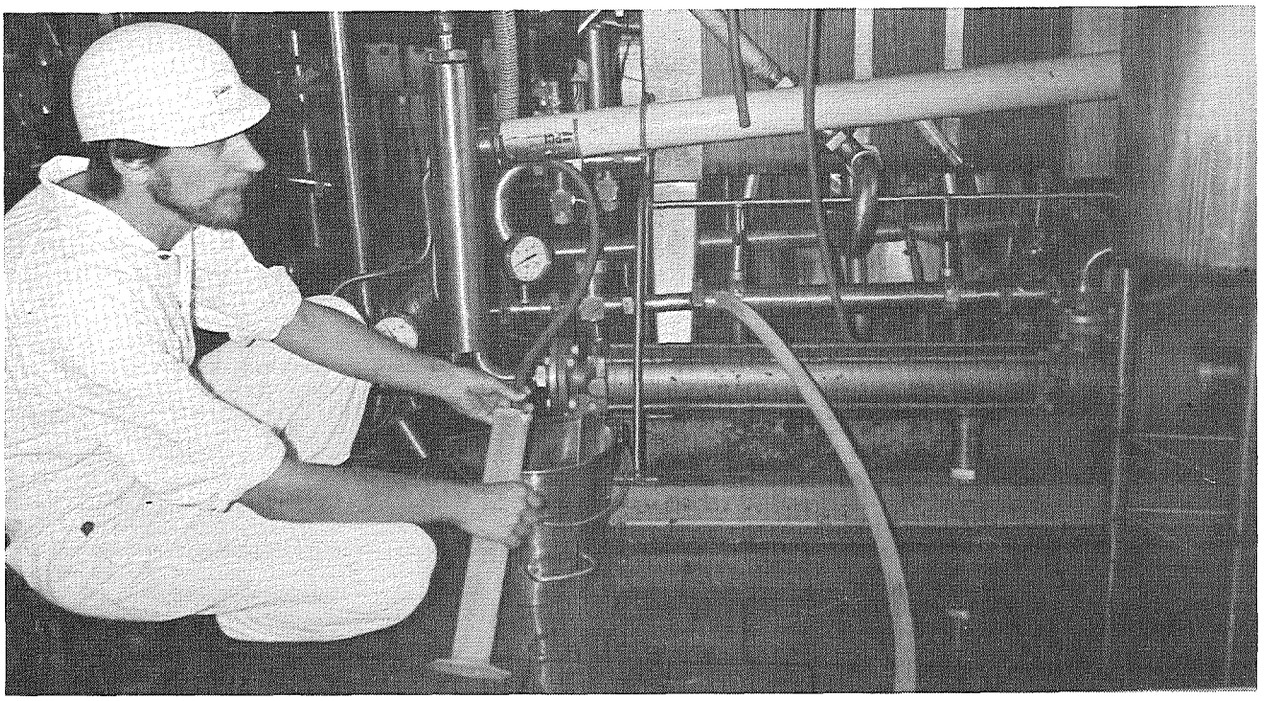
The arrangement of MFGM components within the membrane matrix was further examined using detergent release and surface labelling techniques. Treatment of MFGM material with detergents showed that there was a selective release of polypeptides and enzymes. It is likely that those components which are not easily released (that is, acid phosphatase, alkaline phosphatase, polypeptides of apparent molecular weights 40 000 and 44 000) are important in the stability of the MFGM structure in milk.

Cheese

Accelerated cheese ripening

Work designed to develop methods of accelerating the rate of flavour development in Cheddar cheese has continued. Under normal conditions, mature Cheddar cheese requires refrigerated storage for 9 months to develop full flavour. Because of the high cost of refrigerated storage, any reduction in storage time by accelerating flavour development would benefit both the industry and the consumer.

During the last 12 months, two accelerated ripening methods have been studied in detail. Firstly, from an earlier observation that storage at 20° for the first month of ripening led to accelerated flavour development, a trial was initiated to enable statistical evaluation of a number of time-temperature combinations. For this trial, 49 cheeses were manufactured using the following treatments: 1. control 8°C; 2. 20°C/4 weeks/13°C/4 weeks/8°C; 3. 20°C/4 weeks/13°C; 4. 20°C/4 weeks/8°C; 5. control 8°C; 6. 13°C/8 weeks/8°C; 7. 13°C/4 weeks/8°C; 8. 13°C.



Measuring the steam frothing ability of milk.

These cheeses were graded, taste-panelled and chemically analysed at 1, 2, 4, 6 and 8 months of age. Overall the quality of the cheeses was excellent and, at 6 months of age, the more severely treated cheeses (that is, cheeses 2, 3 and 8) achieved approximately 1 month advancement over the controls. That is, at 6 months of age, these cheeses had the flavour intensity of a normal 7-month-old cheese. Data at 8 months of age are not yet available but are expected to follow a similar trend.

The second acceleration technique involved the addition of thermophilic starter organisms to the cheese milk along with the normal starter. This trial was initiated following reports of increased flavour development in Cheddar cheeses with thermophiles added. Although these cheeses have only been analysed to 6 months of age, it is apparent that flavour development has been markedly increased especially in those with added *Lactobacillus helveticus* var. *jugurti* LBl. However, although most of the taste panellists show a strong preference for this cheese, its flavour is not typical of Cheddar cheese. The agents responsible for this atypical flavour are not known at this stage.

Cheese from ultrafiltration

The work on cheese from ultrafiltration (UF) retentate has concentrated on fresh cheese types containing large levels of fat such as Neufchatel (45% fat in the dry matter) and cream cheese (65% FDM).

Initial trials involved collecting retentate from Queensland Farmers' Co-operative Association (QFCA) and manufacturing a cheese product by a method published by Covacevich and Kosikowski (1977) in the *Journal of Food Science.*

A number of problems arose using this method. It became evident that a large starter inoculation would be required to get satisfactory fermentation due to the high buffering capacity of the retained minerals. Also, heating of the fermented retentate resulted in the formation of a chalky precipitate which could be broken only by homogenization. This precipitate gave the cheese an unsatisfactory texture. The product also had a mineral taste when compared with cheese made by a conventional process involving whey drainage.

Post-fermentation pasteurization and hot-packing were considered essential steps in the process to give the product an extended shelf-life.

Following these initial trials, a literature search was conducted and a small UF facility was established in the pilot plant at OMDRL. The UF unit is a Patterson Candy International, Bl module with T6/B non-cellulosic membranes. These membranes have a suggested 70 000 MW cut off point but have been found capable of retaining whey proteins possibly because of the development of a dynamic protein layer across the membrane surface.

Initial trials on the PCI module using standardized milk, had the following steps—

Pasteurization 63°C/30 min.
UF, concentration ratio approximately 1:5.
Heat treatment 75°C/1 min.
Homogenization 5 MPa.
Fermentation 5% starter/16h/24°C.
Heat treatment 75°C/15 s.
Homogenization 12.5 MPa.

Cheese produced by this process was also very grainy in texture and of undesirable flavour. Following this, trials were designed to alter the aqueous phase of the milk to affect retained minerals in the UF retentate. This was done by direct acidification of the milk using lactic acid before pasteurization. Lowering pH has the effect of causing minerals to go into solution and be lost during ultrafiltration. Heat treatments post-fermentation were also altered. The heating medium was not permitted to exceed 80°C to ensure heat treatment of the product was 75°C/15 s. The combined effect of these two alterations improved cheese texture considerably.

A trial was undertaken on small commercial equipment at QFCA. Problems were encountered in heating the retentate using a plate heat exchanger. The lowered pH of the retentate caused a considerable increase in viscosity when heated and 'clogging' in the plates. Trials were conducted on this cheese using varying amounts and types of stabilizer. A limit for the amount and type of stabilizer was established.

To further improve body and texture of the cheese, one trial has been undertaken using constant volume diafiltration during UF. This was done by adding water (40% original milk weight) when 60% of the original milk weight has been removed as permeate. The final cheese product had improved texture but was considerably softer in body. There was still a slight mineral taste.

Yoghurt from UF retentate

Trials were undertaken to incorporate ultrafiltration retentate in yoghurt formulation and to study its influence on the attributes of the final product. (Sugar was not used in any of the trials). Skim milk yoghurts made using UF retentate had a lower solids level than skim milk yoghurt fortified with skim milk powder (12% v 17%). This was due to the loss of solids (mainly lactose) during UF. Viscosities of the two types were comparable. UF yoghurt lacked a certain amount of sweetness because of the lower lactose level.

Processed cheese

During the year, 29 trials were conducted on processed cheese. Of these trials, 10 were processed block Cheddar cheese, 9 were cheese spread and 10 were processed Feta cheese.

Further measures were undertaken to reduce the amount of moisture added to the cheese during processing. These have included lagging the steam line to the 'Stephan' kettle and putting a new condensate trap on the steam line.

Trials undertaken with block Cheddar cheese have centered on trying to produce a firm bodied sliceable product. Products with improved sliceability have been manufactured by altering the blend of cheese from a large percentage of very young cheese to a greater percentage of mild to medium cheese. The cheese has been less brittle or crumbly than previously but has had a softer body. Also, it has been found that slow cooling of the molten processed cheese helps produce a firmer bodied product.

The trials on the spread products have involved manipulation of the raw materials in the blend and variations in the processing times for working the molten cheese. It has been reported by Thomas (1977) in *The Processed Cheese Industry* that the incorporation of skim milk powder into the processed cheese

blend gave improved spreadability. This was found to occur but at a level of 10% powder in the blend, a characteristic flavour was imparted to the final product. Butterfat has also to be incorporated to maintain the correct level of FDM in the spread. Increased working time was also found to improve the spreadability and give a less stiff product.

Two trials were conducted incorporating ultrafiltration retentate of approximately 38% total solids directly into the cheese blend to produce a cheese spread. The retentate was added at the rate of 40% of the cheese added. A larger addition of the retentate would have caused the final product to exceed the legal limit for moisture in a cheese spread. The product flavour was acceptable but the body of the cheese was firmer than a spread made solely from Cheddar cheese. Also, the increased level of lactose addition may cause problems with the shelf-life of the spread.

Ten trials were conducted on the processing of Feta cheese made from ultrafiltration retentate. Two cheese types were available as raw material. One was 11 months of age with hard lumps throughout. The other cheese was 5 months of age, overmoist and of smooth texture. It was found that direct heating of the cheese in the Stephan kettle caused the cheese to be overmoist so indirect heating had to be employed.

JOHA Salt Sq at 2.5% was used as the emulsifying salt and JOHA Salt T at 0.5% was used as an alkaline corrective salt. A hydrocolloid stabilizer 'Palsgaard 5808' was used when the product appeared to lack viscosity but this was found to be unnecessary when the legal limit for moisture in processed cheese spread was attained. During processing, some small hard lumps could not be broken down and it was necessary to homogenize the molten cheese mixture at 2 000 Kpa. This was successful in producing a smooth cheese product but at the high level of solids it proved difficult to homogenize.

Swiss type cheese

About 60 vats of Swiss type cheese were manufactured, analysed and organoleptically assessed. Work has centred around use of alternate lactic starters for the Hansens lactic ferment normally employed, and effects of salt on propionibacterium growth.

The use of *S. faecium, L. helveticus* and propionibacterium from imported Jarlsberg in conjunction with Hansens lactic ferment CHO1 did not appear to improve cheese flavour gradings or eye formation. Counts of *L. helveticus* in pilot plant cheese were higher than those in imported cheese, and an undesirable sulphide flavour was obtained.

Hansens lactic ferment also performed better than single strains as far as cheese flavour is concerned, but eye formation was often slightly better with single strain AM2. It seems Hansens is still the best culture available for this project.

Measurements of salt, fat, moisture, pH, lactic streptococci counts, propionibacteria counts, PTA and TCA soluble nitrogen, proline, propionic acid, acetic acid and lactic acid were made on samples taken from cheeses at various stages after brining. Results demonstrated that salt penetration occurs gradually throughout maturing and that propionibacteria growth occurs most rapidly in the central area of cheeses probably due to lower salt and diffused oxygen levels.

Use of a gas producing lactic starter leads to small gas pockets during pressing, which lead to defective eye formation during the 20°C incubation. Further work has continued to isolate suitable starters from imported cheese samples.

Cooloola cheese

Cooloola cheese developed at the Otto Madsen Dairy Research Laboratory, was promoted and preliminary market research carried out.

Cheedam cheese

This type of cheese, which is made by the 'new way process' developed by CSIRO, Highett, was manufactured in the Pilot Plant at OMDRL. Variables examined have included vertical and horizontal vats, rate of acid development, cooking temperatures, salting and pressing. Yields, quality and costs have been assessed to evaluate the importance of each variable.

Methodology

Fluorogenic media

Use of fluorogenic media for rapid differential bacterial counts in dairy products was studied.

From this work, a fluorogenic medium and optimal UV viewing system have been developed and evaluated with a selection of gram positive and gram negative known cultures. On this medium, the gram positive bacteria could be identified by the lower fluorescence and smaller size of the colonies; the gram negative bacteria produced colonies which were high in fluorescence and larger in size. By using these two parameters, practically all bacteria could be categorized correctly.

Since most thermoduric bacteria are gram positive and most post-pasteurization contaminants are gram negative, the technique seems promising as an aid to investigations into causes of high count milk by giving three counts for the cost of one. Currently, the medium is being evaluated on liquid milk samples with isolation and identification of the microbial types giving either of the reactions.

Mastitis control

Dried inoculated mastitis pH test strips were tested for the recovery of viable pathogens. Results indicated that coagulase positive staphylococci were readily recovered, so proper care in handling and disposing of the used strips is necessary.

Psychrotroph methods for IDF standard

Four methods were compared on behalf of the International Dairy Federation. Incubation at 15°C for 24 h plus 7°C for 72 h gave the highest correlation with the IDF traditional procedure of 6.5°C for 10 d. Satisfactory correlation also occurred if incubation at 17°C for 16 h plus 7°C for 72 h was employed. Lowest correlation existed when 21°C for 25 h was used.

Phosphatase testing

Evaluations of the Aschaffenburg and Mullen phosphatase test revealed that APTW7 discs were suitable for products such as cream-line milk, homogenized milk and fortified reduced fat milk, but were less accurate for skim milk, reconstituted skim milk, 35% and 42% cream and flavoured milk products. An extraction/spectrophotometric preliminary step has been developed to overcome the above problems. This method can be used successfully to test uncoloured as well as coloured dairy products.

Egg yoghurt

This project is a collaborative one with Sunny Queen Eggs. Formulation and developmental work has now been completed to the stage where successful pilot plant scale manufacture has been attained. The developed product is considered to be a viable commercial proposition.

Staff

Mr A. Lyall, Chemist, died of a coronary occlusion on 14 March 1982. Mr V. C. Tucker, Supervising Technologist, successfully completed a Graduate Diploma in Business Administration while on a year's study leave at the QIT. Dr B. J. Kitchen, Supervising Chemist, was the guest of Alfa Laval in Sweden for 1 month in November 1981.

Fisheries Research Branch

FISHERIES Research Branch has the responsibility to provide recommendations and guidelines for effective management of commercial and recreational fisheries both in State waters and those adjacent to the Great Barrier Reef; to foster the rational development of Queensland's fishery resources; and to promote the State's fishing industry.

To fulfil this role, the Branch is involved in a variety of activities including—

- The assessment of the biological status of aquatic resources and the effects of amateur and professional fishing and other activities on these resources.
- The consideration of socio-economic factors which may affect the fishing industry.
- The identification and evaluation of the potential of unexploited fisheries resources and the development of appropriate fishing, product handling and processing techniques.
- The improvement of freshwater recreational fisheries through impoundment stocking programmes.
- The development of improved handling, processing and storage techniques to upgrade the standard of Queensland fisheries products.

Fisheries facilities

The Northern Fisheries Research Centre at Cairns took delivery of its first large research vessel in February 1982. The vessel, 'Gwendoline May', is a 19 m steel trawler with a 525 hp

GM engine, accommodation for six scientists plus crew, a large laboratory area and two walk-in specimen freezers. She is equipped with two Jaden hydraulic winches carrying 1 000 fathoms of warp.

The addition of a single deep water winch next year will enable the vessel to carry out exploratory work on the continental slope as part of the new Demersal Fisheries Resource Survey funded by the Fishing Industry Research Trust Account.

The Walkamin Research Station on the Atherton Tableland is a centre for freshwater fish breeding programmes. General improvements to the facilities have resulted in an impressive yield of fingerling fish during 1981–82.

The Fisheries Station at Burnett Heads near Bundaberg is equipped with an experimental larval rearing laboratory and algal culture facilities, and has been the centre of research into the scallop fishery. The scallop project is in its final stages, and the Station has acquired a 5 m aluminium boat for an investigation of the local beam trawl fishery for prawns in the Burnett River.

The southernmost station operated by the Research Branch is situated at Deception Bay. During the year, the 13.5 m research trawler 'Bar-ea-Mul' was transferred to the Southern Fisheries Research Centre from Bundaberg on completion of field operations related to the Scallop Project. The vessel is being used for research on squid, spanner crabs and prawns in and around Moreton Bay.

Construction of an urgently needed storage shed for equipment and boats began late in the year, and a blast freezer, to be used for experimental work on seafood handling and processing, has been installed and commissioned.

Fisheries statistics

Production statistics for commercial fish in Queensland are compiled by the Fisheries Research Branch. In 1980–81, the total Queensland fisheries production was worth $86.3m an increase of $23.5m on the previous year's figure. Of this increase, $20m was accounted for by a rise in the crustacean catch.

The annual survey of licensed Master Fishermen was continued to monitor changes in the industry. Trends identified from this survey included an increase over the previous year in the number of trawl fishermen (up 8% to 1 459) and scallop fisherman (up 120% to 66), and significant decreases in the number of mud crab fishermen (down 25% to 80) and reef fishermen (down 28% to 112). The geographic distribution of fishing operations, the interdependence of certain types of fishing and the mobility of fishermen have changed little since the previous survey.

Economic research

A study of economic conditions within the sand crab and mud crab fisheries of south east Queensland was undertaken during the latter half of 1981. While sand crab landings have increased over the past few years, the mud crab fishery has experienced a decline in landings and a decrease in the number of fishermen engaged primarily in crabbing operations.

The study found that sand crabbing was generally more profitable than mud crabbing, but when an 'imputed' wage was allowed for the skippers' labour, both were uneconomic. Fishermen were unable to earn a return on capital funds employed.

Fisheries management conference

In association with the Division of Dairying and Fisheries, Griffith University hosted a conference on the theme of 'Managing Queensland's Fisheries'. The conference, held in August 1981, brought together a wide spectrum of representatives from all sectors of the fishing industry to discuss issues ranging from biological and economic factors involved in fisheries management to product processing and marketing. An illuminating keynote address was given by University of Washington Economics lecturer, Professor Jim Crutchfield.

Advisory services

At the request of the Queensland Fishing Industry Training Committee, seafood handling workshops were conducted in Mackay, Townsville and Cairns during July 1981, and at Stradbroke Island and Bundaberg during October.

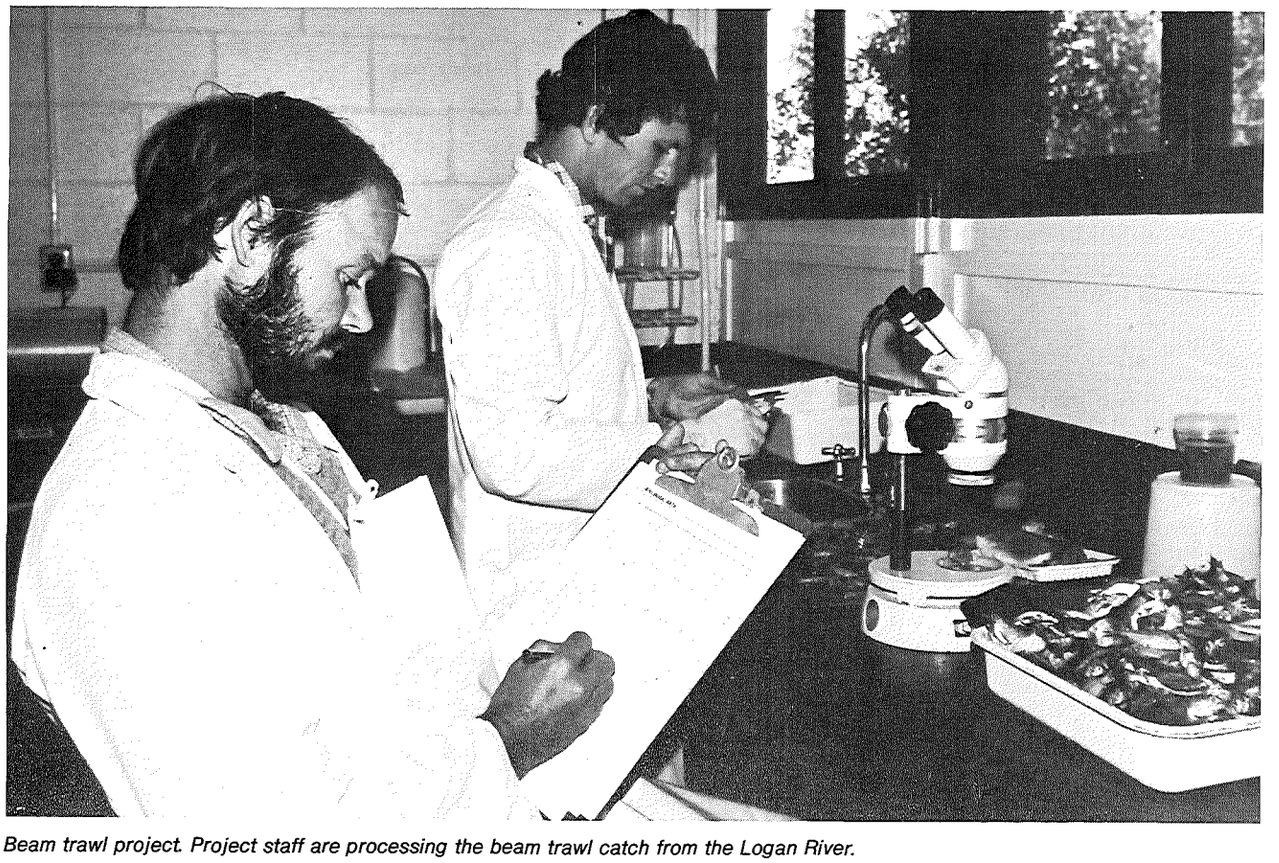
These workshops dealt with current quality problems in the industry and were chiefly oriented towards fishermen, but they also attracted participants from the processing, administration and marketing sectors of the industry.

A complete advisory service on all aspects of seafood handling, processing and storage is maintained for the benefit of fishermen, processors, retailers and the public. This service is based on the results of 12 years' research by Branch officers into basic quality control and practical problems experienced by industry.

Beam trawl fishery

The beam trawl fishery for prawns in the lower reaches of south Queensland rivers has been in existence for many years. This industry is largely responsible for the supply of small prawns to the lucrative recreational angling bait market, but larger prawns suitable for human consumption are also caught. The major areas of beam trawling activity are centred around the rivers which flow into Moreton Bay, those in the vicinity of Bundaberg, parts of Pumicestone Passage, and the Noosa Lakes.

Unlike the offshore otter trawl fishery for prawns, beam trawling is a particularly visible operation, often carried out in areas of high recreational fishing intensity. This factor is one of the causes of controversy which has surrounded the beam trawl fishery for some time: anglers tend to be very concerned that the trash fish by-catch includes the juvenile stages of species of great importance to the recreational (and commercial) fin fishery.



Beam trawl project. Project staff are processing the beam trawl catch from the Logan River.

However, this is not the only problem facing the industry. Otter trawlermen feel that beam trawling activity in the rivers is depleting the stock of prawns which would otherwise have been available to them, at a larger size, later in the season. Conflicts also arise because of the multiple-use nature of the environment: foreshore reclamation, dredging to enlarge shipping channels, and pressure from recreational boating and water-skiing lobbies have all contributed to the destruction or restriction of traditional beam trawling grounds.

Increases in fishing pressure within the industry are causing concern about the state of the prawn stocks and the physical effects on the bottom fauna in general, and have sometimes created marketing problems when large catches of very small juvenile prawns are landed.

Research staff at the Southern Fisheries Research Centre (Deception Bay) and the Burnett Heads Fisheries Laboratory (Bundaberg) have set up programmes to investigate the extent of some of these difficulties, and provide a more quantitative data base than has hitherto been available to assist those responsible for managing the fishery. Sampling sites have been selected in the Burnett River and the Logan-Albert system, and are regularly fished using gear similar in design to that currently in use in the industry.

Outboard powered aluminium runabouts fitted with small electric trawl winches are used to tow the trawl gear because they can be transported quickly to the study areas by trailer. They also provide comparable catch data, which would not be possible if the information were obtained only from commercial operators.

Banana prawns (*Penaeus merguiensis*) are the target species for the Burnett River beam trawl fishery, and they are also taken by otter trawl in coastal waters. There is thus some basis for the belief that both fisheries are exploiting the same stock. CSIRO research has shown that banana prawns use shallow estuarine waters (such as the tidal reaches of rivers) as nursery areas, and move offshore as they grow. Spawning is assumed to occur offshore, and larvae are carried back into the estuaries by prevailing currents to complete the cycle.

Prawns caught within an estuary are obviously not available to the offshore fishery. However, the overall loss of potential catch to such a fishery depends largely on the level of natural mortality to which the prawns are subject in the estuarine system, and the time lag between the inshore and offshore phases of their exploitation.

Attempts are being made to obtain some idea of the level of natural mortality in the early stages of the prawns' life cycle, but population dynamics parameters for banana prawn stocks are particularly difficult to estimate with any degree of accuracy.

Project staff have established that, in the autumn and winter months, *P. merguiensis* is also the main component of the Logan-Albert beam trawl prawn catch. Unlike the situation farther north, this is unlikely to pose real problems of competition with the Moreton Bay otter trawl fishery in which greasyback (*Metapenaeus bennetae*), king (*P. plebejus*) and tiger prawns (*P. esculentus*) are the target species.

However, the Logan-Albert system may not necessarily be typical, and additional studies are to be undertaken in at least one of the other Moreton Bay rivers. Moreover, anecdotal reports suggest that the banana prawns are seasonal and are replaced by greasybacks in the summer months. Sampling will obviously have to be continued over a complete seasonal cycle to verify this hypothesis.

The fish by-catch to date comprises predominantly non-commercial species belonging to the genera *Gerres, Tachysurus, Ambassis, Lovamia, Pelates, Spheroides* and *Harengula.* While a number of commercial species (including bream, tarwhine, whiting and garfish) does appear in the catch, they occur irregularly, and not in the same quantity as the non-commercial fish.

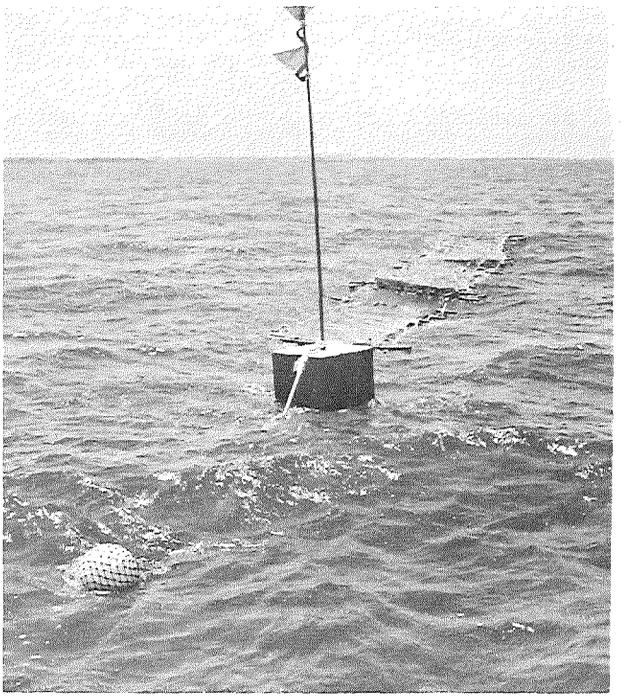
The project data will eventually lead to a far better understanding of spatial and temporal distributional patterns of those species of fish and prawns which utilize estuarine systems at some stage in their life cycle, and provide a solid information base upon which to assess the validity of claims and allegations concerning the beam trawl fishery in southern Queensland.

Fish aggregating device

Early in 1982, staff at the Burnett Heads Fisheries Laboratory co-operated with local angling clubs to assess the effectiveness of a fish aggregating device (FAD) in the Bundaberg area.

A set of bamboo rafts was constructed, tethered together and anchored 2.8 km offshore from Elliott Heads in January. Within 2 weeks, the FAD had attracted a large school of baitfish (amberjack, trevally and herring), and an assemblage of demersal species including whiting and goatfish was observed within a 30 m radius of the anchoring system. Several species of mackerel (migratory pelagic fish) have also been reported in the vicinity from time to time.

Use of the FAD by local anglers has been less than expected, but the device shows definite promise as a means of enhancing the recreational fishery, and possibly also as the basis of a small commercial purse seine operation.



A fish aggregating device moored off Elliott Heads, Hervey Bay.

Ciguatera research

Ciguatera is a form of food poisoning caused by the ingestion of certain fish from coral reefs colonized by a relatively rare, minute toxic alga. Ciguatera poisoning has occurred in north Queensland for many years, but the incidence of reports has always been low. However, a large number of cases (about 50 per year) has been reported from southern Queensland in recent times. The resulting publicity has had a very detrimental effect on the activities of fishermen in the area.

A survey of angling clubs, commercial fishermen and the public in general was initiated in 1980 to identify areas of reef known to produce ciguatoxic fish, and to provide a better estimate of the extent of ciguatera poisoning. The survey failed to shed a great deal more light on the incidence of intoxication, but it did result in the identification of several areas where affected fish are caught.

A research project was subsequently organized to survey levels of the toxic alga on coral reefs in the vicinity of Cairns, and in coral areas near Hervey Bay and Bundaberg. This study may ultimately enable the operation of a routine service to provide advance warning of any increase in the risk of ciguatoxicity from fish caught in specific areas.

Squid

The fishery potential of Queensland's squid resource is being investigated by a trawl programme in Moreton Bay and by analysis of material obtained from prawn trawlers along the Queensland coast.

The species of greatest interest to the Moreton Bay trawl fleet is the common squid *Loligo chinensis,* which is also known to occur in the Gulf of Carpentaria and Torres Strait. Preliminary research indicates that there may be a large, virtually unexploited stock of *L. chinensis* in Queensland's northern waters.

The main research effort is therefore directed towards this species to gain a better understanding of its life cycle, population structure and reproductive biology. All of these are important considerations when assessing the potential of the resource. However, the study is not restricted to *L. chinensis;* data are being collected on other squids from Queensland waters, including the deep water squid *Nototodarus gouldi* (the target species for the southern Australian jig fishery), and the calamary *Sepioteuthis lessoniana.*

Close liaison with staff at the National Museum of Victoria has overcome many taxonomic problems, clarified uncertainties about the distribution of some species, and led to the discovery of several previously undescribed species of octopus and squid.

Participation by one of the project staff in the Commonwealth shipboard observer programme has enabled useful information to be gained from Taiwanese pair-trawlers working in the North-West Shelf area of Western Australia.

Although these vessels trawl primarily for scale fish, squid and cuttlefish make up a valuable part of the by-catch, and their fishing masters have considerable knowledge and experience with squid fishing techniques and trawl grounds around northern Australia.

The project study area will be extended to include Torres Strait and Gulf waters when the Cairns based research trawler becomes fully operational later this year.

Scallops

The fishery. A 5-year project investigating the fishery for saucer scallops (*Amusium japonicum balloti*) in the Bundaberg-Yeppoon area is virtually complete, and project staff at the Burnett Heads Fisheries Laboratory have spent much of the past year analysing the accumulated data and writing up the results for publication. Short-term studies on trawl net efficiency and the applicability of a shipboard scallop grading device were carried out during the year.

Scallops are recruited into the trawl fishery at less than 1 year of age, and recruitment is variable both in location and strength from year to year. Fluctuations in total landings may, however, not be entirely due to variability in recruitment. Analysis of log-book data provided by commercial fishermen between 1976 and 1981 shows that the level of fishing effort directed towards the scallop stock has been increasing steadily.

However, short-term fluctuations in fishing effort are highly significant, as a consequence of fishermen either spending a greater proportion of their time trawling for prawns, or moving their trawling operations outside the area covered by the project.

Scallop trawling grounds have increased considerably in area since 1976. Since most of the commercially viable scallop beds occur in depths ranging from 25 to 60 m, it seems likely that most of the potential trawling areas between 22°30'S and 26°S have been explored within the last 2 or 3 years.

Larval studies. Larvae of the saucer scallop have been successfully raised to the settlement stage under controlled aquarium conditions at the Burnett Heads laboratory. Development is rapid: the larvae pass through six growth stages in a period of 12 to 14 days, increasing in size from 60 µ to about 190 µ, at which time they settle out of the plankton.

Spawning occurs in spring and possibly autumn, and only when the ambient water temperature is within the range of 19 to 23°C. Sea surface circulation in the Bundaberg-Yeppoon area has a pronounced effect on larval distribution because of local wind and current-induced eddy systems. Heavy rainfall in August during the major spring spawning period is thought to cause high larval mortality, thereby reducing scallop catches in the following year.

It may be possible in the future, using the techniques and methodology developed during the course of this project, to raise enough larvae to allow certain parts of the commercial trawl ground to be seeded with 'settlement stage' scallops.

This may be of particular value in local stock supplementation during lean periods when natural larval mortality is high. It could have the additional benefit of reducing the amount of time a vessel has to search for productive scallop beds.

Freshwater fish

North Queensland. The Freshwater Fisheries Research Station at Walkamin on the Atherton Tableland is currently producing native freshwater fish to establish a recreational fishery in Queensland's public water storages.

The Station's facilities have been developed to the point where mass production of fingerlings is possible. The 1981–82 production of fingerlings was a massive 1 100% higher than that in the previous year.

Preliminary production figures for the three major species are as follows—

Sooty grunter (*Hephaestus fuliginosus*)	45 000
Sleepy cod (*Oxyeleotris lineolatus*)	10 000
Silver perch (*Bidyanus bidyanus*)	105 000

Pond breeding of northern saratoga (*Scleropages jardini*) and jewfish (*Tandanus tandanus*) continued on a smaller scale. Of considerable interest is the fact that both silver perch and sleepy cod bred naturally for the first time in the Walkamin ponds this year, so these two species, in addition to saratoga and jewfish, are showing considerable potential as fish capable of being stocked in farm dams and other small impoundments.

Most of this year's production has been released in the Tinaroo Dam (Atherton), Awoonga Dam (Gladstone), and Monduran Dam (Gin Gin), bringing to 15 the number of rivers and storages stocked with fish bred at Walkamin.

As the annual fingerling production over the next few years is expected to be 250 000, a 7 kL milk tanker was purchased for the Station and converted to a fish transporter. The vehicle is already in use, and is capable of transporting up to 35 000 fish per load to any major dam in Queensland.

Funds have been allocated to assess the suitability of introducing Nile perch (*Lates niloticus*) into Queensland. An on-site residence for the biologist in charge of the project has been completed, and some ancillary equipment has been purchased. It is expected that special ponds in a quarantine area will be constructed during the dry season this year.

A future development of particular interest to farmers is the probability that, by the end of the 1982–83 breeding season, the Walkamin Station will be in a position to sell quantities of small fish for stocking farm dams.

At the end of the financial year, an officer from the Station visited Thailand to investigate the techniques currently being used in that country to breed barramundi (*Lates calcarifer*) in captivity. An attempt will be made to adapt these methods for use in north Queensland, with the eventual aim of producing barramundi fingerlings to stock waterways depleted by intensive fishing pressure.

South east Queensland. During 1981–82, research has continued into the biology of the central Queensland 'barramundi' or saratoga, *Scleropages leichhardti*. This investigation has resulted in an increased knowledge of the growth rate, diet, sexual dimorphism, age at sexual maturity, fecundity and general behaviour of this fish within freshwater impoundments.

This information will greatly assist an enhanced breeding programme for *Scleropages* spp. at the Walkamin fish hatchery on the Atherton Tableland, where *S. jardini* has already been reared successfully on a small scale.

In addition, a broodstock of the central Queensland saratoga has been captured and introduced into two small dams in south eastern Queensland. It is intended that the progeny of this stock will be transferred to one or more major impoundments over the next 3 years.

It is hoped that the seeding of such waterways with juvenile saratoga will provide a source of good sportfish and generally enhance the recreational value of freshwater impoundments in south east Queensland.

Demersal reef fish

Tropical multi-species fisheries associated with coral reef environments are poorly understood and consequently very difficult to manage. The demersal reef fish project is aimed at providing the scientific basis for sound management practices by elucidating the life histories, growth, and reproductive strategies of the major components of the commercial and amateur catch.

Before the project's inception, the life histories of only two commercially important demersal reef fish species (coral trout and tricky snapper) had been studied in any detail in Queensland. The project is expanding the data base to include five species of *Lutjanus* (mangrove jack, stripey, large and small mouth nannygais, and red emperor), the spangled emperor (*Lethrinus nebulosus*), blue-spotted rock cod (*Cephalopholis cyanostigma*), five species of coral trout (*Plectropomus* spp.), painted sweetlip (*Spilotichthys pictus*) and a number of others.

Previous work has shown that juveniles of at least two important species (red emperor and large mouth nannygai) are captured regularly in prawn trawls.

After trials with several different capture methods including traps and reef nets, it became apparent that conventional handlining and spear fishing were the most effective and reliable sampling techniques, especially for larger animals.

Regular sampling commenced in August 1981, using the 8.5 m outboard powered vessel 'Netuma'. Since then, 17 overnight line fishing trips and 16 daylight spear fishing trips have resulted in the capture of more than 3 000 fish for biological analysis. Supplementary material is also obtained, when necessary, from commercial fishermen.

In the laboratory, excised gonads are preserved for histological sectioning and assessment of reproductive development stage. Product recovery parameters are recorded, and otoliths, vertebrae and scales retained for age and growth determination. In addition to these routine procedures, biological material is also made available to other research organizations for a variety of purposes.

The State Health Department, which is developing techniques to identify fish fillets to species level by protein electrophoresis, has processed a number of whole coral trout samples supplied by the Demersal Reef Fish Project. The various coral trout species apparently exhibit significantly different protein mobility patterns, and can thus be separated quite easily by electrophoretic methods.

All samples of red bass (*Lutjanus bohar*) and other reef fish suspected of carrying ciguatoxin are being sent to the Physiology and Pharmacology Department at the University of Queensland for ciguatoxin bioassay. This work is part of a joint project between the University and research staff at the Fisheries Research Branch, Deception Bay laboratory. In addition, fresh samples of red emperor (*Lutjanus sebae*) gills have been supplied to the University of New England (Armidale) following a request from a research worker investigating the parasites of tropical reef fish.

Demersal reef fish project. The 8.5 m Power Cat used by the Cairns-based demersal reef fish project.

Recreational fisheries

Although the Department's main fisheries research effort is directed at commercial fisheries, recent surveys have shown that the total catch by anglers exceeds the commercial catch in some fish such as bream and tailor. This indicates the importance of taking both amateurs and professionals into account in fisheries management schemes.

An investigation of the angling fisheries for bream, the species most sought by recreational fishermen in south Queensland, has yielded some interesting results. The average catch per trip recorded by anglers at Jumpinpin and Caloundra increased in the period from 1945 to 1975, after which a slight decrease in catch rates occurred.

The average catch for the 1980 season was about 15 bream per angler per trip. The average size of bream taken by anglers in Moreton Bay has not changed over the past 35 years, and detailed analyses of angling records have provided no evidence of a decline in the bream population in south Queensland.

A study of larval bream confirms that the main spawning areas in south Queensland are the surf bars at Southport, Jumpinpin and Caloundra. Eggs released by spawning bream at the bars are carried by the ebb tide into the ocean, and the young planktonic fish re-enter Moreton Bay when they are 1 cm long and 20 to 30 days old.

A total of 34 fish tagging kits has been issued to sport fishing clubs throughout Queensland. Approximately 3 000 fish have been tagged and released by club fishermen and good tag returns have been obtained for barramundi, bream and jungle perch.

Inshore net fishery

The capture of nearshore fishes with mesh nets or haul nets is the second most important fishery in Queensland, and involves nearly a quarter of the State's Master Fishermen.

In early 1981, a scheme was introduced for the management of the inshore net fishery. Important initiatives included the establishment of separate limited entry fisheries for the Gulf of Carpentaria and the Queensland east coast with different eligibility criteria, and controls on fishing effort through seasonal and area closures as well as gear restrictions. There remains a commitment to monitor the effectiveness of the management package and to determine whether modifications are necessary.

To implement this assessment, two separately staffed and funded concurrent research programmes were initiated at the beginning of the 1981–82 financial year. The objective of the first is to ascertain the efficacy of the management regime for the commercial fishery targeted on barramundi (*Lates calcarifer*) and threadfin salmon (*Polydactylus sheridani*) in the Gulf of Carpentaria and the east coast north of Princess Charlotte Bay.

Commercial catch and effort are being monitored through a compulsory monthly production return system operating in the Gulf. A voluntary arrangement exists for north east coast fishermen. The research team is also investigating seasonal abundance and distribution of target species, the potential of enhanced recruitment to the fishery under the aegis of a closed fishing season, and the merits of closed fishing areas. Investigations are conducted at study sites where the level of commercial fishing pressure is known.

Analyses of the production returns for the 1981 Gulf open fishing season reveal that considerable latent fishing effort exists in the form of 'unused' fishing time and the length of net set. The highest levels of catch per unit effort (CPUE) for principal target species were recorded in the south western Gulf near the border between Queensland and the Northern Territory. This may reflect traditionally low levels of fishing pressure in the area. Low CPUEs were found in the short shallow sandy rivers north of Weipa.

In general, boat-based fishermen reported higher a CPUE than did land-based operators, possibly because boat fishermen enjoy a more flexible and wider ranging operational capability. Catch composition data gathered at study sites during the 1981–82 winter dry season, summer breeding season, monsoon and post-monsoon periods have provided the information base necessary for future comparative analyses.

The closed fishing season was well observed and successful at least in the short term, with generally increased catches at the commencement of the 1982 open season, and increased experimental CPUE values for commercially important species.

The second research programme aims primarily at assessing the impact of the management regime for the mixed species gill net fishery on the east coast. The area presently under investigation is between Mackay and Cairns. A research team has established study sites at Mackay, the Burdekin, Tully and Cairns, where fish populations have been monitored routinely since July 1981.

This sampling programme will yield information on the seasonal abundance and distribution of target fish species, the effectiveness of area and seasonal closures, selectivity of nets, and the influence of netting materials and their breaking strain on the catch. Data have already been collected from about 2 000 fish of 40 different commercial species.

A second aspect of the east coast programme involves the monitoring of the commercial gill net fishery through a voluntary catch production return scheme. This is yielding valuable information on the abundance and seasonality of the target species in each area, and on the effect of different mesh sizes.

Preliminary analyses show that barramundi, which is a major component of the catch in Gulf and northern waters, is less important in the more southern parts of the study area. There are presently about 20 commercial fishermen participating in the scheme, but it is hoped that this number will be increased by the inclusion of fishermen from Gladstone, Yeppoon and Bundaberg.

Research activity in both programmes will continue until 1984, at which time current management strategies will be reviewed.

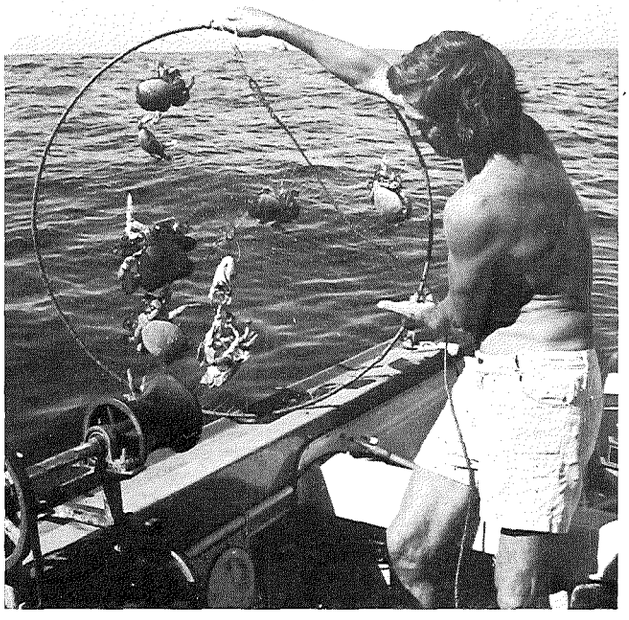
Spanner crabs

The fishery for spanner crabs (*Ranina ranina*) in southern Queensland is of recent origin, not because the resource has suddenly increased in size, but rather as a result of the development of appropriate capture methods.

It is an attractive fishery because it requires a relatively low level of capital investment in vessels and gear. Concern has been expressed that, unless management controls are introduced, the resource may be in danger of over-exploitation.

In 1981, Research Branch staff obtained funding from the Fishing Industry Research Trust Account for a project to investigate the major features in the life history, ecology and dynamics of the spanner crab stock and to carry out an appraisal of the fishery. Regular sampling is conducted at sites to the east and north west of Moreton Island to obtain data on the depth distribution, size structure and seasonality of the crab population.

Bottom sediments are also collected for particle size analysis, as the crabs' offshore distribution may be influenced by the nature of the sediment. Definition of the limits of the resource in Queensland would be facilitated if this relationship could be verified experimentally.



Spanner crab project. A typical catch of spanner crabs east of Moreton Island.

Spawning takes place in November–December, and fecundity estimates have revealed that the number of eggs in the egg mass or 'sponge' of an average sized female is about 120 000. All crabs caught during the project cruises are measured and sexed.

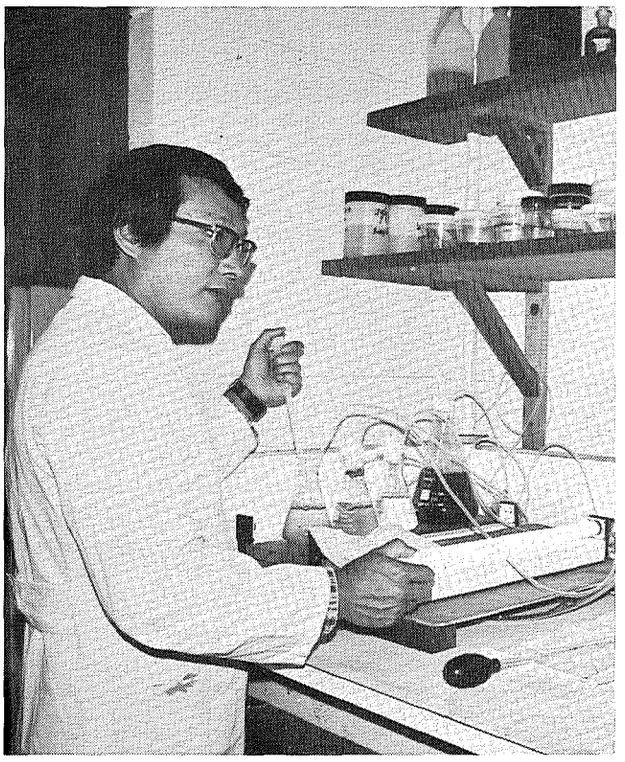
An important feature of the population from the management viewpoint is the marked dimorphism between sexes; female crabs being, on average, much smaller than males. A 10 cm minimum length regulation due to be introduced in the near future should afford protection to the great majority of females, and reduce the proportion of small males being sent to the market.

The bulk of the State's spanner crab catch is landed at Mooloolaba and Scarborough. The lack of a continuous fishery data base in Queensland makes it almost impossible to analyse trends in the crab fishery, or indeed in any fishery.

However, a rough estimate of catch per unit effort (CPUE) has been derived by painstakingly extracting information from the daily records of the Fish Board's Mooloolaba and Scarborough depots. Analyses of catch figures alone give the impression of a marked seasonal cycle in the availability of crabs, but when fishing effort is taken into account, the catch rate (CPUE) is relatively stable throughout the year.

QFB records do not provide an explicit measure of fishing effort, and the landing data often require subjective interpretation. They are therefore less than ideal sources of information from which to draw conclusions about changes in the fishery.

A more reliable source, in the form of a voluntary logbook programme, is being developed and evaluated. Besides providing reasonably accurate catch and effort data, the logbooks should also yield important information on population density in specific areas and depth ranges outside the project's experimental study areas.



Spanner crab project. A Technical Assistant prepares algal and rotifer cultures for feeding spanner crab larvae.

Post-harvest research: mud crabs

Evaluation of factors critical to the survival of mud crabs out of water was finalized this year. This work should minimize losses for fishermen consigning crabs over long distances, and stimulate the utilization of crab resources in more remote areas of the State.

Crab mortalities in commercial consignments in the past have affected the viability of commercial mud crab fishing operations. Factors studied include the effects of temperature on weight loss in low humidity conditions and on the products of nitrogen metabolism, as well as the accumulation of products which cause a fall in blood pH.

Mud crabs were found to be able to compensate well to all the metabolic changes; the most important factor which influenced survival was humidity.

Some additional research was also performed this year on the freezing of partly cooked mud crabs. This process was developed to allow those in the catering trade to store frozen crabs during periods of low supply. Until now, it has not been possible to freeze uncooked mud crabs because of an accompanying loss of texture caused by the action of powerful digestive enzymes leaking from the gut. This problem has been effectively minimized by the incorporation of a rapid chilling step in the process.

Shark taxonomy

The taxonomy of the family of sharks known as 'whalers' is in disarray, the number of nominal species of *Carcharhinus,* in particular, being far in excess of the number of species regularly found in Queensland waters.

A joint project between the Fisheries Research Branch and the Queensland Museum is aimed at revising the systematics of this genus. Samples are obtained by co-operation with other Research Branch projects investigating fisheries in the Gulf and northern Queensland waters.

There is adequate evidence for the potential of a shark fishery in Queensland, but the rational exploitation of this mixed species stock requires that commercial fishermen be able to distinguish between the various shark species.

Several morphologically similar species appear to differ in their reproductive strategies, growth and possibly also their rate of accumulation of heavy metals. The project is preparing a field guide to the genus *Carcharhinus,* with sufficient diagnostic information to allow fishermen to identify their catches.

Prawns

Utilization of seagrass areas: Cairns estuary. A preliminary beam trawl sampling study of juvenile prawns in seagrass nursery areas within the Cairns estuary was initiated in August 1980 and completed in April this year. In all, about 6 000 prawns of 20 species were captured and analysed throughout the duration of the study.

The two commercially important tiger prawn species (the brown tiger prawn *Penaeus esculentus* and the grooved tiger prawn *P. semisulcatus*) exhibited very pronounced, temporarily separated peaks of abundance. Juvenile brown tigers appeared in the nursery areas in greatest numbers from spring to early summer (September to December), while the peak abundance of grooved tigers spanned a longer period, from late summer to autumn (December to April).

From this, it has been deduced that brown tiger prawns spawn from the end of winter to early spring (August to September), and that grooved tiger prawns spawn somewhat later, from mid spring to early summer (October to December). These findings corroborate reports from both Gulf and east coast trawlermen that prawn catches from November–December to February–March are characterized by a high proportion of small juvenile tiger prawns.

Gulf of Carpentaria. A programme was set up in the latter part of 1981 to obtain routine monthly samples of commercial tiger prawn catches from a field study area in the south east corner of the Gulf of Carpentaria. Unfortunately, this strategy subsequently proved inadequate because very few vessels were found to work consistently within the study area and, in many instances, essential logbook data accompanying the samples were sparse and/or inaccurate. Moreover, a 5-month gap in sampling was created by the combined effects of the banana prawn season, trawling closures, and the 'off season' when many vessels undergo refit and maintenance work.

To overcome this problem, project staff intend to collect the required samples directly, using the research trawler 'Gwendoline May'. About 30 separate sites, covering the majority of the commercial tiger prawn grounds, will be trawled at new moon each month.

The results of this programme will be used to complement those of a comprehensive inshore survey of nursery areas. Extensive preparations for the inshore study, including the fitting-out and transportation of a 8 m diesel launch to Mornington Island, are well in hand, and sampling is due to commence before the start of next financial year. In addition, project staff have recently assumed responsibility for local administration of the Northern Prawn Fishery Logbook Scheme.

Estuarine and Foreshore Management Section

THE functions of this Section are to ensure that fisheries conservation and management can be represented in consideration of a wide range of environmental issues. These issues cover such subjects as oyster management, estuarine inventory, habitat reserves, inter-departmental advisory services and mangrove communities.

Oystering

Inspection and review of oyster licence areas continued on a regular basis during the year. There has been a substantial growth in oystering production using intensive methods at those sites which have proved to be suitable for this method of cultivation. Other areas which are not as well suited to tray cultivation and in which oystering follows traditional ground bank methods or harvesting of naturally occurring stocks produced limited returns only.

Total gross production exceeded $500,000 for the 12 months. Of this return, 48 banks in the three major producing areas in Moreton Bay produced $410,000; the remaining 165 banks produced a total of about $115,000—a gross production return of $700 per bank.

Available sites which are suitable for intensive operations are generally being exploited to their capacity. Potential expansion of oyster production appears to be limited in other localities due to alternative use of shoal areas for other fisheries or aquatic use for recreation or navigation.

There are indications that competing uses for these less productive locations may force the future imposition of measures designed to ensure that licence areas are put to effective use or revert to public lands for other activities.

Estuarine inventory

The initial phase of the estuarine inventory has been completed in the field and deficiencies in cartographic information from previous years corrected where necessary for data storage and analysis.

Initial results of the inventory have shown—

1. A lack of correlation between the simple estimation of area of mangroves and the State's fisheries, that is, the area of mangroves is not a limiting factor for fisheries in Queensland due to the differing habitat requirements of commercial and recreational fish.

2. General confirmation of the estimation of Galloway (1979—CSIRO, Division of Land Use Research) that the 'loss' of mangrove area in Australia was about 0.5% of the total extent. The inventory results show a loss from recent development works in Queensland slightly in excess of this national average but nevertheless considerably less than 1% of the total extent.

3. An apparent relationship between the relative rise in sea level and a landward colonization of suitable substrate by mangrove vegetation. The resultant natural increase in mangrove areas is evident at sites throughout Queensland wherever substrate conditions and profile are suitable for mangrove growth. Comparison of sequential air photography at sites in the Gulf of Carpentaria, and in the east coast also show increased luxuriance of mangrove vegetation during the past 15 to 20 years. Increase in mangrove biomass in some estuaries is estimated at a factor of 20 times previous totals.

4. The natural increase in mangrove area consequent on landward colonization has occurred at the expense of previous brackish and freshwater swamps which are now saline mangrove enclaves, thus altering habitat availability for these fish and crustaceans which utilize brackish riverine areas for part of their life cycle.

5. A general increase in the occurrence and luxuriance of seagrass both in south east Queensland and northern regions.

6. Integration of inventory results with investigations of specific fisheries, for example, bream, barramundi, crab and prawns, indicates the importance of overall estuarine and river management compared with site specific and isolated features of limited extent.

7. Shoreline complexity and tidal flushing provide a means of assessing the availabliity and value of habitat for juvenile and adult fish on an overall estuary basis.

Habitat reserves

As an outcome of the estuarine inventory programme, areas of importance for conservation of fishing grounds and juvenile habitat have been identified and are included in a programme of progressive submisison as the results are finalized. Fish Habitat Reserves and other wetland reserves for fisheries purposes have been proposed for—

1. Estuaries between Tannum Sands and Round Hill Head. Both Local Authorities (Calliope and Miriam Vale Shires) support the proposal.

2. Vacant tidal crown land adjacent to Coomera and Woogoompah Islands. Both Local Authorities (Gold Coast City Council and Albert Shire Council) and the Gold Coast Waterways Authority are agreeable to the overall concept.

3. Burrum River. Boundaries to the area have not been finalized; Isis Shire Council supports the proposal. However, discussions have yet to be held with Hervey Bay Council on proposals adjacent to the Shire boundary.

4. Extension and amendment of the existing Fish Habitat Reserves in Pumicestone Strait and on the southern end of Moreton Island to better encompass fishing grounds and habitat in those localities in appropriate reserves for fisheries purposes, for example, protection and management of major oystering grounds and fish hauling grounds.

5. Areas in Trinity Inlet and Bay suitable for reservation for fisheries purposes.

Current proposals also include the Susan River, northern end of Great Sandy Straits and the Moon Point system on Fraser Island.

Advisory services

Advisory comment has been provided on an inter-departmental basis to the Department of Harbours and Marine, Land Administration Commission, Local Authorities and other Government Departments on a wide range of minor proposals. In each instance, the requirements and conditions of authority issued under the Fisheries Act have been incorporated in any relevant approval by those agencies.

The Department has prepared comment on major development works and provided technical appraisal of submitted documents. In a number of instances, the submitted documents have been rejected as unsatisfactory and failing to adequately address matters of importance to fisheries. Supplementary documents have been submitted in most instances; in one case, documentation was reinforced by investigation by Departmental staff to overcome deficiencies in the submission.

The majority of the impact studies which were reviewed adequately met the requirements of the guidelines with some minor amendment or revision of technical matters discussed in the draft documents.

Approximately 200 inquiries of an environmental nature were dealt with during the year by formal correspondence. Telephone inquiries on oystering, coral and shell grit licences created a considerable office work load while the field work associated with oyster grounds occupied some 20% of available time during suitable tide periods and involved some 300 individual site inspections.

Mangrove communities

Monitoring of mangrove regrowth at study plots in the Noosa River and Moreton Bay continued with natural regrowth out-stripping planted material. Additional sites known to have been damaged by cyclonic weather in past years were revisited and recovery rates monitored.

Additional inspection and aerial reconnaissance of estuarine systems were carried out, with particular emphasis on the area of mangrove mortality in the Calliope River and Auckland Inlet, Gladstone. Isolated occurrences of die-back of mangroves have been recorded since 1948 and are a well recognized element in community change throughout the length of the Queensland coastline. The massive and rapid mortality of *Avicennia* recorded in the Calliope River remains confined to that system with only isolated and sporadic mortality in other regions.

Division of Marketing

THE main activities of the Division of Marketing are centred on providing advisory and regulatory services relating to the economics and marketing of Queensland primary produce. This requires the provision of marketing intelligence, financial and economic advice, management planning and quality control services, all of which are supported, where necessary, by appropriate research.

Divisional functions in policy, extension, research and regulatory matters are handled by three Branches: Marketing Services, Economic Services and Standards. At 31 May 1982, 187 staff were employed in the Division of Marketing.

Two senior appointments were made in the Division during the period under review. Mr D. R. J. Densley was appointed Director of Marketing to succeed Mr D. P. Lapidge, now Assistant Director-General (Planning and Development). Mr A. R. Hughes was appointed Assistant Director of Agricultural Standards on the retirement of Mr E. T. Prodonoff.

Marketing organization

With considerable interest in accountability, a paper entitled 'Criteria for the Assessment of Performance of Statutory Marketing Authorities in Primary Industry' was prepared to assist management assess the performance of their organizations using commercially acceptable methods.

Further options were developed to provide for the rationalization of the bread industry. There was also a major involvement in the reorganization of fish marketing, particularly with respect to financial restructuring of the Queensland Fish Board.

The Division was also involved in the Planning Committee established by State Cabinet in September 1980 to identify the needs of the grain and oilseeds industries to the year 2000. The Committee's 1981 report will provide the opportunity for planned development in these industries over the next 20 years.

Significant progress has been achieved in developing future policy objectives for Queensland's agriculture. A Committee with representatives from rural industry organizations is examining a wide range of topics and should complete its report by November 1982. A background document on Queensland agriculture was also prepared for a Commonwealth Working Group, chaired by Mr J. S. Balderstone, which is preparing an agricultural policy statement at the national level.

Legislation

The Division of Marketing was involved in the introduction of the following legislation during the year—

Fishing Industry Organisation and Marketing Act. This Act was designed to replace the *Fish Supply Management Act* 1972. A Fish Supply Management Authority was established to administer marketing and management aspects of the fishing industry. The Queensland Fish Board came under control of the Act but was no longer responsible for overall industry management and regulation.

Margarine Act. The *Margarine Act* updated the packaging and labelling requirements for the marketing of margarine to conform with the *Health Act.* It facilitated the approval of design of margarine packages and provided flexibility for margarine manufacturers.

Filled Milk Act. This Act corrected an anomaly in existing legislation and allows filled milk to be sold for animal and pet food supplements. Filled milk is imitation milk which contains no butterfat. Under Queensland legislation, the sale of filled milk for human consumption is prohibited.

City of Brisbane Market Act. The Act was amended to bring it into line with the many and varied demands of fruit and vegetable marketing in the 1980s. The Brisbane Market Trust was able to vary the hours of trading in the market and was given more specific powers to regulate entry into and presence of people in the market, including removal of people from the market. The Trust's powers to create reserves were extended and its Debt Redemption Fund reconstructed.

Primary Producers' Co-operative Associations Act 1923–1981. The highlight of the year's activities in relation to primary producers' co-operatives was the formation of 12 co-operatives formed by groups of fishermen at ports along the Queensland coast ranging from Labrador on the south coast to Cairns in the north.

In addition, a federation of fishermen's co-operatives was formed with the object of promoting the views of fishermen and liaising with the Government on behalf of the co-operative members.

Inquiries are still being received from fishermen at other ports along the coast and it is expected that further co-operatives will be formed in the near future.

Interest in forming primary producers' co-operatives generally continues to be high and inquiries are on hand from such diverse groups as Cashmere goat breeders to nurserymen and macadamia nut growers.

In addition to the fishermen's co-operatives, one company registered with the *Companies Act* converted to a primary producers' co-operative during the year.

At the completion of the year, 85 co-operatives were registered under the *Primary Producers' Co-operative Associations Act.*

The formation of new co-operatives has highlighted the need for directors and management to receive training in the management of co-operatives and this has been recognized by the co-operatives themselves.

The Registrar and Marketing Services Branch have initiated a programme involving visits of approximately 2 days' duration to the fishermen's co-operatives, in the first instance to guide them in the best methods of running the affairs of their co-operative. It is intended that the service be extended to all interested primary producers' co-operatives as time permits.

Economic and marketing studies

Agreement was reached with the Queensland Milk Board's Prices Advisory Committee on a new base cost structure for the indexation of returns to producers, processors and vendors based on previous survey data.

The structure and operation of the Queensland egg industry were subject to a critical review from a marketing perspective. Current policies relating to the transfer and amalgamation of hen quotas were also reviewed at the request of the South Queensland Commercial Egg Producers' Organization. Cost of production data was updated in southern Queensland and further discussions were held with industry on appropriate methodology in cost of production studies.

A further cost of production study was undertaken for the Chicken Meat Industry Committee covering 1980–81 which provided a factual basis for negotiation of growing fees paid by processors to growers.

A comprehensive study was completed of the level of indebtedness of Queensland fishermen utilizing survey data obtained by Griffith University when undertaking research for the Barrier Reef Marine Park Authority.

To assist rural exporters, a study was undertaken of export procedures and finance with emphasis placed on export contracts and methods of payment for goods shipped overseas.

Departmental submissions were presented to the Industries Assistance Commission on ginger and ginger products and the Australian tobacco growing and manufacturing industry. An analysis of tobacco cost movements from 1980–81 showed an increase of 15c per kg which was accepted by the Australian Tobacco Board as an appropriate increase in the average minimum reserve price for the 1982 selling season.

Despite record production in 1981, the total sugar industry income of $945m was more than $300m down on the 1980 season's return, with average export returns to Australia the lowest in real terms for the past 10 years.

Increased Departmental involvement in the sugar industry included implementation of the industry's request for the establishment of a 30-member Queensland Cane Growers' Council; negotiations with industry representatives and Commonwealth officials in a review of the domestic price formula for refined sugar and the sugar rebate scheme in the 1979 Commonwealth-State Sugar Agreement. Discussions also took place on the implications for the existing industry of the establishment of a sugar industry on the Ord River in Western Australia; rural adjustment assistance; cost of production methodology and legislative matters.

Economic studies in the Burdekin Irrigation Area have been concerned with farm viability. Consultations were held with the sugar, rice, grain and horticultural industry groups in preparing data for consideration by the Burdekin Project Advisory Committee.

A survey of the mango industry in central and northern Queensland showed that the industry is expanding rapidly. Currently the majority of mango trees are under 5 years of age and intended plantings could exceed present tree numbers by 60%. Production can be expected to double within 5 years. This

survey is part of a comprehensive study being undertaken by an Inter-Departmental committee examining the economics and market prospects for horticultural crops in the Bowen and Burdekin regions grown for both the fresh fruit and processing markets.

Additional horticultural studies included a review of the Queensland citrus industry and an examination of a stabilization scheme for bananas.

Survey reports were also released during the year on the economics of peanut growing in the South Burnett and an economic investigation of farm machinery costs on the Darling Downs and adjacent regions. This latter survey in 1980 involved 300 grain growers and is one of the most comprehensive farm machinery cost studies undertaken in Australia. Capital investment in farm machinery averaged $134 000 a farm or $242 a hectare of sown crop.

Closer Economic Relations (CER) with New Zealand

The significant economic and social benefits which could accrue from CER have been subject to detailed study. Consultations were held with industry, senior economists from the other State Departments of Agriculture and Commonwealth officials. The likely impact of CER was assessed in terms of producers in various industries likely to be at risk in the event of an influx of New Zealand imports.

Following the Commonwealth's release of the proposed agreement in May 1982, the Division, in consultation with other States, prepared a report for consideration by the Australian Agricultural Council. This report identified aspects of the agreement requiring further modification to be acceptable to Australian primary producers.

Extension activities

Regional agricultural economists, located at 17 centres throughout the State, are actively involved in Departmental extension activities, particularly through industry committees and direct to farmers and agribusiness.

These extension activities are supported with a very comprehensive range of publications in farm business management. Ninety-two Farmnotes were prepared during the year. It is gratifying that 90% of Economic Services Branch extension publications are distributed either directly to farmers or through educational institutions training potential young farmers.

Extension publications prepared during the year which are in keen demand included an irrigation costs workbook, publications on costs of ownership and operation of farm machinery utilizing farm machinery survey data, a revised booklet on taxation and a new Farmnote series on the on-farm application of microcomputers.

Good progress has been made in an endeavour to have current profitability estimates in the form of gross margins for all crop and livestock activities available on a regional basis. For example, 45 cost and return Farmnotes have been prepared for horticultural crops throughout the State.

Further changes were made to marketing intelligence service reports to improve their content and format. The six regular reports contain relevant and timely information as reflected in an expanding circulation now averaging 450 for each issue of major reports such as Agricultural Trends.

The fruit and vegetable inspection and extension service is of benefit to consumers along with the fruit and vegetable and associated industries. This service ensures that fresh fruit and vegetables offered for sale in Queensland are of an acceptable standard and are handled, transported and stored under conditions conducive to the maintenance of freshness and shelf life.

In farm business management training, a series of schools was conducted for primary producers wishing to use futures trading as part of their marketing strategy. Interest in futures gained momentum during the year with the opening of a delivery centre at Miles for trade steers and the introduction of futures for export bullocks.

The Dairy Farm Management Accounting Scheme involving 133 farmers in six regions is providing a good medium for dairy farmers and extension staff to monitor milk production costs and returns.

The Division was involved in two courses for overseas students from developing countries dealing with cattle production and pasture development and fodder and fodder seed production.

Other items of interest

A detailed feasibility study of the proposed Young Farmer Establishment Scheme provided guidelines for the scheme now being administered by the Department of Lands with an allocation of $16m for the first 7 years of operation.

The microcomputer purchased by Economic Services Branch in June 1981 has been utilized effectively in demonstrating the value of microcomputers in research and extension. Farmers are displaying a growing interest in the use of microcomputers, particularly in the intensive livestock industries where computer programs for piggery and poultry performance analyses have been developed in co-operation with Pig and Poultry Branch.

Increasing use is also being made of computer technology in marketing and administration. For example, technical assistance was provided to the Queensland Meat Industry Organization and Marketing Authority in computerizing their Livestock Market Reporting Service. In Standards Branch, a computer system is being designed for maintaining registrations of agricultural chemicals. This will improve the efficiency of administration procedures under the *Agricultural Standards Act.*

Seed certification of pasture species continued to increase during 1981–82. This was due to a 50% increase in areas of Graham stylo and Callide Rhodes grass submitted for seed certification. The total area of pasture seed crops registered for certification in 1981–82 was 1 828 ha and 48.1 t of pasture seeds were certified. These figures show an increasing demand for pasture seed certification when compared with those for 1980–81 when 1 330 ha were registered and 22 t certified, and 1979–80 with 833 ha and 10 t.

Grain exports from the ports of Brisbane and Gladstone during 1981–82 totalled 1 648 191 t, and were virtually double those recorded for 1980–81. This increase was largely due to favourable weather conditions experienced throughout most production areas.

Wheat exports were some 25% better than the previous season, at 495 216 t. Barley figures increased fivefold to 310 349 t. Sorghum figures were slightly more than double, at 842 626 t. As in the past, Japan took most of the sorghum, while South-East Asia and Russia imported most of the barley. Particularly noteworthy was the large expansion in wheat shipments to China and Russia, who between them took nearly half of this season's export wheat.

An International Workshop on the viability testing of seeds was held in Norway in 1981 and was attended by a member of the seed laboratory staff at Indooroopilly, Miss I. Lamberth. Viability testing is a rapid biochemical method of determining whether seeds are alive or dead.

A separate laboratory for viability testing has been established at Indooroopilly for the provision of a fast assessment service on viability of potentially valuable seed lines, especially new season pasture grasses. The new laboratory will be concerned also with research into wider uses of biochemical testing, and with training staff in the use of this test procedure.

The diversity of the Division's activities is reflected in contributions being made to various committees established to examine a wide range of topics including the effect of higher energy prices on agriculture; the likely impact the Campbell Committee report on the Australian financial system could have on the rural sector if implemented; a review of Departmental services to the sheep industry in western Queensland; and initiatives which may be undertaken by both State and Federal Governments to alleviate the problems facing graziers in western Queensland, particularly beef producers in the more remote regions.

Mr J. S. Dickinson, of Economic Services Branch, was seconded as Chief Economist to the Northern Territory Department of Primary Production for a further 12 months.

Overseas assignments

Mr D. R. J. Densley undertook a tour of the United States, Canada and England in October–November 1981 to study marketing policy and administration in the countries visited, particularly fruit and vegetable marketing at wholesale and retail levels.

To assist in standardizing tetrazolium testing procedures, an International Workshop was convened by the International Seed Testing Association (ISTA) and held in Norway from 21 to 28 June 1981. Australia was represented by Miss Isobel Lamberth. It is particularly important for international trade that Australian representatives attend such workshops.

Mr J. Butler was recently appointed leader of a subcommittee of the ISTA Purity Committee and he attended an International Purity Testing Seminar in Paris in May 1982. Mr Butler was funded by the ISTA for this conference, which discussed problems associated with testing tropical seeds.

Mr R. Lobegeiger, Agricultural Economist, accompanied the Executive of The Central Queensland Grain Sorghum Marketing Board in a study tour to USA to inspect the operations of the Chicago Board of Trade and have discussions with brokers' representatives. The Central Queensland Grain Sorghum Marketing Board is now using corn futures as part of its marketing strategy.

Mr I. F. Whan, Agricultural Economist, undertook an overseas aid assignment to Vanuatu with a University of Queensland team to identify a significant area for agricultural research which could possibly be funded by the Australian Development Assistance Bureau.

Marketing Services Branch

THE role of Marketing Services Branch has been defined as: 'to service the agricultural marketing requirements of the rural sector in Queensland in the first instance and also the non-rural sector to the extent that it is affected by, or has an interest in, developments in the marketing of rural products'.

Servicing is taken in its widest sense to include the provision of information, interpretation and advice in the areas of agricultural policy, legislation, product marketing economics, market intelligence and market research and to ensure an efficient utilization of resources.

Such servicing involves a communication programme incorporating internal and external training in the field of agricultural marketing and resource use.

To fulfil this role within the Departmental context of programme management, the organizational structure of the Branch provides for three sub-programmes in addition to the administration function.

The **Marketing Economic Research** sub-programme has the following objectives—

- To research and evaluate current marketing systems and to co-ordinate Branch resources used in research projects.
- To maintain a Research Register.
- To provide advice and act as a resource base on macro and micro economic issues affecting the economy generally and the rural sector in particular. This incorporates a watching, advisory and co-ordinating brief in a variety of special interest areas including trade, energy, fertilizers, tariffs, finance, currency movements and rural adjustment.
- To provide a financial management advisory service.
- To design, co-ordinate and conduct internal and external training programmes in rural marketing.

The **Marketing Intelligence Services** sub-programme has the following objectives—

- To provide rural and commercial recipients with up-to-date and reliable information on crop prospects.
- To provide marketing information to as wide a cross-section of the public as needed.
- To provide market situation reports on the fruit and vegetable market at Brisbane.
- To maintain a rural statistical data bank.

The **Organized Marketing Services** sub-programme has the following objectives—

- To provide advice to the Department and to statutory and non-statutory primary producer marketing organizations on agricultural marketing policies.
- To administer the *Primary Producers' Organization and Marketing Act* 1926–1981 and other State statutes relating to the marketing of primary produce of Queensland origin.
- To assist in the administration of the various industry stabilization schemes and, in this context, to provide an appeals tribunal secretariat for the hen, tobacco and milk stabilization schemes.
- To provide a registration facility for vignerons.
- To provide an inspection service for farm produce agents.
- To provide marketing advice to primary producers' organizations, growers and commercial interests.

In working towards meeting the above objectives, the Branch engaged in a wide range of activities during the year. Some of these activities, under the respective sub-programme headings, are reported below.

Marketing Economic Research

During the year, officers of the Branch completed a variety of work directed towards providing assistance to rural marketing organizations.

The year's research programme continued to give a measure of priority to the on-going evaluation of marketing systems. In this regard, several projects have been of particular importance.

A paper entitled 'Criteria for the Assessment of Performance of Statutory Marketing Authorities in Primary Industry' was finalized. The object of this paper was to develop criteria to enable management and directors of these authorities to assess the performance of their organizations using commercially accepted methods.

'A Critical Review of the Queensland Egg Industry' provided background information on the structure and operation of the Queensland egg industry and critically reviewed the operations of the industry from a marketing perspective.

At the request of the South Queensland Commercial Egg Producers' Organization a 'Review of Current Policies' relating to hen quota transfers in Queensland was undertaken. The review presented arguments for and against relaxing requirements in relation to the transfer and amalgamation of hen quotas.

A review was undertaken of 'Queensland's Citrus Industry' following a request from industry for information pertaining to citrus production in Queensland. The aim of the report was to provide an overall review of the industry, highlighting some of the main features at the regional level.

An examination was undertaken on a proposal for the establishment of a stabilization scheme for bananas. An analysis of previous Queensland and New South Wales demand and/or supply oriented stabilization measures showed that exports and processing outlets for bananas have limited prospects and that area and quantity control measures were not likely to succeed. It was found that improvements to the National Banana Market Development Scheme were the most attractive workable alternatives to restrictive control measures.

The study of 'Export Procedures and Finance' dealt with procedures that concern those who act as principals in export transactions. Emphasis was placed on export contracts, basic documents and instruments used in export trade, with particular reference to agricultural commodities, as well as rates of exchange and methods available for obtaining payment for goods shipped overseas, including exchange control matters.

The Branch was closely involved with work carried out on the problems facing this State concerning the impact that Closer Economic Relations with New Zealand might have on primary producers. On present indications, Australia's entry on terms insisted upon by New Zealand will have a detrimental effect on groups of Queensland primary producers.

The Branch also continued to participate in hearings before the Industries Assistance Commission. Submissions were prepared and presented on ginger and ginger products and the Australian tobacco growing and manufacturing industry.

The Branch continued with its internal training programme during the year. This consisted largely of Branch personnel attending seminars, workshops and short courses organized by professional bodies. The aim of the programme is to keep officers abreast of the latest professional developments in their respective fields.

Marketing Intelligence Services

Marketing Intelligence Services placed a high priority on the evaluation of the unit's publications during the year. Major changes were made to improve the content, format and number of reports published.

Two approaches were used. With the first, the aim was to improve the competence of the individual officers. Key to this was ensuring officer familiarity with and understanding of all areas for which they had responsibility.

The other stream of activity related to improvements in the data presented. New sources of data were canvassed and improvements were made in the timeliness of data presentation. Considerable effort was put into providing additional marketing intelligence as well as meaningful interpretation of important contemporary events.

The Service's aim of providing relevant and timely marketing intelligence is considered successful in view of the substantial growth in the circulation list of the various Trend reports. In addition, the telephone recorded messages of daily fruit and vegetable price and throughput information from the Brisbane Market has proved popular among producers, merchants and consumers.

Six regular reports were issued a total of 82 times during the year. Average circulation of the four major reports of *Marketing Newsletter, Agricultural Trends, Horticultural Trends* and *Trends in Animal Industries* is 450.

Organized Marketing Services

Organized Marketing Services continue to have high priority within the Branch because of the operation of statutory marketing authorities for many rural products in Queensland. Marketing officers in the Branch act as deputies for the Director of Marketing on all of the State's commodity marketing boards. In this capacity, they attend meetings of boards and provide input on all relevant matters pertaining to the marketing of products handled by the boards.

Officers of the Branch continued to be heavily involved in the important work of a Planning Committee which was set up by Cabinet in September 1980 to identify the needs of the grain and oilseeds industries to the year 2000.

Secretarial and supportive services were provided to working parties that were established to assist the Committee to examine in detail a number of specific areas which include future production, port facilities, transport, storage and handling, pest controls, financial requirements and administrative matters.

The Committee's report, which was submitted to the Minister for Primary Industries on 30 September 1981, will provide the opportunity for planned development within the grain and oilseeds components of the agricultural sector over the next 20 years.

Officers also became involved in a Government Committee set up to determine future policy objectives for Queensland's primary industries. A separate report was submitted to a Commonwealth Government Committee which was established with similar objectives for Australia's primary industries.

The Queensland Committee is examining such matters as: ownership of agricultural production, land use, conservation, social infrastructure and support, finance, marketing, transport, producer organizations, research and support, mechanization, pest and disease control, animal management practices, veterinary practices, water and air pollution, agricultural and veterinary chemicals, policy management, education, macro economic and sectoral structural adjustment, rural labour and industrial relations, fertilizers, agricultural standards, quality control, fuel and energy and communications.

The Committee's final report is expected by November 1982.

During the year, the Branch continued to develop options to provide for the rationalization of the bread industry and had a substantial input into the reorganization of fish marketing in the State, particularly the financial restructuring of the Queensland Fish Board.

The Branch conducted several workshops during the year to examine ways and means of improving the process of accountability and reporting of rural Statutory Marketing Organizations in Queensland.

The process involves the development of a series of reporting criteria which will be developed further in consultation with the organizations involved. It is expected that this element of accountability will then be capable of being applied in association with the Annual Report of the Director of Marketing which is now tabled by the Minister for Primary Industries in Parliament each year.

Economic Services Branch

ECONOMIC Services Branch provides an economic information and educational service in farm business management for primary producers and also acts as a resource Branch in supporting Departmental extension activities. Agricultural economics research is undertaken in fields such as industry surveys to provide advice to primary producers, industry organizations and agribusiness, and to government, in rural policy matters.

To fulfil these functions the Branch has 21 regional agricultural economists in 17 centres, 14 economists in Head Office engaged in research and administration and a clerical support staff of 6.

In addition to extension and research activities, economists represent the Director of Marketing on the Central Queensland Egg Marketing and Grain Sorghum Boards and the Atherton Tableland Maize Marketing Board.

Regional agricultural economists are actively involved in Departmental extension activities, particularly through industry committees and direct to farmers and agribusiness. Three economists also perform the additional duties of district extension leaders.

Extension activities

Regional economists are engaged in all phases of extension activities in the Department. In addition to serving on extension committees in the region, they work through and with extension officers in other Branches. The activities of the Economists include direct contact with farmers helping them solve business problems on their farms, acting as a resource person providing information for extension planning, and servicing the agribusiness community so that this sector can more readily appreciate conditions in local rural industries and needs of primary producers.

Regular contact with primary producers is an important part of the work of regional economists. On average during the past year, each economist received 83 enquiries from farmers that required substantial follow-up work, conducted 27 farm visits and prepared 25 detailed farm budgets. Extensive use is made of the media to provide timely advice for primary producers in management. All regional economists publish articles regularly through their local press.

Training activities

An important role of agricultural economists is as trainers in farm business management for farmers, Departmental extension officers, agribusiness and students.

Farmer training included workshops and seminars on farm taxation at Nobby, Dayboro and at the Queensland Agricultural College. Assistance was given by economists at a Dalby Extension Planning Workshop at Redcliffe and at a seminar in Brisbane for retiring members of the Armed Services interested in farming.

There was continued interest in the use of futures trading by primary producers as part of their marketing strategy. Schools demonstrating the use of futures were presented in a number of regions. During the year, two significant events occurred which have helped increase the interest in futures trading, namely the opening of a delivery centre at Miles for trade steers and the introduction of futures for export bullocks.

A farm office school was held in the Near North Coast and attracted 28 people. Farmers were shown how to develop and use farm office and bookkeeping systems. In addition, a farm office and dairy farm management school was held in the West Moreton Region with Departmental officers combining with TAFE to present an evening course. Economic Services Branch contributed substantially to the course by presenting sessions on the practice and concepts of Farm Business Management.

Two regional economists assisted in training activities for international participants. Economic aspects of cattle production and pasture development were discussed with Malaysian agricultural extension workers attending a course sponsored by the Australian Development Bureau. Economics of tropical pasture seed production were discussed with participants of a second course sponsored by UN-FAO.

A short course was presented to staff of the Dairy Research Branch on the economic evaluation of research projects. The course was aimed at helping research staff prepare project proposals which incorporate an economic evaluation. The significance of economic aspects of major research projects was also discussed at a meeting of all Branch directors involved in biological research.

A workshop for economists in the south east region of the State was held in June 1981. This workshop provided an opportunity for economists to discuss developments in agricultural economics and to consider important issues relating to project evaluation.

Farm management publications

The Branch produced a wide range of farm management extension and research publications during the year. An on-going analysis of publication distribution revealed that 90% of Branch extension publications were being distributed to farmers, either directly or through educational institutions devoted to young farmer training.

Ninety-two Farmnotes were prepared by both regional and head office staff, comprising 53 new titles and 39 revisions of Farmnotes that had been released previously. New additions included gross margins for horticultural crops in the Burdekin and central Queensland areas, a series of gross margins for sheep enterprises on the southern Darling Downs and a series on computer use at the farm level.

The Farmnote series on taxation was recompiled and released as a saleable publication during the year.

A new edition of the *Farm Management Handbook* and a booklet on agricultural investment opportunities in Queensland will shortly be available as saleable publications.

Work is continuing on the development of an Agdex (Agricultural Index) based filing system for use by farmers for the storage and retrieval of extension information produced in leaflet or booklet form by the Department.

Farm management research publications were prepared on farm machinery usage on grain farms and on the peanut industry in the South Burnett.

Together with the publication of comprehensive research on Queensland farm machinery cost and usage, Branch officers also revised two guidebooks on machinery ownership and operating costs and calculation of machinery costs at the farm level. These extension booklets have been further supplemented by a revised Farmnote on dealing with machinery costs and incorporating the latest Queensland research findings.

Irrigation extension publications arising from the publication of an irrigation costs workbook were published in a number of leading farm magazines.

An extension publication on finance for primary producers was also prepared in order to supplement regularly revised Farmnotes dealing with the sources and cost of finance for primary producers. Two revisions of this Farmnote were prepared during the year. A booklet on rural credit in Queensland is currently being prepared for distribution as a saleable publication.

Branch officers contributed eight articles to the *Queensland Agricultural Journal* during the year on topics including the cost of drought in the Goondiwindi district and the profitability of limited tropical pasture development in subcoastal south Queensland.

At the regional level, agricultural economists prepared a wide range of practical farm management publications for use by farmers.

In the dairying industry, agricultural economists produced a simple yet comprehensive record-keeping system for recording both production and breeding data. Further development work on these publications will continue on a joint basis with Dairy Field Services Branch following an assessment of the effectiveness of the system.

Basis graphs to assist live cattle futures hedging operations were prepared for use by central Queensland graziers. A series of regional handouts assessing piggery management aids was prepared for pig producers on the Darling Downs.

Other regional farm management publications in addition to Farmnotes authored by regional economists included crop gross margins for the Central Highlands, South Burnett and Dawson-Callide, crop prices bulletins for Queensland grain and oilseed crops, and an analysis of industries in far north Queensland.

Altogether, 46 local farm management publications were produced for use primarily by farmers and extension officers in the Department.

Economists also contributed material on farm management topics to national, State and local newspapers and to local newsletters and information sheets. They also contributed research papers on farm management topics and closely related commodity outlook fields at national and State-wide conferences throughout the year.

Papers were presented to the Australian Rangelands Society Conference at Alice Springs, to the BAE's Central Queensland Outlook Conference and to a number of national and State industry conferences.

Papers delivered to the Rangelands Society Conference were of particular significance in view of the current studies being undertaken by a Cabinet appointed committee to assess future demands for Departmental services in western Queensland. They included a paper on the implications of changing land tenure and death duties on pastoral business structures in far southwest Queensland. Additional economic data were prepared for another committee examining the needs of graziers in western Queensland.

Economics research and special projects

Cost of production studies

In the egg industry, cost of production updates based on historical data were calculated and a report was prepared for the South Queensland Commercial Egg Producers' Organization. Branch officers also participated in discussions to assist in reconciling differing views on the most appropriate methodology in cost of production studies.

In the dairy industry, discussions were held with the Queensland Milk Board's Prices Advisory Committee using data for the Milk Costs of Production Survey. Agreement was reached on a new base cost structure for the indexation of returns to producers, processors and vendors. The 'Report of the Costs of Production of Milk in Queensland 1979–80 (Farm Sector)' was made available to interested parties on a limited distribution basis and has been favourably received.

In the sugar industry, assistance is being provided to the Central Sugar Cane Prices Board on ways of streamlining and accelerating the collection of costs of production data from growers, and the appropriateness of methodology for the collection and processing of costs of production data.

Discussions have been held with a number of sugar organizations with a view to amalgamating and rationalizing the two cost surveys currently conducted by the Queensland Cane Growers' Council and the Board. The aims are to remove duplication, overhaul procedures and to improve the basic methodology. The Board will prepare a new manual of procedures to assist in the collection of future survey data.

A further project in the sugar industry has been an examination of alternative domestic pricing arrangements for refined sugar following a midterm review by a joint industry working party of the formula in the 1979 Commonwealth-State Sugar Agreement. The industry has been disadvantaged under the present formula and negotiations are continuing with the Commonwealth to develop a new price setting mechanism for incorporation in a new agreement.

In the Chicken Meat Industry, a cost of production survey covering the 1980–81 year was conducted on behalf of the Chicken Meat Industry Committee. Thirty-four growers were interviewed and individual results were supplied to co-operating growers. The CMIC uses the survey results as a basis for negotiation of growing fees which are paid by processors to growers.

Costs of production estimates have also been prepared for the Australian Tobacco Board to show cost movements from 1980 to 1981. The analysis showed an increase of 15c per kg which was accepted by the Board as the appropriate increase in the average minimum reserve price for the 1982 selling season.

Computers and farm management

The Apple microcomputer purchased in June 1981 has been used for a wide variety of applications and has effectively demonstrated the value of microcomputers in research and extension.

The Apple was one of three microcomputers purchased for evaluation and the branch assisted in the evaluation and in the preparation of the report on microcomputers in regional research and other Departmental applications.

Branch representation on the SCA Working Party on Computers continued during the year and all State Departments prepared lists of major computer systems, applications, microcomputers and terminals used. Other issues discussed were a pricing policy for programs developed by Departments and legal liability for such programs used by extension officers and farmers.

A national workshop in Tasmania on computer applications to dairy farm management was attended. Topics covered all aspects including feed budgeting and herd health. The Branch's newly appointed computer specialist contributed to the development of the Dairy Farm Management Scheme.

A third edition of the inventory of farm management programs is being prepared. This involves a survey of up to 120 agricultural institutions, placing the information gathered on the the CSIRONET computer system and field testing.

To meet the growing interest in farm use of computers, extension activities were stepped up during the year. An article comparing microcomputers with computer bureau services, and outlining the availability and characteristics of relevant software, was published in the *Queensland Country Life* in October 1981. Four articles on computers in agriculture and possible on-farm use were published in the *Queensland Graingrower* in February and March 1982. Four farmnotes were subsequently prepared to handle general inquiries on microcomputers.

Other computer related activities included presentation of papers to a summer school at the Darling Downs Institute of Advanced Education, evaluation of a program for the sheep industry and evaluation of the usefulness of the Farmplan computer package initially developed in England.

Policy discussion paper on agriculture

In October 1981, a working party of officers from Economic and Marketing Services Branches was established to prepare a submission to the Commonwealth Working Group chaired by Mr J. S. Balderstone. Contributions were also received from other sections of the Department.

The terms of reference of the Balderstone Committee were very wide and a substantial report was prepared as a background document for the working party rather than as an official statement of Departmental policy.

A State Committee, comprised mainly of representatives of industry organizations, was also established in 1981 to develop a policy statement on Queensland agriculture. The document presented to the Commonwealth committee was also favourably received by the State policy group.

Closer Economic Relations with New Zealand

Early in 1980, the Prime Ministers of Australia and New Zealand agreed that significant economic and social benefits could accrue from CER. Since then, negotiations at both Ministerial and officer level have been held to establish common ground.

State Governments expressed concern as to the level of State-Commonwealth consultation on this issue and the Chairman of SCA suggested that senior economists of State Departments get together to consult with the Commonwealth on matters relevant to the rural sector.

This meeting identified the impact of CER on primary industries in certain regions as being a major concern. State Departments agreed that an attempt should be made to assess any adverse impacts.

Queensland's assessment was carried out by the Branch using economists in both regional centres and in Head Office. Based on readily available data, it was established that 900 to 1 000 primary producers could be 'at risk' should imports from NZ be allowed to enter in an uncontrolled manner. Dairy farmers appeared most vulnerable with approximately 700 potentially at risk. Other industries with significant numbers at risk are bean growing and fishing.

While it was acknowledged that a percentage of these producers could be at risk in the absence of CER, it was recognized that an acceleration of the adjustment process was likely to result.

Information supplied by regional economists indicated that, should producers be placed at risk as a result of imports from NZ, it was unlikely, in many cases, that sufficient funds would be available from normal sources to allow necessary adjustment to occur. To assist such producers, it was estimated that an extra $9m to $10m would be required through the Rural Adjustment Scheme.

The Commonwealth released details of the proposed CER agreement in May 1982. Chief Economists from all State Departments of Agriculture (and the Northern Territory) have examined the proposals in detail and have accepted a report, which was largely prepared by Queensland, for consideration by a special meeting of Australian Agricultural Council. This report, which included a summary of industry reaction, identified the following major aspects as unacceptable:

- the excessively long period of time envisaged for the phasing out by NZ of its export incentives and import licensing schemes;
- the uncertainty associated with the effectiveness of the 'fast track' anti-dumping procedures; and
- the lack of Commonwealth commitment to the provision of adequately funded adjustment schemes to assist industries and enterprises adversely affected by CER.

Examination of development proposals

The Branch contributed to a joint study with other Branches of the Department to estimate agricultural water requirements in southeast Queensland in the next 10 years and beyond for submission to the Queensland Water Resources Commission. The Branch's role was to assess the economic viability of existing and potential land uses in the light of market prospects for the range and quantity of products likely to be produced in the region by 1990–2000.

A preliminary economic assessment of the Proserpine River irrigation and flood mitigation project indicated that the project is unlikely to be viable from an economic viewpoint.

Mr B. Bartholomew, Senior Agricultural Economist, has continued his full-time study at the University of Queensland into the pricing and allocation of irrigation water for submission as a Masters thesis in 1982.

A detailed study of economies of size has been undertaken in the Burdekin Irrigation Area in association with industry groups for consideration by the Burdekin Project Advisory Committee.

Financial assistance from the Queensland Grain Growers' Association will allow more detailed study of the effects of economies of size on the profitability of different sized irrigation grain farms in the Burdekin Irrigation Area. The study will include field crops such as sorghum, soybeans and maize.

The Branch has also played a major role on an Inter-Departmental Committee examining the prospects for horticultural development in the Bowen-Burdekin Region of north Queensland. The report of this Committee will be published in August 1982 and will include the economics and market prospects for horticultural crop production and the results of a survey of the mango industry from Sarina north.

A seminar was conducted at the Darling Downs Institute of Advanced Education on the methodology used in the economic assessment of major agricultural development projects. This information will shortly be published as a Branch bulletin.

Young Farmer Establishment Scheme

A detailed feasibility study was undertaken as part of a joint Department of Primary Industries-Lands Department study of a young farmer establishment scheme proposed by the National Party.

A scheme which represented a modification of the proposals originally put forward was formulated and approved by Cabinet. Funds of $16m have been approved for the first 7 years of operation of the scheme and it is envisaged that some 20 to 30 applicants could be assisted each year.

Livestock Market Reporting Service

The computerized version of the Livestock Market Reporting Service became operational late in 1981. The upgraded computer equipment, installed in June 1981, helped overcome the operational difficulties experienced with the original equipment. Initial tests in October 1981 showed that the system was working satisfactorily and, by the end of the year, reports were being prepared for some of the major livestock selling centres.

Since January 1982, the service has been operating with only occasional problems due mainly to poor transmission over the telephone network. Further development of the service will include an index of cattle prices.

Soil conservation

Economic investigation of soil conservation continued in the period under review, and a paper 'An Evaluation of Proposed Research into the Effect of Soil Erosion on Productivity' was prepared.

Carcass classification

The Branch is represented on the State Working Party and economic sub-committee on carcass classification. Two new trials have been implemented to examine the relationship between classification parameters and saleable meat yield.

The Branch also assisted in the evaluation of carcass auctions as an alternative to traditional methods of marketing livestock for a report published by the Queensland Meat Industry Organization and Marketing Authority.

Other projects

The Branch was represented at a 2-day seminar conducted by the Australian Rural Adjustment Unit in Canberra to consider the implications for rural finance of the findings of the Committee of Inquiry into the Australian Financial system (the Campbell Committee). Economic Services Branch and Marketing Services Branch jointly prepared a discussion paper for an Inter-Departmental committee on Campbell Committee Recommendations affecting the Rural Sector.

Other research projects included the preparation of a paper 'The Structure and Economics of Fish and Seafood Marketing in Queensland', jointly with Marketing Services Branch and a report on the debt position of fishermen which represented the first comprehensive presentation of statistics for Queensland fishermen on finance and debts; an economic evaluation of Alpha versus hybrid grain sorghum; and preparation, jointly with Marketing Services Branch, of a paper 'Development in Queensland: Prospects for Rural Industries in the 1980s', which was presented by the Director-General to a Commonwealth Executive Development course.

A paper on future economic prospects of Australian rural industries was presented to a Land Administration seminar at the Queensland Institute of Technology. The Branch was also represented on an Interstate Working Party to assess the impact of higher energy prices on agriculture for submission to Standing Committee on Agriculture.

In addition, summaries of taxation provisions applicable to chicken growers and the financing aspects of proposed assistance for eradication of cattle ticks in the northwest were prepared.

Industry studies

Field cropping

Demands for information of the profitability of summer and winter crops, both irrigated and dryland, resulted in Farmnotes and local publications being available for most field crops grown throughout the State. Fifteen new or revised Farmnotes and three local publications about field crops were prepared to meet this need.

Some interest was expressed in cropping in the marginal lands in western districts and the probabilities of successful crop production are being assessed.

In the areas growing cotton, lower cotton prices are expected to cause considerable cash flow problems. Many growers are investigating alternative irrigated cropping strategies.

In the Roma region, guar bean was grown commercially for the first time. The net returns from this crop are comparable with those received from wheat.

A joint Agriculture Branch-Economic Services Branch report examined alternative crops available to tobacco growers in the Mareeba area. The major conclusion is that no single crop is a satisfactory replacement for tobacco. Major limitations to a shift to other crops include: distance from markets; the small size of potential markets; small farm sizes; high intensity summer rainfall; and availability of labour.

As a result of the Farming for Profit Seminar held at Dalby, the variability of returns from wheat and sorghum in the Tara Shire was investigated and the results presented at a discussion meeting. The results show that, over the longer term, wheat was more profitable than sorghum. Also at the workshop, data were presented on real cost and price trends and the effect of technology and farm size in maintaining farm income.

In the central and western areas of the State, there is increasing interest in grain sharefarming. A study is being undertaken to prepare guidelines on various types of sharefarming agreements.

Regional economists attended many of the grower meetings organized by the Planning Committee for Grain Storage Handling and Transport to discuss the recommendations of the Planning Committee.

Interest has increased in the use of conservation cropping techniques for cereals and oilseeds. Although conservation cropping techniques may mean lower costs, these benefits in the short term may be more than offset by lower yields. The long-term benefits of maintaining soil productivity must be compared with the reduction in yields due to soil degradation.

Because of the time scale involved, little recognition is given to the long-term gains when compared with short-term costs. Allowance should be made for the changes in the real value of money through time when weighing up financial with other objective and subjective considerations in any decision on whether the new technique should be adopted.

An extensive study into the capital and labour utilization under the different cultivation systems on the Darling Downs is being undertaken. The study will use technical data available including information from the Farm Machinery Survey to examine cultivation systems termed conservation cropping. A Multiperiod Linear Programming Model is being used to look at alternative systems. It is planned to incorporate in the study aspects such as longer term soil conservation benefits, investment considerations and short-term production costs for each of the cultivation systems studied.

More than 300 people applied for the ballots for the Emerald Irrigation Area Ballot Blocks released in 1981. Considerable demands were made for information on the costs, returns and development costs for irrigation blocks in the area. A booklet on the economics of cropping dryland and irrigated land met much of this demand.

Lucerne and cotton growers in the Biloela area were surveyed to obtain basic cost information. Based on current output prices for these commodities, net returns were approximately $600 per ha for lucerne and $70 per ha for cotton.

An analysis of 20 years of data for production of wheat and sorghum in the Darling Downs region was carried out. The results show that regional production variability of wheat can be mostly explained by yield variability, whereas the regional production variability of sorghum is largely explained by area variability.

Assistance was given to the Queensland Grain Growers' Association in developing an all risk crop insurance proposal for the major grain growing areas of Queensland. Premiums for specific areas were estimated taking into account expected yield, yield variability between years and a range of price expectations.

The results of a survey into the economics of peanut growing in the South Burnett were published. The study documented the various cropping systems in use. As a result of the study, a farm record system has been set up with a number of farmers to monitor the economic and financial changes that occur when cropping systems are changed.

Horticulture

A Farmnote was published on the economics of tomato growing in the Bundaberg region based on intensive farming practices.

Economic studies were undertaken of plantation crops for Far North Queensland, namely the mango, avocado, litchi, pecan and macadamia. Mangoes were shown to be an economic proposition at average yields and with prices greater than $7 per tray. A 6 ha orchard is considered to be a one-man operation. This area requires an initial capital investment of $65,550 or around $11,000 per ha.

The study of pecan nut production showed that expected yield levels are well below those required for economic viability. This study highlighted the problem of inadequate data on which to base an *ex ante* economic evaluation.

On the other hand, litchi growing should be an economic proposition if medium to high yields are obtained with a price above $5 per kg. Estimated payback period for this investment ranges from 9 to 14 years depending on the yield and price.

Avocado production in Far North Queensland is profitable if yields of greater than 25 trays per mature tree are obtained at prices above $14 per tray. The short-term outlook for avocados seems optimistic although the medium to long-term outlook is uncertain with the large plantings now taking place.

Macadamia nut is profitable if yields greater than 7 000 kg per ha and prices greater than $1.85 per kg are obtained; however, both these yield and price estimates are high.

Living areas for various horticultural crops for North Queensland were estimated using current returns and production methods.

A recent study indicated limited potential for horticultural production in the Charters Towers region.

A survey of the mango industry in central and north Queensland showed that the industry was expanding rapidly. Currently, 60% of all trees are under 5 years old and intended plantings could exceed present tree numbers by 60%. Production levels can be expected to double within 5 years.

A study of the economics of seed production of green beans in north Queensland indicated that, when compared with other crops that could be grown, the price paid for bean seed needed to be increased. If production from the area could be increased, import of bean seed supplies from the USA could be decreased.

Cost of production indices developed for beetroot, carrots, beans and peas in the West Moreton region provide a factual basis for negotiations between growers and processors in price determination.

Twenty-one new titles of horticultural cost and return Farmnotes were prepared covering a range of commodities grown throughout Queensland. There are currently 45 cost and return Farmnotes available for horticultural crops.

Tobacco

The movements in the costs of production of tobacco 1980 to 1981 were analysed for the Australian Tobacco Board. The analysis showed an increase of 15c per kg which was accepted by the Board as the appropriate increase in the average minimum reserve price for the 1982 selling season.

An IAC inquiry into the tobacco industry was conducted in March–April 1982. Preparatory work for the inquiry included a review paper on the operation of the tobacco cost 'index' for the information of the Australian Tobacco Board, and collection of information on capital investment, quota values and the cost of production for the consultants to the Australian Tobacco Growers' Council.

The potential cost of production for north Queensland, given a number of likely developments, was prepared for inclusion in the Departmental submission to the inquiry.

Livestock

Beef. Price relationships between futures type steers at Homebush (Sydney) and seven categories of cattle sold through Gracemere (Rockhampton) were analysed from 1976 to 1981. The 'basis' for cattle sold at Gracemere is the price differential between these two markets. The prediction of the basis is essential for any hedging programme where cattle cannot be delivered against the contract.

The study demonstrated the difficulties in accurately predicting a basis for Gracemere cattle. Data prepared from the existing graphs were requested by the Australian Business Research Unit, UNE, Armidale, and are currently used in their futures courses. The recent availability of the export bullock contract necessitated reworking the figures for the various non-deliverable classes of cattle for the main Queensland saleyards.

Ten Beef Futures workshops were held in the Burnett and Central Highlands regions. The major emphasis in these workshops is in helping cattlemen understand futures and how they may be used to ensure a particular level of income at a particular time. At most of the workshops, emphasis is placed on the establishment of a basis, that is, the price difference between the futures type steer and type of steer normally produced by the grazier.

The establishment of an export bullock contract is likely to increase interest in the use of beef futures in the central Queensland region as the Gracemere Saleyards sell the largest numbers of this type of bullock in Queensland.

Preliminary economic analysis and research are being done to re-evaluate pasture improvement technology for the beef industry in the Burnett. The work includes *ex post* evaluation of the biological research already completed and *ex ante* evaluation of future research.

A separate study used performance functions to estimate optimum stocking rates for different classes of cattle for native and improved (oversown) pasture in the western Burnett. The model used total property gross margin and return on investment to measure the response to increases in areas of oversown pasture. The results showed that property returns increased with increases in the area of oversown pastures.

The model also showed that if below 50% of the stock were run on oversown pasture, the optimum stocking rate was less than the maximum stocking rate. However, if more than 50% of stock were run on oversown pasture, the maximum stocking rate became the optimum rate. In addition, it was demonstrated that,

when sufficient area of oversown pasture was available on the property to graze all breeding cows, it was more profitable to use this feed source for the cows than to graze the other classes of animal.

A study into profitable beef production strategies for improved tropical pastures in the coastal Burnett indicated that the profitability of breeding herds on improved pasture properties can be significantly increased if management practices aimed at vealer production are used. However, there is little difference in profitability between a vealer system and growing and finishing cattle.

Choice of operation is often determined by other factors; for example, some producers perceive the financial risk as lower with a breeder herd while others see growing and finishing dry cattle as more flexible with less drought risk and being more compatible with pasture seed enterprises.

Diversification on and off the farm in the beef industry is once again the concern of beef producers given the current depressed prices. However, there is still some interest in adopting improved pasture technology in the Burnett and an address on this topic was given at a Tropical Grassland Society meeting in central Queensland.

A study to assess the feasibility of installing liveweight scales at the Mareeba cattle saleyards was undertaken for the Shire Council which subsequently decided to proceed with the proposal.

The cost of drought in 1980 for seven properties in the Goondiwindi region was estimated. No attempt was made to suggest which was the best or worst drought strategy because circumstances and availability of resources differ between properties. The survey showed that four of the seven properties incurred costs of $200 or more per breeder. Stock losses through deaths and forced sales have resulted in a substantial decline in profit to the individual grazier and it takes considerable time to overcome these setbacks when the drought breaks.

At Goondiwindi, although there was a 'negative' price margin for beef fatteners in 1981 (with stores costing 5.6c per kg more than was received for fat cattle), some operators were able to make a profit because of favourable growing conditions for oats. In the situation examined, weaner steers were more profitable per head than either heifers or older steers.

Dairy. Trends in the dairy industry indicate increased confidence because of the higher prices being received for market and manufacturing milk. This has resulted in capital investment into larger herds, labour saving devices and better feeding systems for the herd.

There has been a strong move throughout the State to involve dairy farmers in planning extension programmes in their industry. Increased emphasis is being placed on the role of cheaper, home grown feed in farm systems. On many farms, purchased feed (molasses, hay, grain) represents up to 8c per L of milk produced, or about 60% of total variable costs. Attempts are being made by farmers to reduce the cost of feed by growing it on-farm.

A publication comparing costs of feeding dairy cows a range of standing and stored fodder for a milking herd of 75 cows for a 100-day period is being prepared. Estimates of labour, land and water requirements for the different feeding systems were also made. Irrigated high N ryegrass provided the cheapest feed source of the nine alternatives considered, given the basic assumption of its being a dry period of the year. Silage was the cheapest form of stored feed, followed by irrigated baled lucerne hay.

Costs and returns for dairy farming on the southern Downs were also estimated. Gross margin, excluding feed costs and wages, was estimated to be $545 per cow for cows producing 3 000 L milk per year.

A study was undertaken of the Dairy Farm Management Scheme to describe the systems being used in the regions throughout the State. One hundred and thirty-three farms in six dairying regions use the scheme. These schemes are serviced by Regional Economists and Dairy Field Services Branch officers. A computer service analysed the data for 36 of the farms; the remainder are analysed by hand in the specific regions.

The frequency of collection and reporting varies between regions from month to month and from year to year. All schemes report to farmers individually with some group data and discussion. In the Gympie region, the Wide Bay factory and the Department combined to set up and operate a Dairy Farm Recording System for the advantage of farmers in the supply area.

Dairy Breeding Record systems received considerable attention during the year. A system was developed to signal when the farmer should expect to see first heat and other physical characteristics. The system is unique in how it arranges the events in a chronological order so that the time period is the signal to investigate the physical characteristics.

In two separate studies, the returns to suppliers from different processors were compared. Both studies were undertaken jointly with Dairy Field Services Branch and related to possible transfer of suppliers from one processor to the other.

The most economical method of herd replacement was studied for south east Queensland and the Atherton Tableland. Factors that affect the best replacement method include age of first mating, price received for milk, cost of agistment, and the purchase price of similar quality cows.

A separate study on economic aspects of dairy heifer replacement for north Queensland suggests dairy farmers can make significant financial gains by reducing the age of entry of replacement heifers into the herd from 3 1/2 to 2 1/2 years. An alternative is to agist 2 1/2 to 3 1/2-year-old heifers. This allows more milkers to run on the home farm.

Pigs. The Piggery Performance Analysis scheme continued to grow rapidly. To facilitate the analysis of co-operating pig producers' records a computer program has been developed and documented. It is planned to make the program available for sale.

A national workshop on Farm Management Recording Systems for intensive animal production was attended, and a paper was presented on piggery farm recording systems and the need to keep them simple.

Sheep. Two surveys on resource regions have been completed, the Eastern Mulga Survey and the Ward Warrego River Frontage Survey. The Eastern Mulga Survey, with data collected from 1972–73 to 1979–80, indicated that sheep were about twice as profitable as cattle for 8 years as a whole, and the income from sheep was more stable than that for cattle. Complementarity of sheep and cattle diets, however, should ensure that both types of stock will continue to be grazed on these mulga properties in south west Queensland.

An interesting aspect of the results was the levels of capital valuation and equity over the period. Average capital valuation and equity were lowest in 1975–76 ($160,000 and $77,000) and the highest in 1979–80 ($300,000 and $259,000).

Currently, 10 properties have been surveyed in the Blackall district. The Blackall survey was the result of a request from the Blackall Graziers' Association for a survey similar to the Eastern Mulga Survey. This request was reinforced by a request from the committee reviewing Departmental activities in the far western Queensland sheep growing areas for economic data.

A study comparing breeding weaners for sale with breeding weaners and retaining wethers for wool production was undertaken. The estimated sale price of the wether compared with the sale price of the weaner had the greatest impact on the selection of the alternative to use.

For example, if weaner wethers can be sold for $10 per head, it will be worth keeping them only if they will be worth more than $12.15 at 1 1/2 years and $9.27 at 2 1/2 years.

Wethers must appreciate in value from weaning to 1 1/2 years to justify retention, whereas a degree of depreciation is allowable after 1 1/2 years (due to higher wool cuts assumed after that age).

Four Farmnotes were prepared about alternatives for sheep production systems on the Darling Downs. Prime lambs from crossbred ewes were estimated to have a gross margin per ha of $55 compared with $30 for producing prime lambs from Merino ewes. Wool production gross margin from wethers was estimated to be $7.22 per wether. Fattening lambs on high N ryegrass gave an estimated gross margin for each lamb of $5.48.

Goats. Four Farmnotes were prepared on Angora goats and mohair production. Estimates were made of the costs and returns of upgrading to pure bred Angora goats from white foundation does. Gross margins were also estimated for breeding with purebred does and mohair production from Angora wethers. A Farmnote was also prepared on marketing and prices for mohair in Queensland.

Poultry. A cost of production survey covering the 1980–81 year was conducted on behalf of the Chicken Meat Industry Committee. Thirty-four growers were interviewed and individual results were supplied to co-operating growers. The CMIC uses the survey results as a basis for negotiation of growing fees which are paid to growers.

Analysis of the survey data provided an opportunity to use the 'Visicalc' package on the Apple microcomputer. This facility proved to be extremely useful for both the analysis of data and the printing of grower reports. There appears to be ample scope for using the 'Visicalc' package for analysing survey results and for the updating of 'index' type data.

Comments were provided to Marketing Services Branch on grower proposals to change the existing legislation to provide greater protection to growers. The major area of concern is the erection of new shedding by some processing companies, while other companies are operating at less than 70% capacity.

Special projects

The development, use and renovation of the northern wallum land was investigated during the year. The study showed that wallum land use continues to be a marginal proposition. Those primary producers with developed pastures which have been allowed to degenerate could benefit from renovating their pastures through a brief cash cropping phase.

The continued economic viability of wallum landholdings depends on identifying profitable crops that can be used in two to three crop-pasture rotations.

Intergenerational transfer of the family firm is of particular importance in pastoral industries as it is the most common means of establishing young people on the land. A study of this largely unexplored subject was carried out using a case study approach. Thirteen family firms in far south west Queensland were examined to determine the respondents' reason for undertaking intergenerational transfers, the methods used, the problems encountered and some of the solutions reached.

Partnerships were found to be the common vehicle for bringing family members into the business. The study concentrated largely on the legal, sociological and financial aspects of working within family partnerships.

Successful partnerships were considered by a number of respondents to be those that were established to achieve a set objective and, having achieved that objective, subsequently were dissolved or the partnership set new objectives.

Of those successful partnerships studied, two factors were common to all. Firstly, family relationships had not been adversely affected by operating as a family partnership and, secondly, one of the resident partners was a managing partner or 'boss'.

Other important factors were the early retirement of the partners before any management differences between father and son could lead to permanent damage to family relations. Early retirement also avoided the situation of two family units having to live and work in close proximity on the one property.

Important causes of disagreement among partners were purchase of additional blocks of land, the presence of non working partners, a lack of information exchange (particularly of financial information), and management differences between fathers and sons.

The present upper weight limit for road vehicles without special permit is 38.4 t. The effect of enforcing this upper weight limit would cause the withdrawal of at least 400 double decker livestock vehicles costing about $35,000 each from the cattle haulage industry. This could result in an increase in road haulage costs for beef producers of up to 82%.

Livestock vehicle owners believe that if the gross loaded weight of beef transport vehicles were temporarily increased to 41.9 t, the industry, through improved trailer design and improvements in materials used in trailer construction, would be able to meet the present gross load requirements within 5 years.

A report on a survey on costs of ownership and operation of farm machinery on wheat farms from the Darling Downs and adjacent south west region was published. A major survey of nearly 300 farms provided information on farm machinery investment levels, operating procedures, replacement strategies, fuel use, and repairs and maintenance costs for all farm machinery.

The information collected enables extension and research workers, together with farmers and consultants, to use up-to-date information on machinery costs. As an adjunct to a survey to investigate the peanut industry in the Burnett, machinery costs were collected for that area.

Agribusiness extension projects aimed at informing financial institutions and other agribusiness, such as accounting firms, of the profitability and problems of primary producers within various regions have had considerable success during the year. These programmes will help bridge the gap in knowledge between the often changing population in these institutions and the farming residents in the area.

Standards Branch

THE role of Standards Branch is to benefit primary industries by maintaining appropriate standards and control systems for agricultural requirements and agricultural products.

Its objectives are—

- To ensure that agricultural chemicals, stock foods and veterinary medicines offered for sale are effective.
- To ensure that agricultural chemicals, stock foods and veterinary medicines and seeds offered for sale are true to label and/or up to standard.
- To facilitate the marketing of agricultural produce by ensuring that commodities: comply with prescribed domestic, interstate and overseas requirements; agree with their trade description; are acceptable to consumers; are packed, handled and transported economically.
- To ensure that the commercial distribution of agricultural chemicals is carried out in a safe, responsible and competent manner, and to assist people whose crops and stock are damaged as a result of accidental drift.
- To maintain a seed technology unit to service the second and third objectives listed above, and to provide information on seed quality to farmers and seed merchants.

Staff

The total staff strength of the Branch is 97. This number equals that for 1980–1981 and includes officers recruited to fill those vacancies caused by several resignations, transfers and retirements.

Agricultural Standards

Legislation

The Agricultural Standards Act 1952–1981 relates to the sale of many materials used by primary producers including seeds, stock foods, fertilizers, limes, pest destroyers, veterinary medicines and growth regulating materials.

Alterations effected in April 1981 will improve administrative procedures by removing several redundant, outmoded and some over-restrictive provisions from the original Act. Firms selling the relevant materials, Standards Branch, and the consumers of these materials, that is, the primary producers, the home gardener and the pet owner, should appreciate the benefits.

One important aim of the *Agricultural Standards Act* is to ensure that Queensland buyers of agricultural chemicals receive materials which, when used as directed, will be effective for the purposes for which they are sold.

Registration

A total of 4 819 applications for registration, including re-registration and renewal, was processed during 1981–1982. This represents a decrease of 80 on last year's applications. Approval was also granted for the supply of five special mixtures of pest destroyers and 53 special mixtures of fertilizers.

The Technical Committee on Agricultural Chemicals referred to its member in Standards Branch 54 submissions for clearance of new agricultural chemicals and of new uses of agricultural chemicals already being sold. Consultants from within and outside the Department contributed advice on the effectiveness of each of the subject pesticides. Subsequent clearances from this Technical Committee were used in applications for registration in Queensland.

The Agricultural Requirements Board considered the claims made by primary dealers regarding the efficacy of 1964 preparations. This represents an increase of 20 compared with the previous equivalent year (1978–79) in the registration cycle.

The following table provides an indication of the Board's activities—

——	1978–79	1979–80	1980–81	1981–82
Pest Destroyers	830	1,195	599	761
Veterinary Medicines	924	757	764	1 122
Stock Foods.....	117	47	120	61
Fertilizers.....	43	15	36	6
Growth regulating materials.....	30	38	36	14
Total	1 944	2 052	1 555	1 964

Requests for approval of 31 recommendations from Departmental sources were also considered by the Board.

The review of veterinary medicines which began last year is now almost complete. The increase in the number of veterinary medicines considered by the Board this year is because of this review.

Following a request by the Board last year to primary dealers, recommendations for the use of DDT on cotton have now been removed from all labels. The only remaining acceptable recommendations for preparations containing DDT are for use against apple dimpling bug in apples and pears and certain pests in bananas.

There are no preparations containing camphechlor and DDT now registered for sale. These were previously approved for use on cotton.

The expansion of Standards Branch Pamphlet No. 74 was continued during the year despite staffing difficulties. Information on the approved uses, methods of application, limitations on use and toxicology of eight pesticides was added. Similar information on 26 pesticides already in the pamphlet was updated.

Data sheets have now been issued on all currently registered plant fungicides.

Design work in conjunction with Biometry Branch has begun on a computerized system for keeping registration records. It is expected that the system, which should come into operation next year, will improve the efficiency of administration procedures under the Act. Its introduction will help new procedures introduced by the *Agricultural Standards Amendment Act* to streamline renewal of registration.

The system will permit rapid renewal of registration to occur. Notices produced by the system will be forwarded to primary dealers advising them of renewal details required. Upon receipt of return advice and the appropriate fees, notices of renewal of registration will be generated by the computer.

The system will facilitate the production of up-to-date lists to assist field staff in their surveillance of agricultural requirements in the market place.

Agricultural requirements

Inspection and Chemical Analysis Service

The purpose of the Inspection and associated Chemical Analysis Service is to protect primary producers and consumers by ensuring that agricultural requirements offered for sale in Queensland are of an acceptable standard, true to label guarantee and are distributed by commercial spray operators in a responsible manner.

Inspection and sampling of agricultural requirements, as provided for by the *Agricultural Standards Act* 1952–1981, continued during the year at a level similar to that during 1980–81. Again there was an increase in emphasis on the penal provisions of the Act.

A stock food manufacturer was successfully prosecuted during the year while an appeal against a decision in the Dalby Magistrate's Court was dismissed. Other cases are pending.

To facilitate the conduct of actions involving the Courts, improved procedures for handling samples and reporting results have been developed. Close liaison with officers of the Solicitor-General's Department has been beneficial.

The following table provides a summary of inspection activities—

Action on agricultural requirements offered for sale in Queensland

—	Seed	Pest destroyers	Veterinary medicines	Stock food	Fertilizers and limes
No. of lines sampled .	1 524	144	42	320	70
No. of lines that failed to Comply...	155	30	8	78	21
Action taken for non-compliance					
No. of lines seized....	108	14	1	13	0
Action taken for non-registration					
No. of lines seized....	..	3	1	8	4

A major reason for the non-compliance of seed samples was incorrect labelling or absence of labelling on seed lines containing restricted seeds. Merchants have been warned that failure to correctly label seed lines which contain restricted seeds may result in legal proceedings being instituted against them.

The presence of esters, other than those stated on the label, in certain formulations of a phenoxyacetic acid type herbicide was of concern. Discussions were held with a large formulator and officers of the Agricultural Chemistry Branch on this matter.

Deficiencies were detected in several batches of an aldrin formulation. The cause of the problem was attributed to the use of below specification technical material in formulation.

The level of non-compliance of stock foods continues to be a problem. Legal proceedings have been started in some cases where deficiencies have been detected.

A significant number of samples of agricultural limes failed to comply with label guarantees. This issue is to receive particular attention.

Samples were submitted to Commonwealth testing authorities analysing 2,4,5-T for dioxin, grains and feeds for aflatoxin, and dairy cleansers and chemical sterilizers for compliance with set standards.

Considerable effort was devoted during the year to checking records kept by commercial operators licensed under the *Agricultural Chemicals Distribution Control Act* 1966–1978. These operators are required to make and keep a record of their commercial spraying of herbicides. A record includes information on the location of the spraying, the date, the herbicide used, the rate, the wind speed and direction, and the crop sprayed.

Assistance was provided to the organizers of the first International Training Course on fodder and fodder seed production.

Seed certification

Certified pasture seed

The area planted to pasture seed increased a further 50% to 1 828 ha registered as basic and certified seed. The quantity of seed actually labelled increased some 2¼ times from 22 t in the previous year to 48.1 t in 1981–82. This increase in production was a result of Graham stylo and Callide Rhodes grass plantings of the previous year coming into production.

Supplies of Callide Rhodes grass seed were ample to meet the local demand, with some seed carried over. Basic seed of Fitzroy and Oxley stylo was in short supply, with the seed available being rationed out to prospective certified seed growers.

OECD labelling

Orders were received during the year for 10 t of pasture seed to be exported and labelled with OECD labels. A total of 6.4 t of Callide Rhodes was finally labelled and sealed and exported through the South Australian Seed Growers' Co-operative. Some of this seed was re-tested under the International Method, as requested by the buyer, because the International Seed Testing Association does not recognize the Irish method for testing of Rhodes grass

Cleaning problems of stylo

Many stylo lines are failing to pass the purity standards because they contain excess weed seeds. This is due to a number of factors, but primarily that these cultivars are relatively new. Furthermore, growers and the operators of harvesting and seed cleaning equipment have not had much experience with these species.

These problems are expected to lessen as the areas become better established and operators gain more experience.

Approved oats

Interest in Approved and Certified oats continued with the production of 16 t of Certified Stout oats. This seed is free from black oats and will be available to all SIA members who wish to produce approved seed or to other growers for the planting of oats free of black oats. One merchant also showed interest in Approved Camelia oats. This resulted in the production of a small quantity of this variety.

Hybrid maize and sweetcorn

Seed of only two hybrids, QK657 and QK690 (both north Queensland varieties) was produced to a significant level during the year. The New South Wales hybrid GH5004 was grown in south Queensland but only 500 kg of seed were produced. Problems of seed set were encountered in the production area.

Problems continued to plague the hybrid sweetcorn seed production programme, with only one grower attempting to produce seed. A new variety Aztec was accepted into the scheme in February, but plantings have yet to be made.

The major problem with the only variety currently in the scheme, QS467, is the flowering difference of the parents. Aztec does not possess this problem and should also be well accepted because of its resistance to sugarcane mosaic virus, as well as its better flavour and colour than QS467.

Certified bean seed

Production of all types of bean seed fell during the year. The area planted was about half that of the previous year, with yield per hectare being maintained.

All seed produced for an area has been included in the year's production, although some seed is held as carryover seed and is unslurried. The merchants will progressively slurry this seed over the next 12 months.

Certified tomato seed

The quantities of tomato seed packaged for sale as certified seed increased slightly in the year. Only seed which was actually sealed has been included in the statistics. Large quantities of Flora-Dade seed have been produced but are in store.

The new variety Scorpio was released and 3.66 kg of seed were packaged as certified seed.

Procedural methods

These remained on the whole unchanged during the year. Minor improvements in pre-printing labels, such as colour coding and the printing of cultivar names, were introduced and these will be progressively adopted as old stocks are exhausted. The new colour codes are as follows—

Special mother seed	white label with green ink
Pre-basic seed	white label with red ink
Basic seed	white label with blue ink
Certified seed	white label with black ink

Areas registered and seed certified (including basic seed)

	1979–80		1980–81		1981–82	
	ha	t	ha	t	ha	t
Hybrid maize	59	186	44	158	29.5	88.0
Hybrid sweetcorn	..	..	1	0.5	1	0.5
French bean	63	79	107	96	52.8	55.5
Navy bean	6.5	9	12	24	12	12.5
Oats	0.5	1.4	6	8.6	9	16.6
Pasture	833	10.3	1 330	22	1 828.5	48.1
Tomato	..	0.37	..	0.08	..	0.1
Total	**962**	**286**	**1 500**	**309**	**1 932.8**	**221.3**

Special Mother Bean			
Stage A (t)	0.2	0.17	0.66
Stage B (t)	3.7	1.17	0.75
Total (t)	**3.9**	**1.34**	**1.41**

Approved oats	Areas accepted (ha)		
Stout	109	30	62

Fruit and vegetable services

The purpose of activities carried out by the Fruit and Vegetable Inspection and Extension Service is to benefit consumers as well as the fruit and vegetable industry and associated industries. This is done through inspection activities and extension services designed to ensure that fresh fruit and vegetables offered for sale in Queensland are of an acceptable standard, and are handled, transported and stored under conditions conducive to the maintenance of freshness and shelf life.

Inspections of fruit and vegetables offered for sale in Queensland are carried out under the *Fruit and Vegetables Act* 1947–1972 by inspectors based at the Brisbane Market and in the major country areas of Warwick, Toowoomba, Kingaroy, Bundaberg, Gladstone, Rockhampton, Townsville, Cairns and Mareeba. In other country areas, staff of other Branches of the Department co-operate by carrying out inspections as required.

Inspection service

The following table is a record of actions taken under the Act at the Brisbane Market, Rocklea—

Commodity	No. of actions taken	Quantity seized for non-compliance	
		Packages	Bins
Fruit	2 677	52 176	247
Vegetables	1 494	28 655	372
Heavy produce	321	25 430	96

Actions taken in major regional centres, where Standards Branch Inspectors carry out inspections of wholesale premises, are summarized below—

Centre	No. of packages subject to action		
	Fruit	Vegetables	Heavy produce
Rockhampton	413	1 015	518
Townsville	3 199	4 079	218
Cairns	4 079	4 616	135
Toowoomba	270	37	90

Retail inspections have a high priority in Branch work. Two officers have been recently transferred to the Indooroopilly complex to spend most of their time on this activity. There were 2 076 inspections of retail outlets during the year in Brisbane, Ipswich, Moreton and North and South Coast areas. Within this activity, 624 lines were found not to comply.

Seizures of fruit at the Brisbane Market remained at about the same level as in the previous year. Significant causes of loss during the year included the incidence of anthracnose in the early Fuerte avocado, immaturity in early season 'white' grapes, maturity variations in common mangoes, a large number of unsound and immature rockmelons and hail damaged stone fruit.

Seizures of vegetables in bins increased by approximately 70 compared with last year's total, with the number of packages seized being approximately 1 000 fewer. Faulty vegetables coming significantly under the notice of inspectors included capsicum, cucumber, lettuce, carrot and celery, as well as large numbers of packages of potatoes, pumpkins and onions. The actions taken with these commodities are shown below—

Commodity	Consignments examined	Packages seized	Packages destroyed
Avocado	61	349	219
Grape	145	5 389	4 498
Rockmelon	542	12 110	10 564
Capsicum	125	3 047	2 081
Cucumber	213	4 714	4 274
Lettuce	121	6 592	4 581
Carrot	36	1 907	1 523
Celery	31	1 071	873
Potato	151	17 681	5 146
Onion	23	5 676	3 064
Tomato	302	9 381	7 335

It is noteworthy that seizures of melons and tomatoes were again the cause of concern. The figure for rockmelons increased from 11 387 packages last year to 12 110 this year, and tomatoes from 6 740 to 9 381. By contrast, the seizures of carrots and capsicums this year were substantially fewer than in the previous year.

In addition to taking action where appropriate, inspectors issued 240 infringement notices to growers advising them of non-compliance, as well as 190 reports containing observations of poor presentation and suggested methods for improvement. In addition, 104 samples of diseased fruit and vegetables were taken and submitted to Plant Pathology Branch for identification of the causal organisms.

Activities under the *Diseases in Plants Act* 1929–1972 included the checking of certificates of treatment against *Sclerotinia laxa* and *Phylloxera*. In addition, 211 certificates of fumigation of straw used for packing material were issued under the provisions of the *Stock Act* 1915–1976.

Fruit maturity testing

The Fruit Maturity Testing Service is carried out primarily to check samples taken by inspectors for compliance with the relevant maturity standards. It also partially meets the needs of those growers wishing to plan optimal times of harvesting.

During the year under review, 1 342 samples were examined—a figure almost double that of the previous year. A dissection of the samples taken at the Brisbane market and results obtained are set out in the following table—

Commodity	No. of samples tested		No. failed to comply	
	1981–82	1980–81	1981–82	1980–81
Apricot	26	0	Experimental tests	
Apples	117	0	Experimental tests	
Avocado	309	170	121	56
Citrus	145	203	43	86
Grape	286	132	122	32
Mango	243	88	67	19
Pineapple	32	16	7	6
Plum	42	47	Experimental tests	
Rockmelon	142	72	80	40

Extension services

Activities of the Marketing Extension Service have been substantially transferred to Horticulture Branch. The involvement of Standards Branch inspectorial staff in this extension role is now centered upon supplying information on market quality and outturn to growers, district extension officers and merchants, as well as retail outlets.

Initiatives are being taken by market inspectors to increase their allocation of time into extension to retailers, agents and merchants. This has been facilitated by the placement at Indooroopilly of two inspectors engaged primarily in purely inspectional duties. More time is now available for inspectors based at the Brisbane Market to plan and execute extension activities.

The fruit maturity testing service for growers' samples is seen as a useful extension adjunct to the enforcement of grade standards. A future expansion of this service to include the testing

of samples of fruit intended for despatch to northern and western centres is being contemplated. This move will be another step in a programme designed to improve the quality of fruit and vegetables marketed in distant areas.

Some northern and southwestern areas were visited by senior Standards Branch inspectorial staff. This exercise was undertaken primarily to ensure that methods of inspection were consistent. Information obtained from this survey will also assist in planning further improvements in marketing fruit and vegetables in these areas.

Two new problem areas have arisen where close co-operation between the Marketing Extension Service and Standards Branch inspectorial staff will be needed in the planning of effective extension activities. One is the incidence of the toxic principle cucurbitacin E in zucchini; the other is the need for a thorough situational analysis of the apple industry.

Agricultural chemical distribution control

Standards Branch services The Agricultural Chemicals Distribution Control Board which was formed under the *Agricultural Chemicals Distribution Control Act* 1966–1978. The activities of the Board provide landholders with some protection from damage caused by commercially distributed agricultural chemicals. Responsibilities include the licensing of agricultural pilots and commercial weed control operators, recommending controls on the use of agricultural chemicals in the State and the consideration of requests for permits to use restricted chemicals in Hazardous Areas.

Owners of crops and livestock damaged by drifting agricultural chemicals from aerial spraying and of herbicides from ground spraying obtain assistance from an investigational service provided under the Act. An investigation usually includes an inspection of an affected crop, or animal, the examination of the records of licensed pilots and commercial weed control operators, and the analysis of samples for chemical residues. The reports from these examinations and inspections by officers of the Department are considered and the Board makes a statement on its findings in relation to the complaint. The statement is issued to the owner of the damaged crop or animal.

Licensing

Seventy-eight examinations for unrestricted licences were held in 15 centres during the year. One hundred and eighty applicants were examined for commercial operator's licences, as well as 12 candidates for pilot chemical rating licences. From these and earlier examinations the following licences were issued or renewed—

176 unrestricted commercial operator's licences issued;
171 restricted commercial operator's licences issued;
1 134 commercial operator's licences renewed;
24 pilot chemical rating licences issued;
61 pilot chemical rating licences renewed.

Export inspection services

The role of the Export Inspection Service is to maintain the standards of quality of Queensland plants and plant products in line with Commonwealth export legislation. In addition, this service facilitates the movement of plant and plant products in international trade by providing inspection services and documentation in conformity with the International Plant Protection Convention.

Standards Branch inspectors supervised the inspection of fresh fruit, vegetables, plants, grain and other field crops, and issued phytosanitary certificates when required by overseas countries.

Associated duties involved ship and container inspections before the commodities were loaded. This year, 59 vessels were inspected at the port of Brisbane and 37 vessels at Gladstone.

There were 2 447 inspections of empty containers at metropolitan containers depots. Of these, 257 containers were rejected and a further 982 were withdrawn from use pending fumigation, spraying, cleaning or repairs.

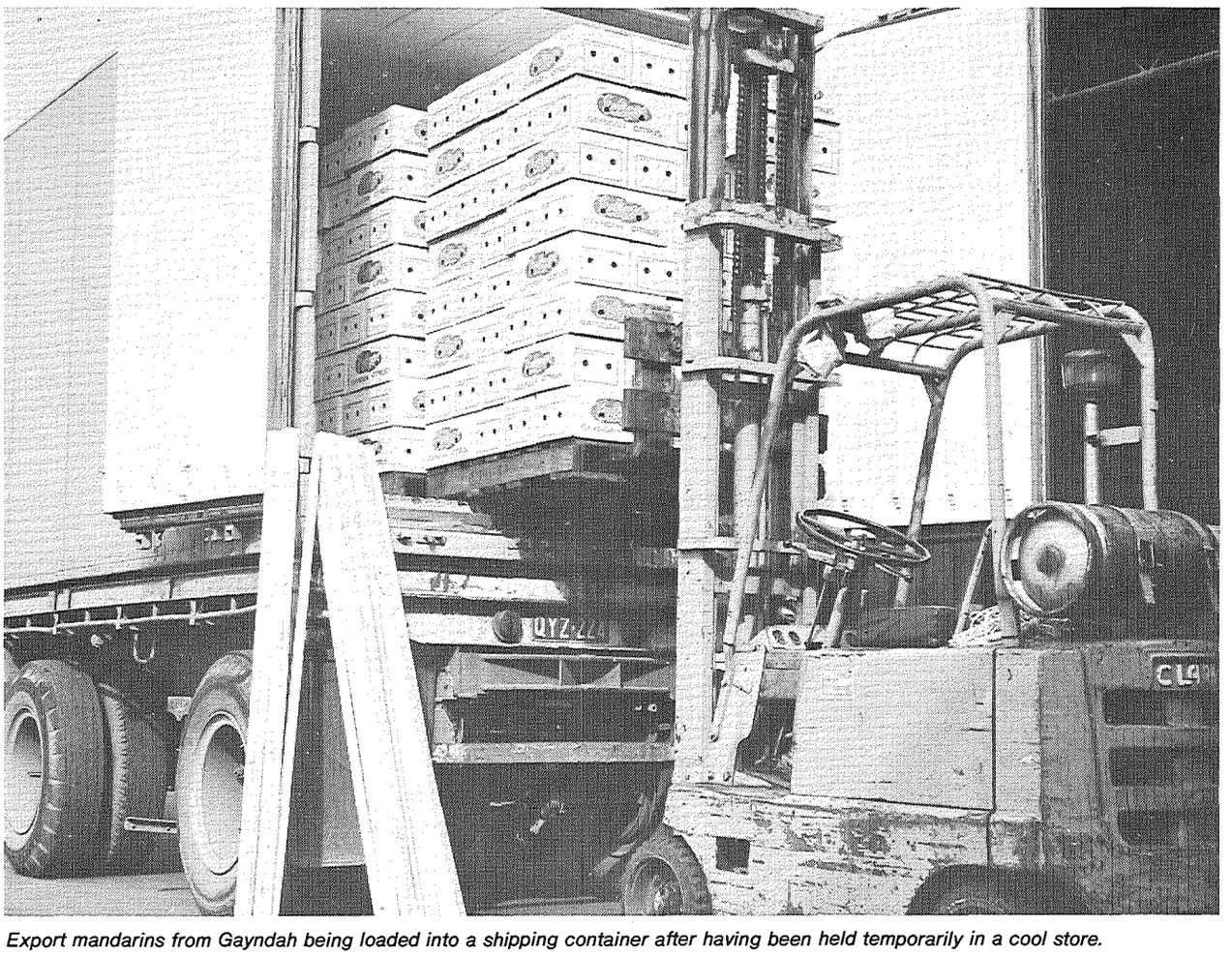
Regular inspections were carried out at the export grain terminals at Pinkenba and Gladstone to ensure the proper maintenance of hygiene standards.

Other duties included the supervision of fumigation, heat treatment and other insect disinfestation measures. In addition, inspectors took samples of fruit for maturity determinations and of grain and other produce for pesticide residue analyses.

Cereals and coarse grains

Favourable weather conditions contributed to a substantial increase in grain exports from the ports of Brisbane and Gladstone.

Increasing shipments of containerized units were loaded from country storages on the Darling Downs. Total shipments of cereal and coarse grains from Queensland were 1 648 191 t, comprising: wheat 495 216 t, barley 310 349 t and sorghum 842 626 t.



Export mandarins from Gayndah being loaded into a shipping container after having been held temporarily in a cool store.

Details of shipments from Brisbane and Gladstone are—

Destination	Wheat (t)	Barley (t)	Sorghum (t)
Japan and Far East	77 098	..	729 921
South-East Asia	156 623	278 687	43 513
Papua New Guinea and Pacific Islands	29 616	..	17 845
Near and Middle East	26 145	251	..
Russia	143 754	23 438	51 347
China	61 980	..	..
South America	..	7 973	..
Total	495 216	310 349	842 626

Other grains and seeds

Standards Branch inspectors were also required to examine a wide range of produce for export and/or to issue phytosanitary certificates. Details are summarized (in tonnes) in the table at the foot of the page.

Pertinent comments on the exports in the table are—

- The quantity of seeds for sowing is an increase over that exported during the previous year.
- Carpet grass (*Axonopus* spp.) and *Panicum maximum* were again the two main tropical pasture species exported.
- Birdseed grains, peanuts, mung beans, rice and other crops for culinary purposes were exported to traditional markets in the Pacific from southern and central Queensland districts.
- The macadamia nut industry remained stable with 111 tonnes of raw kernels being exported, mainly to Central Europe.
- The pecan nut industry based at Moree exported 652 t of nuts through the port of Brisbane to the USA.

In addition to the above, numerous small consignments of miscellaneous grocery trade products comprising 198 t, including dried beans, peas, lentils and other culinary items were exported to Papua New Guinea and Pacific Islands.

Other activities of significance were the inspection and fumigation of gift shipments of 1 000 t of maize for Mozambique, 3 650 t of flour for Burma and 4 000 t of flour for Korea, on behalf of the Department of Administrative Services.

Fruit and vegetables

Supervision of the export of fruit and vegetables on behalf of the Commonwealth was continued during the year.

Exports of citrus fruit, especially of mandarins to Canada, the Middle East and Europe, were considerable but still only a little over half of the previous year's high figure. Quality was high and most out-turn reports were complimentary.

Smaller quantities of apples were exported. These went mainly to our traditional markets of Papua New Guinea and to Singapore.

Pear exports increased in number. The main overseas destinations were Papua New Guinea, Singapore and Europe. There were heavy rejections of pears offered for intended export to Norway and other countries in Europe because of the presence of San Jose scale for which a nil tolerance prevails in European countries.

Heavy vegetable exports decreased from 1 636 t in 1980–81 to 1 102 t in 1981–82. Substantial consignments of onions were shipped to Fiji during the summer. There was a slight increase in the quantity of light vegetables exported. Most of these went to New Guinea, but increasing amounts of high quality broccoli have been airfreighted to Singapore and Hong Kong.

The following table summarizes the quantity (in tonnes) of fruit and vegetables exported during 1980–81 and 1981–82—

Commodity	1980–81	1981–82
Citrus fruits		
Lemon	169	89
Grapefruit	493	159
Mandarin	6 749	4 286
Orange	2 992	1 254
Total citrus	10 403	5 788
Other fruit and vegetables		
Apple	1 212	569
Pear	333	389
Other fruit	385	323
Heavy vegetables	1 636	1 102
Light vegetables	875	948
Total other fruit and vegetables	4 441	3 331
Total all fruit and vegetables	14 844	9 119

Plants

The number of consignments of plants inspected for the phytosanitary requirements of importing countries increased from 303 last year to 428.

Fumigation

Supervision of fumigation of fruit and vegetables with ethylene dibromide (EDB) or methyl bromide was carried out to meet both export and interstate requirements. Total quantities supervised were considerably less than in the previous year, because of a change made by the Victorian Department of Agriculture in procedures associated with the importation of produce liable to fruit fly infestation.

It is no longer necessary for Queensland Departmental officers to supervise the fumigation of fruit and vegetables going to Victoria. A declaration signed by the fumigation room operator and giving prescribed details is now accepted by the Victorian authorities.

The three approved EDB fumigation rooms in north Queensland at Ayr, Home Hill and Bowen have been used extensively for the fumigation of capsicums sent to interstate markets.

Those export fruit and vegetables requiring fumigation with EDB were treated at Mundubbera and Brisbane. Pineapples requiring methyl bromide fumigation were treated at the Brisbane Market, Rocklea.

The following table lists the quantities of fruit and vegetables fumigated under supervision during 1981–82—

Kind of produce fumigated	Packages
Fruit	
Grapefruit	2 944
Lemon	900
Mandarin	59 659
Mango	1 256
Orange	4 854
Pineapple	871
Rockmelon	94
Vegetables	
Capsicum	74 785
Cucumber	325
Eggfruit	27
Zucchini	218

Countries of destination	Nature of produce						
	Seeds sowing	Seeds culinary	Peanuts	Bird seeds	Malt	Rice	Stock foods
U.K. and Northern Europe	1	680	1 683	187	..	750	37
Southern Europe	3	153	..	2 540	..	..	..
North America	148	1 209	..	17	..	295	..
South America	275	140	..	..	..	..	..
Central America	9	..	..	..	..	..	..
New Zealand	37	11	921	1 226	..	..	..
Papua New Guinea and Pacific Islands	312	123	1 143	2 502	3 400	35	1 129
South-East Asia	402	99	1 254	957	..	..	..
Far East—Japan	86	55	1 472	3 962	370	..	197
Far East—Taiwan	15	449	..	6 235	..	..	..
Far East—China	13	..	..	18	..	..	..
Far East—Others	19	18	..	600	..	..	..
Near and Middle East	60	71	..	295	..	..	..
Africa	70	..	..	252	..	..	..
Total	1 450	3 008	6 473	18 791	3 770	1 080	1 363

Quarantine

Sampling and inspection of imported seeds for sowing and fruit and vegetables are carried out on behalf of Plant Quarantine Service at the port of Brisbane.

Most of the seed imported under Quarantine supervision came from the USA and New Zealand. Seed of ryegrass (*Lolium* spp.), lucerne (*Medicago* spp.) and Bermuda grass (*Cynodon dactylon*) comprised more than three-quarters of the 1 267 t of seed imported.

Citrus fruits from the USA, tomatoes and stonefruit from New Zealand comprised the major fruit and vegetables imports inspected.

Branch officers also work closely with Quarantine officers at the ports of Townsville, Gladstone and Cairns, assisting with cargo inspections and other items subject to Quarantine inspection.

Seed testing and research

The role of the seed testing service is to provide information for regulatory purposes, and to verify seed quality for research purposes. In addition, the service provides assistance to intending purchasers of seed in the selection of an appropriate quality for planting. Tests on seed submitted by a farmer for his own sowing are carried out free of charge.

Sources of samples

The following table indicates the extent of general seed testing carried out conjointly during the year by the Queensland Seed Testing Station at Indooroopilly, the Seed Testing Sub-station at Toowoomba, and the North Queensland Sub-station at Mareeba.

Samples received at Indooroopilly during the year were again predominantly pasture grass seeds, the main species being *Panicum maximum*. By contrast, the Toowoomba Sub-station analysed the bulk of cereal, birdseed and oilseed samples. The Mareeba Sub-station handled mainly field crops.

Sources of seed samples received for analysis at the Departmental seed testing laboratories were—

Source of sample	Purity	Germ.	P & G	Bird seed	*T.T.C.	Totals
Merchant	111	1 977	3 758	13	231	6 090
Farmer	16	980	331	..	13	1 340
Inspector	15	1 087	736	17	2	1 857
Export	86	2	293	1 337	8	1 726
Import	58	2	112	..	3	175
Departmental	52	798	76	..	30	956
Other Departments	..	32	7	..	..	39
Totals	338	4 878	5 313	1 367	287	12 183

*Tetrazolium chloride tests.

In addition, 80 samples were tested for moisture content.

Overall, this represents a slight reduction in the total number of samples being submitted for testing, when compared with the previous year.

International certificates

Approximately 200 Blue International Seed Sample Certificates relating to samples submitted by merchants were issued during the year. This was much the same as last year. However, there were slightly fewer Orange International Seed Lot Certificates, relating to samples taken by Government Inspectors, of which only 116 were issued this year.

Tetrazolium testing

A special laboratory was established during the year in expectation of an increased demand for the tetrazolium test. This laboratory is currently being operated by one analyst, who is also training others in this specialized technique. Results from the tetrazolium test can be obtained in one-tenth of the time of the traditional test methods for viability.

Staff and staff training

During the year, four senior seed testing staff retired. Considerable input has been required to train new appointees.

Staff have participated in a number of DPI training schools during the year, including supervisor training, management training, and role specification.

Reliability of analytical results

To maintain a high standard of expertise, our laboratory participates in programmes which compare our analytical results with those obtained by laboratories throughout Australia and overseas.

All government laboratories in Australia have participated in the testing programme involving soybeans, French beans, pigeon pea and pasture species.

On the international scene, our laboratory participated in the testing programme involving sunflower, lucerne, and brassica.

In addition to these, an extensive retesting programme has been introduced at Indooroopilly to ensure consistency of test results.

Research

Several problems involving peanut seed quality have been investigated this year. As a result of this work, Standards Branch was able to advise on the development of a blueprint for peanut seed production. The initial stages of implementing some of the recommendations have already begun. Investigations will continue in the areas of artificial drying, storage and chemical dressings.

Further trials on the dry heat treatment of seed of *Leucaena leucocephala* indicated that care is needed when the hard seed content is already low. A low moisture content is required to ensure that viability of the seed remains unimpaired during heat treatment.

Tetrazolium studies on sunflower seed have indicated that even small amounts of Rutherglen bug damage can cause seeds to fail to germinate. It is suggested that bug damage is involved in the entry of pathogens into the seed.

Visitors

The Seed Testing Laboratory was again a centre of interest for overseas, university and college study groups.

Dr John Ferguson, of CIAT, Colombia, and Mrs T. Sudikno, of Gadja Mada University, Indonesia, both spent periods of sabbatical leave at the Brisbane laboratory.

Two groups of international students from a wide range of developing countries received training in seed testing from Standards Branch. The second group is additionally receiving an intensive course in fodder production under the supervision of Mr T. E. Friend.

Miss I. Lamberth organized a 3-day workshop at Indooroopilly on tetrazolium testing to demonstrate techniques developed at an international workshop in Norway. The local workshop was attended by 17 people representing government and seed industry in the eastern Australian States.

Publications

In 1981, Mr J. Butler was appointed as editor of the *Australian Seed Science Newsletter*. This publication is a valuable forum for the exchange of ideas and information on any seed related topic. The Newsletter is widely distributed within Australia and overseas.

Miss H. Low prepared and published a new edition of *Queensland Seed Testing Procedures*. This manual describes the current techniques used by Standards Branch in assessing seed quality.

Division of Land Utilisation

THERE is little doubt that the land of this State is being subjected to severe damage. This damage results from inappropriate management techniques which allow soil erosion, salinity, structural damage and loss of fertility to occur.

In some cases, this is due to management on the farm, in others to practices outside the farm, and sometimes simply to inappropriate use of the land in the first place.

It is the work of the Division of Land Utilisation to assist in developing sound uses of the State's land resources. It provides an agricultural engineering service to the farming community and to other sections of the Department. In addition, it maintains a drafting section to help with the production of maps and other drawings which relate to the work of the Division.

So that the main thrust of the Division's goals may be achieved, it must study the present use of the land in relation to its ability to sustain production, its potential for use in the future, and the management practices which might most securely stabilize its productivity. In the process, information is collected about the State's resources and, based on this information, opportunities for development are evaluated. Problems of land degradation are researched, practical solutions are developed and tested, and these are used as a basis for providing extension and farm services to the rural community.

The Division has organized its operations into a suite of sub-programmes. Each of these sub-programmes comprises related areas of activity and each is a clear portion of the work which the Division must do to achieve its goals.

Land Resource Assessment, Development Planning and Evaluation, Land Management Research, General Soil Conservation Services and Areas of Erosion Hazard Services are the sub-programmes which make up the land use area of the Division's activity. These headings are used as a basis for this report. Agricultural Engineering Research and Environment and Resources Research are the two sub-programmes in the Engineering Services area. These are reported together.

Implementation of soil conservation measures

Some 69 000 ha of land were treated with soil conservation measures during the year. This is again a record and is an increase of 10% over the area treated in 1980–81. Because the potential for loss of soil from any individual hectare of cultivated land is far greater than from any hectare of pasture, work has concentrated on the treatment of cropping land. Therefore, virtually all this area relates to cropping.

While it is appreciated that, in total, a considerable amount of erosion occurs in grazing country and that in some specific cases this is severe, it is also recognized that, in the vast areas of grazing, treatment for rehabilitation with our present methods would be far from economic. Records were again set in both extensive and intensive crop areas. Interest in strip cropping following the Dalby floods remains evident in the figures.

With the present huge expansions of the area under crop, particularly in the grain industry, even these record figures are not keeping up with the growing need for service. Much of this expansion is occurring on land which is marginal for cropping and which is extremely prone to erosion. Because of the shallow depth of these soils, their use is finite and indeed shortlived without early treatment.

Requests for service remain very high and virtually every district has a large backlog of requests which represent a delay of many months for interested co-operators.

According to revised estimates, the progress of treatments applied in the present cropping land of Queensland remains much as it was at the end of last year—

Treatment required	% treated
Intensive treatment.....	53
Simple practices.....	22
Intensive cropping lands	15

This year, considerably greater effort has been put into the development and extension of conservation cropping practices which are designed to keep cover on the soil over as much of the year as possible, and especially during the period of intense erosive rains. This cover may be in the form of a crop or a surface mulch of crop residues. This is proving a useful adjunct to soil conservation structures in many areas of the State.

Because the system requires some modifications to machinery, some new equipment and a change in management thinking and practice, its initial acceptance is relatively slow. There is, however, considerable interest in the approach. Work is continuing in the grain areas and is now properly under way within the sugar industry where greater problems may well exist.

Approval was obtained during the year for three new field positions at Biloela, Atherton and Roma. This will assist to some extent in alleviating the severe shortage of staff for soil conservation. In addition, the Department received a special grant from Treasury equivalent to our expectations from the Federal Government under their aborted assistance scheme. This has allowed, among other things, the purchase of some sophisticated surveying equipment for testing in field situations.

Soil Conservation Authority

The Soil Conservation Authority held no full formal meetings during the year, but several meetings of reduced size discussed problems within the Areas of Soil Erosion Hazard, particularly the potential use of mandatory powers and the operation of the new Advisory Group Committees in the Burnett area. Relations with all the Advisory Group Committees have been excellent, although some problems have arisen from time to time.

Planning Committee for Soil Conservation

During 1981–82, Cabinet directed the appointment of the Planning Committee for Soil Conservation under the Chairmanship of Mr D. Eather, General President of Queensland Grain Growers' Association, to study and report on management aspects of soil conservation throughout the State. Particular reference was directed towards the responsibilities of Government bodies and landholders for handling the problem.

Several visits to country centres have been held to hear the views of landholders, local authorities and others on these subjects. The Committee is to report towards the end of 1982, and its recommendations are expected to point the way for better use of Departmental resources in the future.

Land resources

Mapping associated with the huge western arid land use study has now been completed. The survey covered 60m ha of western Queensland and draft maps at a scale of 1:250 000 are now available for all of this region.

Field work for land resources studies in the horticultural area in the near north coast is now complete as is the field work in the Central Burnett. In the South Burnett area, report and mapping have been concluded. Major resource areas on the Eastern Darling Downs have been studied in detail. Other cropping areas of the State are still being studied including a survey on the extent of cropping in the near south west region. These studies are already proving of considerable value to local authorities, other sections of the Department and many other organizations.

The Department has continued its involvement with local authorities in the area of town planning.

It was responsible for a shift of sugar-cane assignments from badly eroded sloping land at Childers onto soils already treated for erosion control and was pleased to see that this shift has proved successful during this year.

Increased assignments in sugar-cane areas over the last 2 years have involved Division officers in considerable work reporting on the suitability of specific parcels of land suggested for use for cane farming. In addition, other areas are being studied for possible further expansions. Field work for land use studies in the Mackay area were completed. Discussions with the local sugar industry on the use of the preliminary findings have been most encouraging. Suggestions for possible assignment transfers in the Maryborough area have not been acceptable to the local farmers at this stage.

Research

Research into methods of describing, measuring and countering the effects of soil erosion have continued. Emphasis is being placed on the development of technical guides that can be used for design and implementation of soil conservation measures and on the effects of reduced tillage in grain and sugar crops.

Studies have shown that one particular grass, Indian bluegrass *(Bothriochloa pertusa)* continues to be valuable as a stabilizer for waterways in many parts of southern Queensland and studies of its establishment using cover crops have had success. Salinity is another problem area being researched.

Liaison

It is not possible to install soil conservation measures, especially in a planned catchment approach, without liaison with local authorities, Government departments and the farmers themselves. Resource assessment and development planning require similar consultation with outside bodies.

Officers continued to work closely with the Central Sugar Cane Prices Board and with Local Assignment Committees on the suitability of land for expansion or substitution of sugar-cane assignments and have added significantly to their work load by undertaking inspections and surveying for those bodies.

Officers of the Division continued their association with Mines Department, exploration companies and the Queensland Grain Growers' Association to develop guidelines for seismic surveys and other operations which have often caused problems for producers. They have given their time freely to assist the Planning Committee for Soil Conservation and have continued to liaise with many other organizations.

Involvement with Environmental Impact Statements continues to be a major part of the Divisional work load.

Engineering

A project involving tractor-implement matching and fuel saving techniques was generously supplied with a large tractor by International Harvester Co. of Australia on loan for use in field demonstrations. These demonstrations have only just begun, but they have shown, using specially designed gauges, how savings in fuel can be made. They are already proving popular with the farming community. Growers are encouraged to bring their own implements for use with the tractor. Plans envisage a number of field days like this over the next year.

The Section designed, in association with CSIRO, a complete tool bar design and arrangement for minimum tillage crop planting in the Northern Territory. It also assembled and tested two such rigs for CSIRO. They are now being used at Katherine in agronomic research work. This co-operation is expected to provide much two-way communication into the future.

In addition, arrangements were made for a commercial Darling Downs machinery manufacturer to build, with design assistance from Departmental officers, a prototype broadacre zero till planter for Departmental research. More than 30 commercially available plough, scarifier and cultivator tines were tested with a tine characteristic dynamometer. The results of these tests will be published shortly.

Work continues in the field of environmental control for livestock buildings in design, testing and extension. The Section is also involved with fruit fumigation, bean seed harvesting, sampling systems for sunflower receivals at depots and development of experimental machinery.

Farmers examine a modern chisel plough with good trash clearance after demonstration at a field day conducted by the DPI South Burnett Crop Industry Committee at Wooroolin on 10 March 1982. (Queensland Country Life *picture)*

Drought and Natural Disaster Administration

THE drought areas of Queensland became less widespread during 1981–82 as many declarations were revoked. Other natural disasters affecting primary producers in this year were hail storms and flooding in south east Queensland and cyclonic rains in north Queensland.

Drought conditions

The Local Authority Areas which were Drought Declared as at 26 May 1982 were Paroo and Quilpie, that part of the Booringa Shire south of the Eastern Dingo Barrier Fence and that part of the Murweh Shire south of the Western railway line. All these are situated in the far south west quarter of the State. As these areas again missed effective 1981–82 summer rain, none of the declarations is likely to be revoked in the near future.

Good rain in the south east quarter of the State in November, December and March resulted in this area experiencing a very good summer. All drought declared shires in the south east quarter were revoked by the end of March 1982.

The northern half of the State has experienced a light summer, due to the failure of the normal wet season. Central coastal and inland areas could warrant Drought Declarations by August or September 1982.

The number of declared shires (4) is much lower than in May 1981 (19). However, with the continuation of drought conditions in the far south west and the possibility of declarations in central Queensland in spring, the position is not as bright as the number of currently declared shires may indicate.

No alterations have been made to the relief measures available to primary producers in the past year. The rebates on transport costs of stock, fodder, machinery and equipment and the

Drought Relief Loans Schemes are still in operation. Expenditure on these relief measures is as follows—

Assistance measure	Expenditure (30–6–81 to 30–4–82) $
Road transport	
Concessions on fodder, stock, machinery	3,272,000
Rail transport	
Concessions on fodder, stock, machinery	142,221
Drought Relief Loans	
For carry-on and restocking purposes for primary producers	2,720,000
For small businesses	56,000

As the number of Local Authority Areas declared Drought Stricken during 1981–82 was reduced, the number of claims being received for both rail and road transport concessions decreased. Approximately 5 000 road transport concessions were processed in 1981–82.

Natural Disaster Administration

A series of severe hailstorms in late November-early December caused losses to primary producers in the Stanthorpe-Warwick area and coastal regions just north of Brisbane. Approximately 300 producers suffered losses amounting to more than $7m. A scheme of low interest loans was implemented through the Agricultural Bank to assist recovery by affected producers. As at 26 May 1982, 36 loans had been approved with a total value of $480,000.

Tropical cyclone 'Dominic' crossed the east coast of Cape York Peninsula near Cooktown on 14 April 1982 causing severe flood rains as far south as Tully. The value of sugar-cane and banana crop production lost was in the vicinity of $7m. A low interest loans scheme was introduced for eligible producers. As at 26 May 1982, three applications had been received and were being processed. More are expected as producers realize the full extent of their losses.

An upper level trough over southern Queensland resulted in torrential rain and flash flooding in the Gatton and Laidley Local Authority areas on 9 to 11 March 1982. Cost to farmers, estimated at several hundreds of thousands of dollars, was made up of small crops losses, erosion and damage to irrigation equipment. A loans scheme was introduced earlier in May to assist eligible farmers with recovery costs.

The terms of the low interest loans schemes implemented for the three disasters described above included a concession interest rate of 7% per annum. The maximum amount available for victims of the hailstorm was $20,000, with exceptional cases being allowed as much as $30,000. Victims of the latter two disasters are being allowed a maximum of $10,000 which can be lifted to $20,000 in exceptional cases.

General Soil Conservation Services

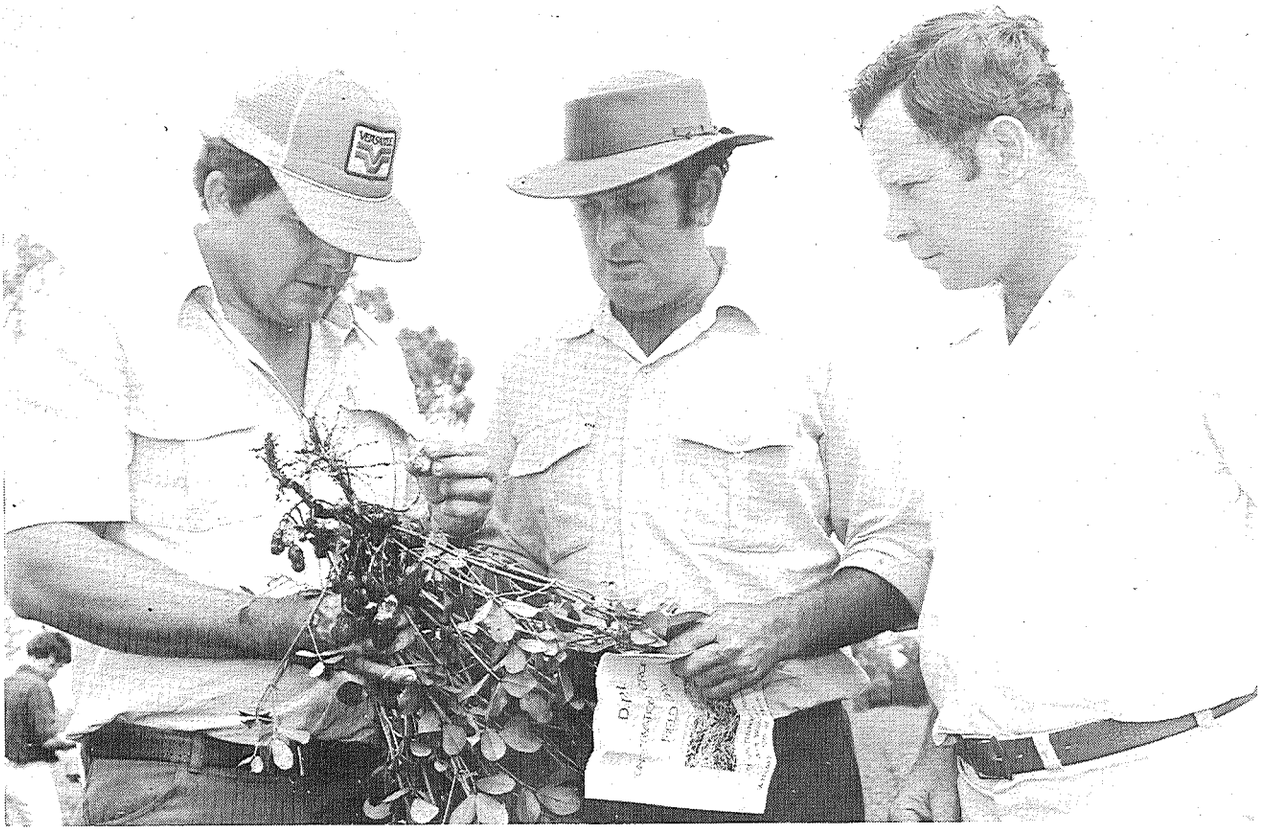
UNDER the General Soil Conservation Services sub-programme, soil conservation extension and planning services are provided outside the declared Areas of Soil Erosion Hazard on the Darling Downs and in the Burnett. These lands account for approximately two-thirds of the non-arid lands requiring soil conservation treatment in Queensland.

With development of cropping on large areas of previously uncultivated land and increased concern about erosion in almost all parts of the State, emphasis in this sub-programme in 1981–82 was on steps, such as using the most suitable land and appropriate cropping practices, that land users could take themselves to prevent erosion.

In addition, the active involvement of land users in the planning of group or catchment schemes was further encouraged, and more efficient technical equipment was investigated to enhance services to land users.

Land degradation incidence

Cultivation makes land more vulnerable to degradation because of soil disturbance and loss of vegetative cover. About 70% of the land used for cropping requires a combination of soil conservation works and land management practices. Suitable management practices are required on almost all of the remaining land. Current indications are that the area of cropping land is increasing by about 65 000 ha annually, thus increasing the likelihood that this land will be eroded by wind or water.



Farmers who attended the DPI Conservation Cropping Field Day at Wooroolin in March examine peanuts planted into winter crop stubble. (Queensland Country Life *picture)*

Serious erosion was caused by heavy storm rains in the Atherton Tableland and Wet Tropical Coast during November. Heavy rains in April created further erosion damage and flooding in this area. Heavy rains in parts of the Near South West region early in the 1981 winter season caused considerable damage to land prepared for winter crops.

Isolated storms caused erosion damage in other parts of the State, but there were few reports of serious erosion because of generally moderate rains.

Erosion of agricultural land resulting from mining exploration activities became an issue during 1981–82. Serious erosion over large areas is likely to occur unless preventive measures are taken.

Development of soil conservation measures

Cropping practices that maximize soil cover throughout the year enable a measure of erosion control to be undertaken by farmers on a self help basis. Efforts to develop conservation cropping systems suited to different regions were stepped up during 1981–82. A position for a conservation cropping officer was created for Biloela to augment the activities of officers working from Toowoomba, Kingaroy and Emerald on the development of suitable cropping systems.

Extension officers from Soil Conservation and Agriculture Branches, with assistance from regional engineers and economists, began team efforts on a part-time basis in other districts to develop conservation cropping systems. Farmer experience, machinery developments, and the findings of research into surface management are being integrated to try to achieve practical, economic cropping practices which prevent soil erosion.

Results of 3 years no-till winter cropping in the southern wheat belt showed that the average yield for no-till compared favourably with yield under conventional systems, with advantages to no-till in drier years. Seedling vigour was slightly reduced on average, but this did not greatly reduce yield.

As part of this development, a commercial no-till seeder suitable for heavy clay soils was designed by Engineering Services Section and a commercial firm. The lack of such a machine had been seen by representatives of the grain industry as a limiting factor in the adoption of reduced tillage practices.

Recommendations for measures to prevent erosion along seismic survey lines were prepared with Mines Department, exploration companies and the Queensland Grain Growers' Association. Observation trials embodying different approaches and intensities of treatment were established with an exploration company to enable guidelines to be prepared for the rehabilitation of erosion in existing seismic lines.

Land management recommendations were reviewed for agricultural management units in the inland Burnett. Workshops were held to review and document specifications for soil conservation measures and to prepare a soils base for farm planning as part of the land management field-manual project. Early drafts of manuals for Wandoan, Roma, coastal Wide Bay-Burnett, Mackay and Goondiwindi districts were prepared.

Techniques for contour bank layout using a laser beam were evaluated and these indicated a potential threefold increase in the rate of marking contours. A laser beacon and tracking equipment were purchased to enable rapid layout of works in broadacre cropping areas.

A controlled gradient surveying target developed jointly by a Soil Conservation Branch field officer, Mr J. McLatchey, and Engineering Services Section for surveying graded lines for contour banks was evaluated. Results indicated a possible doubling in the implementation rate using these targets and 10 were constructed for field use.

As part of a consultancy project to advise on techniques of land use planning and soil erosion control in Malaysian sugar plantations, a manual for erosion control in canelands was prepared. The development of a 5-year plan for erosion control, irrigation development and soil improvement for that project provides a useful basis for preparing similar guidelines in Queensland.

Extension

Extension efforts in 1981–82 gave emphasis to erosion control in canelands at Mackay, Innisfail and Julatten, and to conservation cropping practices in the South Burnett and Central Highlands districts.

In the Mackay cane district, extension efforts which included field days and meetings resulted in 23 new co-operators. In the Julatten area, newly developed for cane, a farm walk attracted 50 farmers. Trash retention was demonstrated, highlighting the benefits of green cane harvesting. At Innisfail, extension is at an early stage. A survey was carried out with the Department's Extension Evaluation Unit to assess canegrowers' attitudes to soil conservation.

A comprehensive planned extension programme involving the integration of the development and extension of conservation cropping and the close co-operation of Soil Conservation and Agriculture Branch staff continued in the South Burnett. In the project, teams consisting of one Soil Conservation and one Agriculture Branch officer worked closely with selected farmers to modify a recently developed conservation cropping system for summer cropping to suit local conditions.

Farms selected for this are used for field days, farm walks and as contact points for farmers to obtain information from other farmers. The major activity for the year was a field day at Wooroolin attended by 180 farmers and agribusiness representatives.

A display van promoting increased awareness of the benefits of conservation cropping was exhibited at several agricultural shows in southern Queensland.

In the Central Highlands, wheat reliability and the retention of wheat stubble through to planting of summer crops were emphasized.

To stimulate interest in the adoption of soil conservation practices in the near south west grain areas, a seminar emphasizing self help was presented at Goondiwindi under the auspices of the Queensland Grain Growers' Association.

To identify more effective approaches to extension of soil conservation measures, a joint project was undertaken with the University of Queensland's Department of Agriculture to study the adoption process for soil conservation and farmers' use of information services. The study involved a survey of 128 farmers in the Kingaroy, Wandoan and Linthorpe areas.

General awareness material for farmers and the general community produced by the information services project also emphasized conservation cropping. Material produced with the conservation cropping development group included a caravan display, a newsletter (to be published twice a year), a folder for handouts, photograph albums and slide resource kits for extension officers, and the first stages of a video film. Other general awareness features during the year included a display at the Brisbane RNA show, featuring a short film in the 'Helicopter Ride', photographs, and a Soil Conservation game, 25 000 copies of which were distributed at the show.

A 16 mm film titled 'Soil, there's still plenty of it . . . isn't there?' was almost completed during the year by Photography Section of Information Branch with the Soil Conservation Information Services Project.

During the year, 134 group extension activities were undertaken and 88 press or media items prepared as part of General Soil Conservation Services sub-programme extension.

Land user involvement

Landholder interest in soil conservation in non-statutory areas was high, although fewer requests for service were made than in the previous year. The following table compares the level of interest over the last 3 years—

Landholder requests for Soil Conservation Service in Non-statutory Areas 1979–80 to 1981–82

	Requests for service		Property visits	New co-operators
	Initial	Follow-up		
1979–80	479	1 611	2 666	234
1980–81	700	2 089	3 440	307
1981–82	508	2 101	2 818	325

Initial requests for service and property visits were below the high level achieved in 1980–81. This is partly because last year's figures include heavy involvement with property visits caused by the expansion of the sugar industry. However, in 1981–82 the number of requests from landowners who have already begun a soil conservation programme and the number of new co-operators were both higher than in 1980–81.

Willingness by landholders to enter into catchment approaches to soil conservation was indicated by the constitution of a project area at Cherry Creek on the Atherton Tableland after a poll in which the majority favoured its formation.

Soil conservation planning

Whole farm plans showing agricultural capability and management requirements were prepared and issued for 59 properties covering 44 508 ha, and a catchment plan prepared for advertisement for the Cherry Creek Project Area consisting of 48 properties covering 2 500 ha.

Preliminary catchment planning was carried out for three catchments in the Kalbar area.

Insufficient topographic information acted as a constraint on catchment planning in the caneland development project at Mount Ossa, Mackay, and in the Billa Billa catchment, Goondiwindi. Topographic maps are now being prepared for the Mount Ossa area as a demonstration project under joint funding by this Department and the sugar industry.

Soil conservation implementation

Soil Conservation Branch officers carried out the final design and location of soil conservation structures to protect 47 731 ha during the year. Landholders implemented the measures by using their own equipment or by hiring earthmoving contractors.

The 1981–82 achievement is set out in the following table in comparison with the previous year and with the overall target.

Summary of soil conservation treatment needs and progress for cropping lands in the General Soil Conservation Services Sub-programme

	Extensive cropping lands (ha)		Intensive cropping lands (ha)
	Category I*	Category II†	
Area requiring protection .	1 007 000	474 000	136 000
Area treated in 1980–81 ..	40 905	1 843	1 712
Area treated in 1981–82 ..	44 867	901	1 963
Progressive total area treated at May 1982	510 984	111 846	17 602

* Category I needs intensive treatment with contour banks, contour strip cropping or contour grass strips for long-term cultivation.

† Category II land can be safely cultivated with simple practices of strip cropping and contour cultivation.

Contour banks are recognized as a necessary part of erosion control management in the undulating clay soils of central Queensland and the near south west. Most of the area treated during the year was in these areas. It has not been possible to establish the extent to which suitable conservation cropping practices have been implemented either as an adjunct to contour banks or as the sole measure.

Financial assistance to landholders

Only two landholders made use of Agricultural Bank Loans for Soil Conservation Works, receiving $2,880. The current interest rate is 13.5%.

Areas of Erosion Hazard Services

THE declaration of parts of the State as Areas of Soil Erosion Hazard under the provisions of the *Soil Conservation Act* 1965–1980 has enabled the progressive planning of soil conservation measures on some of the State's most productive but vulnerable land.

The Areas of Soil Erosion Hazard are the Darling Downs Shires of Allora, Cambooya, Chinchilla, Clifton, Crows Nest, Glengallan, Jondaryan, Millmerran, Pittsworth, Rosalie and Wambo, and the Isis and Gin Gin Land Use Study Areas in the Isis and Kolan Shires. Their agricultural importance and serious erosion problems give these shires high priority for protection.

Land degradation incidence

Rainfall in the Shires declared as Areas of Soil Erosion Hazard was generally of low intensity during the year, and there were few reports of visibly serious erosion. Isolated severe storms, hail and flooding caused some damage on the eastern part of the Darling Downs region.

Development of soil conservation measures

Existing specifications for the Burnett district were reviewed and the first draft of a technical manual to document land management measures was prepared. On the Darling Downs, the Crows Nest technical manual has been completed and the manual to cover Warwick, Allora and Clifton districts is nearing completion.

Waterway establishment and stabilization trials carried out in the Isis area illustrated the benefits of using mill mud as a topdressing for either seed or runner establishment. Mill mud and straw matting as a surface mulch were shown to benefit pasture and leucaena establishment on eroded, abandoned caneland at Childers and Gin Gin.

A farmer survey was conducted on the eastern Darling Downs with the University of Queensland to establish what cropping practices farmers were carrying out and their readiness to adopt more conservation cropping practices. This has enabled a better understanding of directions for both future extension and the development of conservation cropping systems on the eastern uplands, where many cropping options exist and where weed control is more difficult than in other areas.

The study was led by Professor M. Coughenour, rural-sociologist from the University of Kentucky and visiting research professor to the University of Queensland during 1982.

Extension

Extension activities within the Areas of Erosion Hazard emphasized the need to improve maintenance of structures, particularly grassed waterways, and to implement conservation tillage practices.

Maintenance of structures was a feature of the RNA 'Producer of the Year' field day held on the properties of Messrs H. Tod, Jondaryan, and M. Mason, Mount Irving, who received first and second places in the competition. The successful management of strip cropping rotations on Mr Tod's property provided clear evidence of the benefits of this type of soil conservation measure on low sloping land to the 200 who attended.

Conservation cropping practices were promoted at two field days including 'Producer of the year', at Farmfest, through a workshop at Bell attended by 30 farmers, and at local shows in a display caravan. Conservation cropping, including the development of suitable rotations for strip cropping, was jointly promoted by Soil Conservation and Agriculture Branch both during planned activities and on an opportunity basis during farm visits. Soil Conservation Branch officers made 2 915 property visits on the Darling Downs during 1981–82 as part of the planning and implementation activity.

The participation of both Soil Conservation and Agriculture Branches in the survey of landholders regarding their conservation cropping practices and attitudes to soil conservation will assist the co-operative development of future extension efforts.

A project to promote horticultural production on abandoned caneland in the Isis and Gin Gin Areas of Soil Erosion Hazard is in progress. A photo story on stabilization of canelands was a feature of show displays at Childers and Bundaberg, and at 'Agrotrend' and the Bundaberg BSES field day.

In carrying out extension activities in the Areas of Erosion Hazard, Soil Conservation Branch officers engaged in 83 group extension activities and prepared 23 media items.

The Minister for Primary Industries (Mr Mike Ahern) (centre) and Mr Hector Tod, winner of the RNA award for 'Producer of the Year', discuss progress in soil conservation on the Darling Downs with retired DPI officer Mr Frank Skinner (left) who installed the first soil conservation measures on the Downs in 1935.

Land user involvement

Landholder requests for soil conservation service showed a slight increase over the high level of inquiries in 1980–81. The number of new co-operators in Areas of Erosion Hazard in 1981–82 was, however, below the 1980–81 figure, yet equal to the 1979–80 figure. Information on landholder interest in soil conservation over the past 3 years is summarized in the following table—

Landholder requests for Soil Conservation Service in the Areas of Soil Erosion Hazard, 1979–80 to 1981–82

—	Requests for service		Property visits	New co-operators
	Initial	Follow up		
1979–80	140	1 776	4 031	136
1980–81	236	1 951	4 418	186
1981–82	248	2 054	4 060	136

The high level of interest in strip cropping generated by the February 1981 floods on the Darling Downs continued this year.

Landholders in the Isis and Gin Gin Areas, who had been involved in land use schemes in previous years, showed willingness to undertake soil conservation which was required as a condition of cane expansion in 1981. All expansion land was inspected before development and again when landholders had conformed with the soil erosion control conditions placed on expansions. Response was less positive from growers outside the land use scheme areas.

An Advisory Group Committee (AGC) was established in the Gin Gin Area of Soil Erosion Hazard. It is the sixth AGC to be formed in Areas of Soil Erosion Hazard. These committees allow landholders and local authorities to advise the Soil Conservation Authority on the development and implementation of soil conservation programmes.

A major activity of Advisory Group Committees this year was to prepare submissions to the soil conservation planning committee. Other issues receiving attention included erosion problems with mining exploration, mandatory provisions of the Act, education of children in soil conservation matters, and the implementation of community works.

Soil conservation planning

During the year, three project plans covering an area of 4 153 ha and involving 62 landholders were prepared and advertised. In addition, 210 provisional project plans were prepared covering 27 333 ha. This involved 195 land users on the Darling Downs and Burnett Areas of Soil Erosion Hazard.

Annual figures for this type of planning have declined progressively as the percentage of properties planned increased. More than 60% of farmers on the Darling Downs have now received plans either as Provisional Project Plans or as part of the 78 sub-catchment Project Plans that have been gazetted. Additionally, the need to follow up plans with implementation means that, as the number of plans increases, so more time is required to encourage and service implementation. This reduces the time available for planning.

To increase the efficiency of collecting topographic information for planning, two electronic tacheometers with data storage and retrieval facilities were purchased. These will considerably speed up ground surveys which are mainly required for strip cropping layouts on the Darling Downs, and for the planning of straight and parallel contour layouts on low sloping canelands.

As part of the co-ordinated soil and water conservation project, 17 gully dam sites were investigated on the Darling Downs. Of these, seven were constructed.

Soil conservation implementation

Soil Conservation Branch officers carried out surveys to lay out soil conservation structures covering 21 267 ha during the year, to be implemented by landholders.

The following table shows the 1981–82 achievements in relation to other relevant information.

Summary of soil conservation treatment needs and progress in declared Areas of Soil Erosion Hazard in Queensland

—	Extensive cropping lands (ha)		Intensive cropping lands (ha)
	Category I	Category II	
Area requiring protection .	333 000	358 000	27 000
Area treated 1980–81	10 683	5 373	931
Area treated 1981–82	12 617	7 838	812
Progressive total area treated at May 1982	202 629	83 148	7 605

The area treated with structures such as banks and waterways increased by 16%. The area of Category II, work comprising strip cropping on the Darling Downs, was up by 46% on 1980–81.

Financial assistance to land users

In the Areas of Soil Erosion Hazard, dollar-for-dollar grants, up to a ceiling of $1,500 on the Darling Downs and $1,000 in the Burnett are available to landholders for the implementation of measures with approved schemes.

Grants totalling $226,178 were paid during the year, bringing the total grants paid to landholders since the scheme began in 1974 to $1,512,170.

In addition, $8,651 was paid to Local Authorities as part of cost sharing arrangements for road cross-drainage structures which are required in approved project plans.

During the year, approval was obtained for the payment by the Soil Conservation Authority of a 25% contribution towards the cost of 'Community Works' constructed by Statutory Authorities in approved Project Plans. Community Works are works which, in the opinion of the Soil Conservation Authority, are for the general benefit of the locality or the particular benefit of a group of owners of land in that locality. The availability of these funds will facilitate the implementation of a number of catchment plans where the cost of community works has been a major obstacle.

Land Management Research

THE aims of the Land Management Research Sub-programme are to determine the extent and significance of land degradation in Queensland, to describe the mechanisms involved, and to develop and extend practical management systems and practices to ensure land productivity and stability.

Soil erosion by water is the major cause of land degradation in Queensland, accounting for 98% of the degradation in cultivated lands and 75% in grazing lands. The land management research programme is directed predominantly at soil erosion by water. This involves erosion processes studies, land management practices investigations, conservation practices evaluation and development, and salinity assessment.

While the erosion process studies are being carried out under simulated rain and controlled or selected conditions, the effects of land management practices on soil erosion are being investigated under natural rainfall and field conditions. The evaluation and development programme aims at evaluating existing practices and developing guidelines and techniques for stable land use.

Major achievements with which we were associated this year are—

- Establishment of a land management project near Capella in central Queensland aimed at assessing the effects of cultivation and cover on soil erosion, runoff and yield of wheat, sunflower and sorghum on the black earths of the open downs.
- The extension of the catchment studies on Brigalow Research Station to assess the effects of developing virgin land for pasture and crops on runoff, soil erosion, soil salinity and soil nutrients.
- The development of a trash management programme in the canelands with the Bureau of Sugar Experiment Stations.
- The training experience for Mr D. Freebairn at Griffith University and the resultant work achievement in evaluation of data from the surface management practices studies on the Darling Downs.
- The fabrication of field data storage units and the data extraction units using designs, expertise and the willing co-operation of Mr Brian O'Neil and Dr Peter Ross, of CSIRO Cunningham Laboratory.

Other notable activities which will assist in the development and co-ordination of research activities were—

- A report on priorities for action by the Salinity Co-ordinating Committee following an overview of salinity problems in the State and a review of Departmental activities.
- Establishment of the Soil Conservation Research Committee as an advisory committee to the Standing Committee on Soil Conservation.
- The erosion research section workshop at which progress of particular projects was reviewed and techniques were evaluated.
- A workshop on the effects of erosion on productivity held at Cowra in April 1982.

Erosion research

Erosion research in the past has been confined largely to the measurement of runoff and soil loss from small field plots for extended time periods. The data collected from such studies are site specific and it is difficult to relate the results to the broader field problem.

Studies of erosion processes are needed as a basis for extrapolating the limited data which are being collected to other environmental zones. In eastern Australia, erosion rates increase northwards especially in the tropical coast. This indicates the importance of soil erosion research in Queensland.

Erosion process. The main emphasis of the erosion process studies has been towards gaining an understanding of the physical characteristics and sediment properties of soils and relating these to their erosion behaviours under simulated rain.

In conjunction with Griffith University, data were collected on soil loss, runoff and soil detachability for a black earth using the small disc simulator and the tower simulator and used to evaluate an erosion-deposition model.

Using data from the 1 ha field bays outside Toowoomba, it was found that all measured erosion events could be interpreted with the erosion-deposition theory and that entrainment efficiency depended on cover in contact with the soil.

The theory used provides a means of linking erosion experiments at different scales (microplot to field scale), and this will assist greatly in the integration of the various types and scales of studies in progress.

In the rainulator studies on erosion processes of a black earth and krasnozem, it was found that most of the eroded sediment was bed-load and attempts have been made to establish relationships between soil properties and erodibility. The differences between the black earths and krasnozem in rates of sediment transport may be related to differences in aggregate densities and this may be an important factor influencing soil erodibility.

Management practices. In several parts of the State, field studies under natural rainfall are being used to measure the effects of crop and residue covers, soil surface conditions, and soil moisture on soil erosion and runoff.

These studies are part of an overall surface management programme which has been developing steadily in the last 4 years. It has proved to be particularly successful in focusing wider attention on the need for more improved management practices in the dryland grain growing areas in southern and central Queensland. It is likely to be extended into the near south-western districts in the near future and into the high rainfall areas of the sugar-cane lands in the Innisfail, Mackay and Bundaberg areas.

Field experiments on various stubble management practices have been in progress since 1978 at Greenmount (black earth site) and Greenwood (grey clay site) near Toowoomba.

In all years, increased surface cover has resulted in dramatic decreases in soil loss. Runoff was reduced by cover except on some occasions, where higher runoff volumes were measured on zero-tilled areas relative to a stubble mulch condition. Tillage in conjunction with high ground cover (mulch) resulted in maximum infiltration capacity for these high clay soils.

The practice of stubble mulching has consistently resulted in the highest fallow efficiency or moisture storage. This has sometimes resulted in yield increases, but generally treatment effects on yield have not been large.

Sediment concentration of runoff water passing through the flumes or weirs was found to be inversely related to ground cover for a range of storm types on both the black earth and grey clay sites. The apparent generality of this result is promising for the development of empirical soil loss models.

In the Capricornia region, crop production is expanding rapidly, particularly on the heavy cracking clay soils. However, soil erosion is a major concern in this area of high intensity rainfall and the application of traditional conservation structures is not keeping pace with development. In addition, it has been estimated that present management techniques by themselves are not sufficient to reduce soil loss to acceptable levels.

A major new project has been established near Capella on a basaltic black earth to measure the effect of crop and residue cover and tillage on soil water, runoff and soil loss. Crop growth and production are recorded for each treatment to determine any agronomic advantages or problems. This aspect is important in gaining farmer acceptance of any modified farming system.

A group has been set up to develop a model integrating various aspects of crop production and soil erosion. The objectives of the model are to simulate runoff, soil erosion and grain yield in arable systems as influenced by weather, soil type, slope, crop sequence and tillage practices. The main use of the model is to enable probability and economic analyses of the impact of crop sequence and tillage strategies on runoff, soil loss and crop production. The sunflower and wheat production modelling is well advanced with data collection for the sorghum model in progress. An empirical soil loss model is being developed using simulated rainfall and field rainfall-runoff.

The land use surveys in central and north Queensland cane growing districts have identified soil erosion as a serious problem affecting long-term productivity and siltation on other productive lands. The problem is particularly acute in those land-locked mill areas were sugar-cane is currently grown on very steep lands without adequate land management or protection.

The programme involves a number of different phases—the assessment of productivity changes under both eroded and non-eroded systems, the assessment of different trash retention and management systems to control erosion, and the assessment of agronomic effects of trash systems. This programme has been jointly developed with BSES over the last year.

To obtain a first level assessment of the effects on cane production from soil erosion, sugar-cane production records were obtained for a sample of whole farms in one mill area in north Queensland and two in the Mackay region. The technique has been to compare temporal production trends on sloping lands of various soil type with that of lands with low or no slope.

The preliminary results show that some soil types, especially podzolics derived from metamorphic sediments and granitic materials, are showing a loss of productivity with time. On the other hand, the krasnozem and earths derived from weathered basalt are not showing any obvious decline in productivity. In fact, the farms on soils predominantly derived from basalt are exhibiting better performance than farms on flat alluvial soils. Other factors such as wetness, drainage and 'northern poor root syndrome', and grower management are complications which have not yet been adequately isolated. These matters are being pursued actively at the present time.

Techniques such as trash farming, strip cropping, row direction and contour banks have been used to control erosion in canelands in South Africa and Hawaii. However, they have not been fully tested under various soils, climate and cane farming practices of Queensland.

A programme studying trash management for soil conservation in canelands is being conducted jointly by officers of this Division and the Bureau of Sugar Experiment Stations.

The programme is being carried out at three centres—Innisfail, Mackay and Bundaberg, representing the northern, central and southern major cane growing areas of Queensland. The short-term aim of this programme is to compare the effects of various trash management practices on soil loss and cane yield with those of normal cane growing practices. However, the long-term objective of the programme is to provide land and crop management guidelines for soil conservation and maintenance of productivity.

In the Upper Nogoa catchment in central Queensland, monitoring of grazing effects on pasture composition, ground cover, runoff and soil loss is being carried out in an effort to formulate suitable grazing management guidelines for these highly erodible lands. Two catchments are being monitored, one grazed and the other ungrazed. This demonstrated the modifying effects of vegetative cover on infiltration during the summer. Because of the relatively wet winter experienced in the area and the resulting vegetative cover, virtually no soil loss was measured.

Four catchments ranging from 250 ha to 6 500 ha are being monitored for runoff and soil loss in the black earth soils of the eastern Darling Downs to provide information for soil conservation design work for strip cropping, valley outlet areas and crossroad drainages. Some runoff results have been compiled but final figures are not yet complete. Good progress has been made with the compilation of catchment data for analysis.

The Brigalow Research Station catchment study in central Queensland began in 1965 and is a long-term, small catchment runoff experiment to provide information for the design of land use and land management systems. Stage 2 of the project studying catchment response to land use changes has commenced.

Salinity

To date 8 000 ha of land severely affected by seepage salting have been identified in Queensland. The findings of a State-wide investigation into dryland salinity in Queensland are contained in 'Salting of Non Irrigated Land in Australia' about to be published.

A broad overview of the State suggests that about 1.6% of the area potentially susceptible to seepage salting is currently affected. There is a large potential for salinization to develop as a result of indiscriminate development of land. It is therefore important for areas susceptible to salting to be identified so that preventive measures against salinity development can be taken. Parts of the basaltic lands are associated with seepage salting, and a high priority is placed on protecting these high value lands.

In central Queensland, basaltic lands with *Melaleuca bracteata* (black tea tree) have been found to be susceptible to seepage salting. This indicator species, and other species, are being investigated elsewhere in Queensland to determine the extent to which botanical indicators can be utilized. Selected salting outbreaks are being investigated to determine the most effective corrective measures against salinity. Work has been carried out by the Branch during the year in the Rockhampton, Biloela, Springsure, Clermont, Mackay, Maryborough and Kalbar areas.

Methods for identifying susceptible lands have been developed and applied with promising results in the Maryborough area. Monitoring of selected saline areas in the Lockyer and Bremer Valleys has been continued to provide basic data on reclamation.

The salinity data for Queensland have been compiled through relevant Branches of the Department of Primary Industries, in liaison with organizations such as the Bureau of Sugar Experiment Stations, Mines Department and Water Resources Commission.

Management practice evaluation and documentation

Farm planning for successful land management requires a clear definition of the soil limitations and management practices.

The land management Technical Guide Programme aims at improving the technical standard of Soil Conservation staff by documenting land management information for land types and extending research knowledge.

The programme provides a suitable resource base for farm planning, specifications for runoff control structures, the limitations and management of the soil resource and suitable conservation management systems.

The Technical Guide Programme has made great advances during the 1981–82 period. Five 'Soils-Agronomy' workshops covering 10 Soil Conservation Districts and three 'Soil Conservation Measures' workshops covering 11 Soil Conservation Districts were held during the period. In addition, the final draft of the Crows Nest Field Manual has been edited and early drafts of the South East Darling Downs, Wandoan, Roma, Coastal Wide Bay-Burnett, Mackay and Goondiwindi districts have been prepared. Interim Agricultural Management Units have been defined for Roma, Wandoan, Goondiwindi, Miles, Atherton-Mareeba, coastal Wide Bay-Burnett, Inland Burnett and Central Highlands Districts.

Species selection and management for waterways

One of the major problems in conservation designs in Queensland is inadequate stabilization of waterways. Many failures of waterways can be attributed to the lack of effective grass cover or to the use of an unsuitable species.

Indian blue grass *(Bothriochloa pertusa)* continues to be the best species at the Amberley site—Yeppoon is the outstanding strain. Condamine couch *(Phyla nodifila)* has spread well, but it could not compete with weeds during the dry periods.

Because of the dry weather, only the Biloela and Bowen strains of Indian bluegrass established at Miles. Very good establishment has been obtained with the Bowen strain west of Miles.

Winter frosts may kill most top growth of Indian bluegrass, but spring regrowth provides an excellent and even cover. Establishment of Indian bluegrass on the dark cracking clays of the eastern Darling Downs was greatly improved by an oat cover crop. In addition, the cover crop provided a good ground cover for the waterway floor against early storms. An oat cover crop was also effective in promoting waterway establishment at the Mutdapilly Research Station.

In the Childers district on a gleyed podzolic waterway, very good establishment of green couch *(Cynodon dactylon)* was achieved in a millet cover crop, and mill mud was more effective than a complete NPK fertilizer mixture in promoting early establishment. However, the best establishment was obtained with Environmat, a nylon-wood shaving surface stabilizer.

Despite heavy tramping by cattle, the land stabilization site at Wivenhoe Dam remains very stable and in excellent condition.

More than 70% of *Leucaena leucocephala* (cv. Cunningham) planted in November 1980 on badly eroded old canelands in the Childers district have survived. Preliminary results of this trial indicated that moisture retention is probably the most important factor limiting the revegetation on these badly eroded sites.

Land Resource Assessment

DOCUMENTATION of the land resources of the State is essential for sound land use planning. Maps and reports prepared by the Development Planning Branch are being used to protect prime agricultural land from land degradation, limit subdivision of prime agricultural land, prepare land management guidelines for soil conservation and indicate the potential of land for development.

There has been increased demand on the Development Planning Branch for detailed land resource information. This has been due to a major expansion in the sugar industry, increased pressure from local authorities for information which allows them to consider the needs for agricultural land in their strategy plans and the rapid growth of agriculture on marginal lands.

The resource studies in the high rainfall areas where sugar-cane is growing are well advanced and it is expected that these studies should be completed by 1986. Surveys of the southern areas are completed. For the next year, the major effort will be concentrated on the Mackay and Northern Regions. The maps of land suitability from these studies are in constant demand for identifying suitable land for expansion and shire planning.

Staff will then be moved progressively into the grainlands and marginal cropping areas where there is a pressing need for information on distribution and characteristics and management needs of soils suitable for development.

A highlight of the year is the completion of the mapping programme in the Western Arid Studies. Draft maps at a scale of 1:250 000 are now available for 60m hectares in the arid and semi-arid grazing areas of the State.

Sugar industry land use studies

The sugar industry land use study aims at preparing land resources and land suitability maps at a scale of at least 1:100 000 for all the important sugar growing areas. Highlights of the year

were the completion of the field programme in the Mackay district and the preparation of interim land suitability maps for the Isis and Ingham areas. These interim maps will fill a gap until the detailed reports become available later. A feature of the sugar land studies is the close co-operation between our staff and staff of the BSES and CSIRO Division of Soils.

Northern Region

There have been numerous requests for land resource and land suitability information in the Northern Region to resolve conflicts between land uses, plan catchment development, advise on development potential and prevent loss of good agricultural land. Three officers and an experimentalist now work in the region.

In conjunction with the CSIRO Division of Soils, soil surveys are being undertaken to publish a series of soil maps of the region from Rollingstone to Alexandra Bay. One-quarter of the Herbert River Valley has been mapped while CSIRO has completed soil mapping between the Tully River and the North Johnstone River and in the Mossman mill area. This exceeds 200 000 ha.

Future programming is for this Branch to map the North Johnstone River to Cairns section and CSIRO to complete the Cardwell-Tully River section. Soil and land suitability surveying of the remaining 260 000 hectares will be completed by mid 1986.

Julatten. A sugar-cane suitability study of the Julatten Tableland began to determine the area of suitable land for expansion. Julatten is an area of erodible soils on an undulating landform with narrow alluvial stream flats. Preliminary findings confirm the need for a 6% slope limit in this area as was recommended for the 1981 sugar industry expansion. There are areas of soil which have potential for sugar-cane growing provided adequate land management practices are implemented right from the development stages.

Innisfail. Preparatory aerial photo interpretation has been completed and soil, vegetation and geomorphology base maps are at hand. Approximately 10% of the area north of the Tully River has been mapped for preliminary sugar-cane land suitability at 1:100 000 scale.

Ingham. Following completion of the overview study and the planning work in the forestry areas, good progress has been made in the soil and land capability survey. Detailed field surveying of 40 000 ha of the 150 000 ha total is now completed.

Current Cane Assignment Maps. During the period, the mapping of current cane assignments on air photographs has been proceeding. So far, cane assignment boundaries have been transferred to aerial photographs for five of the 10 northern mill areas and the remaining mill areas will be completed along with the overview study by August.

Central Region

Following the success of land use studies in the Southern Region of the State, the sugar industry of the Central Region made specific requests to have similar work undertaken in the Mackay district. This work began in 1979 and a second field team was established in 1981.

The first project covered the supply areas for the six central mills, and includes some 200 000 ha. The second project covers the southern extent of cane lands south of Sarina and includes 120 000 ha. The final phase, to begin in the coming year, will cover the northern supply areas to just north of Proserpine.

The Mackay District Land Use Study Committee was set up to guide and co-ordinate the studies and to work with the Department on application of the results. An 'action committee' to concentrate specifically on the southern project area of interest was also established this year.

Mackay Land Suitability Study. The field work for this study was finalized in December 1981. Over the period of the survey, some 2 000 field sites were inspected and described. These data were interpreted and air photo mapping undertaken to delineate 2 200 unique map units for recording in computer data files. Arising from the site investigations, 55 soil profile classes were identified. The map units have been assigned land suitability ratings.

The digitizing of map units is in progress and preparation of maps for printing is in hand. The computer data files and working copies of maps have already been put to use in a shire strategic plan.

Plane Creek Caneland Suitability Study. Field data collected during 1981 are being processed to produce preliminary Soil Profile Classes which will be correlated with those of the Mackay Land Suitability Study. All Class I land is already planted to sugar-cane, most Class II land is used for cane and Class III land is split evenly between cane and other uses. A small proportion of the Class IV (marginal) land and Class V (unsuitable) also supports cane. This provides semi-quantitative confirmation that sugar-cane is moving onto lands more difficult to manage.

Meanwhile, data collection is proceeding in priority areas indicated by the Plane Creek Land Use Action Committee. A provisional land classification of the Hay Point area was completed in January.

An agroclimatic examination of the area south of the present extent of cane suggests that climatic suitability for dryland sugar cane declines in a south-westerly direction at right angles to the orientation of the coastline. Arising from this, a southern boundary has been defined—approximately Kalarka.

Southern Region

Isis Mill Land Suitability Study. A land suitability study of an area within the 50 km radius of the Isis Mill was undertaken.

A land suitability and land use map of the area was produced in working map form. The findings point to a significant prime land expansion capacity on freehold, leasehold and Crown Land of the order of 80% of current assigned area. The study identified some technical problems which will be encountered in future expansion.

An Inter-Departmental committee controlled the study and agreements on intentions in expansion situations were reached.

Maryborough. The Maryborough Steep Lands Study identified 53 farms with a total of 719 ha of unsuitable land currently assigned to sugar-cane. As a result of this investigation, it was agreed that the Department would investigate the suitability of an area of vacant Crown Land set aside for future agricultural development. Some 3 700 ha of land were grid surveyed.

The map for the Mary River-Tinana Creek area was finalized and printed this year.

Horticultural land use studies

Horticultural production in the Near North Coast region is affected by increasing subdivision of prime agricultural lands and some inappropriate land uses.

Since 1979, a study into horticultural land suitability in the region has been under way. The study area covers the eastern sections of Maroochy, Landsborough and Caboolture Shires, an area of approximately 270 000 ha.

A map of the Maroochy Shire was completed last year. Field work has been completed in the eastern sectors of Landsborough and Caboolture Shires and has identified 12 land resource areas. Information for this area is in demand and publication is expected during the coming year.

Agricultural development studies

Wide Bay-Burnett

This region contributes significantly to the gross value of Queensland's rural production, and expansion and development of rural industries are continuing. Most of the prime agricultural lands are currently being cropped and expansion onto marginal lands is occurring. The grazing industry is endeavouring to increase production by clearing or thinning timber and the use of improved pasture species to supplement existing native pastures.

No detailed data on the resources of the region were available before 1978 and the results of new management strategies and continued development could not be predicted accurately. A resource survey programme was initiated to rectify this situation. The region, comprising about 6m ha, is being mapped in a number of stages.

The programme to investigate and map the resources of the South Burnett was completed in 1981. The total area mapped was some 1 064 000 ha. Sixty-five discrete mapping units were recognized and, within these, some 273 component land units were described. Report preparation is complete.

There is a significant demand developing for the data and much use in diverse areas has already been made.

The land resource survey in Central Burnett began in early 1981. Field work has been completed. Some 450 soil profiles were described and approximately 20% of the mapping units have been described. A current land use map has been completed.

Soils and geology are very complex in the Gayndah and Mundubbera areas resulting in a more detailed field inspection and description for that area. Ten occurrences of water table salting and scalding have been recorded in the western parts of the study area. Areas affected by severe gully erosion are frequently associated with roadside drainage works.

The land resource survey for the North Burnett commenced in 1980. Some 1 143 000 ha are included.

Progress to date includes description of 169 soil profiles, completion of approximately one-third of the field work and delineation and preliminary description of mapping units for the south-western sector.

Field work in Wide Bay-South Port Curtis will begin in early 1983. CSIRO will co-operate in this project.

Eastern Darling Downs

Detailed studies of the major resource areas have been completed for this area. A current study being undertaken will provide detailed resource information for the Brigalow-Belah Walloons Land Resource Area of the eastern Darling Downs. Soils are being studied in three representative areas—Moola, Acland and Millmerran.

The study will provide recommendations on the agricultural and soil conservation management requirements of the important Agricultural Management Units. These recommendations will apply directly to some 110 000 ha of land on the eastern Darling Downs.

Marginal cropping lands

There is concern that cropping, particularly cash cropping, is expanding into traditional pastoral lands throughout southern and central Queensland. Practical management guidelines are not available for many of these areas and a uniform extension approach is not available to advise developers. A programme to evaluate this development and provide sound land use advice is being developed.

An inter-branch programme to determine the extent of cropping in near south west Queensland and to develop practical management guidelines is in progress.

Progress to date includes the preparation of a land resource base for the region and locating the areas currently cropped. Property sales to attempt to ascertain the influence of southern buyers on land use trends are being investigated. Currently-used cropping systems and yield information have been documented and the major soil and land limitations to cropping identified. Areas considered likely to be used for further crop expansion have been delineated and long-term production reliability is being examined.

Practical management and extension guidelines are expected to be available for this region before the end of 1982.

Grazing land degradation

Land degradation in grazing lands is recognized as a serious problem. A programme to identify land degradation causes and to develop land management guidelines for grazing lands in the sub humid zone of Queensland has been commenced. Initially the project will concentrate on the Moreton Region.

Grazing land use studies

Western Arid Region Land Use Studies (WARLUS)

This land use study is aimed at mapping and describing the land resources of 60m ha in western Queensland's semi-arid and arid zones and providing information to formulate land management policies.

All field data collection has been finalized and either published maps or preliminary dyelines are available for all areas. Approximately 230 land systems and 550 land units have been described. Reports on Parts I, II and IV have been published and the other reports are in various stages of preparation. During the year the land systems maps for Part III and Part V were printed. Both of these maps are already in high demand.

Data collection during these studies has provided the necessary resource base for formulating a land use policy aimed at controlling land degradation in arid lands. A situation statement has been prepared for policy development within the Department.

Continued efforts to improve the drought assistance policy have been made during the year. In particular, the need for earlier drought declarations and the case for property build up were stressed as vital to the efforts of controlling land degradation in arid lands.

Application of studies

Property plans are supplied to Veterinary Services Branch for large extensive holdings in western Queensland. These are used in planning a tuberculosis and brucellosis eradication programme on these large properties.

These property plans are prepared at a scale of 1:250 000 based on data collected during the WARLUS programme. An additional 11 plans have proved invaluable in planning an eradication programme with the property managers. A map was prepared at a scale of 1:1 000 000 as the base for formulating a three-State programme attack on the Simpson Desert area. Our officer at Charleville has been involved with representatives from South Australia, the Northern Territory and Queensland in formulating a disease eradication programme.

Land degradation studies. The Western Arid study identified a problem of land degradation in some of the western lands, particularly the hard mulga lands and the alluvial frontage country. Development Planning Branch's role in evaluating this problem consists of establishing sites on selected land types to monitor land degradation. Ten permanent monitoring sites have now been established and three master sites record growth events and facilitate interpretation of Landsat imagery for the area.

The wet winter of 1981 produced a major growth event but lack of summer rains has resulted in drought conditions now prevailing at seven of the 10 sites. Difficulty will be experienced with interpretation of data until a 'normal' summer growth event occurs.

Development Planning and Evaluation

THE Development Planning and Evaluation programme aims at promoting efficient utilization of rural lands through planning. These studies co-ordinate Departmental activities to provide detailed information for catchment planning, project evaluation, shire, regional and State planning.

The emphasis in the past has been the evaluation and planning of irrigation projects. There is a big upsurge in interest in water for urban and industrial uses, however, and efforts have been redirected to ensure that agriculture obtains a reasonable consideration in any re-allocation of water resources.

Despite the fact that large areas of prime land still exist in this State, we see considerable areas of marginal land being developed beyond its current suitability. The lack of suitable land management practices and/or the financial capabilities of developers to manage these lands will cause loss of productivity and pollution.

With the exception of the sugar lands, the Government relies heavily on extension to ensure that land is used and managed according to its suitability. Decisions on land use controls are fraught with difficulty but will need to be considered by local authorities and the State Government to support current extension and planning. A sound land resource base for planning is essential before embarking on such programmes.

Irrigation investigations

South-east Queensland Water Resources Study. An Inter-Departmental study on south-east Queensland water resources is considering the urban, agricultural and industrial consumption and needs of water in south east Queensland.

The study area is approximately 8 800 000 ha extending from Maryborough south to the New South Wales border and west from the coast to 150° longitude. It comprises only 5% of Queensland's total area, but more than half of the State's cropping lands occur within this area.

Information has been provided on the potential agricultural requirements for irrigation water for the next 20 to 30 years. The annual demand for irrigation water has the potential to rise from 283 000 ML now to 873 000 ML within 10 years, and 2.8m ML within 30 years. Agriculture is a major water consumer.

The study also considered the areas of prime irrigation land, the factors influencing the development of irrigation projects and the areas of high priority for irrigation. There is considerable room for improvement in efficiency of water use. The pricing of irrigation water will come under considerable pressure. The protection of valuable irrigation lands and dam sites from other uses is a high priority for future planning.

State regional and catchment planning

The potential for development of the sugar, grain, horticultural and energy crop industries in Queensland is very high, although in many cases this development will move from the better class land to more marginal lands where agricultural technology is not so well developed. The potential productive capacity of our agricultural land, however, is being threatened by land degradation and by the alienation of prime agricultural areas through uncontrolled development.

The responsibility for preserving agricultural productivity is spread among landholders, local authorities and Government departments and, in particular, this Department.

The Division has studied the issues involved and has highlighted areas of concern. A National Conservation Strategy for Australia is being developed as a co-operative effort between the Commonwealth and the States. The objective of the strategy is to show how Australia can attain sustainable development.

Clearly, all land users have the primary responsibility for preventing soil degradation in their lands. Land use should not exceed land capability. Action is required to increase awareness of this responsibility and perhaps to provide incentives for conservation activity and even penalties for over-use.

The process of land use planning or 'town planning' in Queensland is primarily a function of Local Government. All Draft Town Planning Schemes are reviewed by this Department and recommendations are passed on to the Local Authority through the Department of Local Government. During 1981–82, six plans (Albert, Kolan, Hinchinbrook, Moreton, Noosa and Balonne) were inspected in this programme. Comments on three other plans (Cardwell, Stanthorpe and Crows Nest) were made following public exhibition.

The Department of Local Government now refers any proposed rezoning involving assigned caneland to the Branch for comment. Nineteen shires were assisted in relation to minimum subdivision sizes, suitability for agriculture subdivision for hobby farming purposes and land management needs of certain areas. A significant new initiative this year has been the preparation of land suitability plans for Nanango, Wondai, Inglewood and Murgon Shires.

A survey conducted in 1981 into steep lands in the Maryborough supply area found that some 28 sugar-cane growers were growing cane on land which is considered unsuitable for that purpose and in this regard they could be considered elegible for a transfer of cane assignment onto other areas. A nearby area of vacant Crown Land was assessed for suitability of soils and potential for water storages. Further involvement or action in this area will wait on a positive declaration of interest from affected growers.

The land use studies have indicated that there are still significant areas of prime land available for major cane expansion in various parts of the State. However, some mill areas are now 'landlocked' and, in the past, this has led to expansion onto unsuitable land. The Central Sugar Cane Prices Board is now taking initiatives to correct this situation.

The Babinda mill is landlocked and there is a real scarcity of suitable land which can be brought into production. An inspection of some 24 parcels of land in the area was undertaken.

The Central Sugar Cane Prices Board adopts a policy of not expanding onto unsuitable land, and requires that soil erosion control measures be used when required in all new expansions. The Board implements its policy through its Local Assignment Committees which often sought advice and assistance to identify suitable land and the prescription of erosion control practices. Some 30 inspections and reports to the Local Assignment Committee were made in north Queensland.

A land suitability study near Ingham completed in 1980–81, distinguishing the relative suitability of sugar-cane and forestry in the conflict areas at Leach and Lannercost, recommended that 980 ha be used for sugar-cane.

A Strategic Plan for Pioneer Shire was drawn up in March 1982 by town planning consultants. It was possible to supply to the planner a base map showing the map units, and a classification of the map units which could be considered as prime land.

The Mackay Land Use Committee has co-operated in seeking an increase in the rate of adopting soil conservation. The land suitability study work was called on to identify the priority areas requiring soil erosion control.

During this year, the Lands Department sought advice on lease conditions, and recommendations were made for a number of properties on the Central Highlands in terms of the development being subject to inspection and approval by the Soil Conservation Branch.

This prior action should prevent serious erosion occurring which would otherwise become a very costly problem both to the landholder and the community.

Land development

Environmental impact assessment. The Branch has two roles in environmental impact studies. The first is to provide guidelines on the coverage and content of studies, and the second is to comment on study findings for those aspects which affect rural land use.

During the year, the Branch staff either assisted in drawing up guidelines, or commented on guidelines, covering an ammonium nitrate plant at Toowoomba, an aluminium smelter at Bowen, a water pipe line to the Callide Valley and a number of mining lease applications. For the first time, an agricultural development, an irrigation project at Dalby, has been subject to an Environmental Impact Study.

The Blair Athol Coal Mining project has been the subject of four environmental study reports, two produced in 1976, one in 1980 and the last in 1981. All the points raised by the Branch have now been satisfactorily covered by the consultants.

The Kidston Gold Project near Georgetown and the Thiess Coal Development Proposal (Theodore mine) were examined in some detail.

Farmers inspect the trash handling ability of a modern chisel plough demonstrated at a field day conducted by the DPI South Burnett Crop Industry Committee at Wooroolin on 10 March.

Parkland protection. The National Parks and Wildlife Service is constantly adding to the National Park and Environmental Park Estate. As a matter of policy, these proposals are referred to the Department of Primary Industries for comment. Comments are made on the agricultural value of the land.

During 1981, some 32 Environmental Park and 35 National Park proposals were examined by this Division. The majority of proposals were supported, and the only dissension concerned an area of prime agricultural land. Branch officers often recommend various areas as suitable for conservation during the course of resource surveys.

A committee was set up with Forestry Department to study forestry on farmlands and proposals have been prepared for investigation in Atherton Tableland and Lockyer Valley where the removal of trees has led to land degradation.

At the same time, an investigation into tree decline on rural land in Queensland has commenced.

Cassava development. Following inquiries made last year on the climatic constraints to cassava growing in the Collinsville area, a series of water balance analyses using a 60-year period of weekly rainfall data was conducted. A number of strategies was evaluated, such as delaying the application of irrigation water for 1 week after the soil moisture reserve was exhausted. This strategy did not significantly reduce the total amount of irrigation water required, and had negligible effect on reducing the index of increased water runoff caused by high rainfall following irrigation applications. Two smaller irrigation plants were an optimal combination.

As water could not be supplied on a sufficiently reliable basis year to year, however, the project has been dropped by the developers until a more reliable water supply can be obtained.

Technical support and development

The improved availability of Landsat imagery from the Australian Landsat Station made possible a number of activities this year which would not have been feasible previously.

Landsat imagery was used to determine the extent of cropping in near south western Queensland. Actively growing winter crop was readily detected. Some identification problems were evident, however, on fallow lands.

Landsat imagery is being evaluated as a method of cane assignment mapping. There are resolution problems with a land use as intensive in spatial pattern as sugar-cane, but is of considerable use for delineating the present cane lands on the existing air photographs.

Recent Return Beam Vidicon black and white imagery was used to identify current and potential irrigation land use in south east Queensland. The imagery provided an overview which is not possible with air photos, and also provided detail which thematic maps cannot show.

The potential for using Landsat imagery to evaluate parameters such as pasture condition, storm pathways and woody weed infestation in western Queensland is now being investigated. To date, with the limited imagery available, the pathways of storms can be identified without difficulty.

A computer based digitizing system has been installed and suitable programs are being developed for it. General purpose utility routines have been written, which now form the basis of many of the application programs that are being provided.

Area management and map location programs have been written and put to use and contouring and three dimension viewing packages have been acquired.

Production work on map digitizing commenced with the Isis Mill Land Suitability Study and digitizing for the Mackay Land Suitability Study has made good progress.

A project to develop microprocessor based equipment for the automatic recording of rainfall, rainfall rates and runoff has begun. A field unit and a unit to service a number of these are being developed. Five field units are in operation in Emerald.

A program developed some years ago for the six arid land surveys is now also being used in the Canelands and Wide Bay Burnett projects and by a number of other Branches.

ASEHIS is a data base information system which maintains records for the State's Area of Erosion Hazard projects. This is operating successfully and is reducing workload of the regional and head office staff.

All programs for the Broad Regional Assessment of Queensland have been written for Agriculture Branch. Modifications were made to some programs and first copies of all microfiche needed for the report were produced.

Engineering Services

ENGINEERING Services Section provides technical services to those Branches of the Department which require specialist engineering advice. It also undertakes research and development and it provides an extension and advisory service for primary producers and producer organizations who seek advice in engineering matters.

There are four major work areas within the Section—

1. Agricultural Engineering Research and Development, within which engineers research, design, develop, test and modify equipment, mostly for Departmental research officers and for farming industry groups.
2. Environmental and Resources Research, within which a study is made of engineering operations which might minimize the effect of farming practices on the environment and within which more efficient use of energy resources is studied.
3. Farm Organization Operations Management, in which assistance is given with relatively simple machines and buildings which affect the operations of properties.
4. Information Services, in which media and field day support is provided for extension in engineering matters. There is, of course, a big overlap across the boundaries of these work areas. For this reason, this report does not follow these headings.

A considerable amount of resources this year has been channelled into the development of minimum tillage machinery and into ways of reducing tillage costs.

Farm organization operations management

Tractor fuel economy field days have been successful following the generous loan of a large tractor by International Harvester Co. of Australia and following successful testing of equipment designed to test the operating characteristics of a tractor drawing a range of implements. The field days have been organized with the help of Queensland Grain Growers' Association. Attendances were limited in number to allow easy access to instrumentation. This instrument prints out rpm, torque, power and fuel consumed on an instantaneous basis so that operating techniques can be compared.

Growers are encouraged to bring their own implements for use with the tractor. The Section's pto dynamometer is available for growers to check the output of their tractors. The method shows ways of reducing fuel use and the field days have already proved popular. Over the next 18 months, some 25 more are planned throughout the grain belt.

In far north Queensland, an engineer has been heavily involved with the peanut industry and, in particular, with dryer design and performance and curing techniques. There is no financial incentive to growers to produce high quality peanuts, but they are keen to improve their product. Considerable time has been spent in extension of engineering information.

The demonstration research dryer which features the ability to measure airflow, pressure drops, temperature profiles and bin weights while the airflow rates vary, has been commissioned. It is expected that, by next season, demonstrations of improved curing techniques will be possible. Engineering data gathered from these demonstrations will support the basis for the techniques. Shed space and peanuts were made available by a local grower.

The work associated with peanut planter performance was not conclusive because of the variability in seed quality. It will be repeated.

More than 30 commercially available plough, scarifier and cultivator tines were tested on the tine characteristic dynamometer. This information will be published listing data such as jump height and horizontal travel, draught, and vertical displacement and the tine manufacturer's specification. This comprehensive publication will be of value to farmers, machinery dealers and equipment manufacturers.

Mechanization of aspects of the bean seed industry were completed with germination tests of seed harvested with the modified pea-viner which produced excellent results. The engineering aspects were included in a publication for the bean seed industry which is being used as extension material. The

modified harvesting methods have been accepted by several growers in the Burdekin and Biloela areas with most satisfactory results.

Liaison work has continued with a Darling Downs dairy farmer in his attempts to set up and operate an on-farm ethanol plant. Although much has been written throughout the world on ethanol production, the perfection of the recipe to produce an economical quality of fuel is still being developed. Analyses of the brew have been made by Agricultural Chemical Laboratories. This attempt has not yet succeeded.

Updating of a considerable suite of standard drawings or reference plans relating to piggery buildings and their associated fixtures is beginning. Three new designs for inclusion were completed this year.

Considerable work was accomplished this year in respect to environmental controls for livestock buildings. Seven new ventilation/heating systems were designed as were three modifications to existing installations. Many inquiries are received on general aspects of construction and layout of buildings, and handling, storage and disposal of effluent.

Several fruit fumigation rooms in southern and northern Queensland were inspected as the first stage of preparation of a publication on construction and operations of such rooms for the use of growers who might be contemplating such a move.

Engineers, apart from their research and development role, are also committed to extension, especially those situated in regional centres. They have given considerable advice on new machinery specifications and other items and have been part of the regionalized extension organization, providing resource information for extension officers of other Branches.

Advice has also been offered to the Maize Board on the advantages of automatically controlled aeration systems. This resulted in the installation of a controller on one of the Board's silos. Engineering aspects of the grass seed industry relating to harvester performance and dryer design have also received attention.

Considerable time was spent by one engineer as part of a Departmental team selected to produce a handbook on spray application technology. The work for this has been completed. After printing, it will be the basis of a series of workshops throughout the State to produce awareness among extension officers of problems in this field and of the state of knowledge at present.

Experimental and farm machinery equipment

A single tine dynamometer which provides data on forces and their effects on tines at various depths and under different field conditions was designed and used to collect field data. The tillage forces information collected in the northern wheat belt is expected to assist in advising farmers of the tool type most suited to their farming situation.

This machine has now been expanded to a three bar machine to provide additional data. Two bars are instrumented for draught and vertical force, while the third measures all components, including moments. The instrumentation includes a dedicated microcomputer and a second microcomputer which processes the result.

Thirty-four different no-till planter combinations were compared for seedling emergence and vigour in single row experiments in heavy clay soils with officers involved in the conservation cropping area. As a result of this work, a commercial prototype no-till planter was designed with representatives of an equipment manufacturer and this unit is now being field tested. Another local Darling Downs manufacturer also used the results of the planter combination trials and is presently prototype testing his no-till planter.

The engineer involved in this work was invited to join with CSIRO and Northern Territory Department of Primary Production officers in no-till planter evaluation work. Subsequently, he designed and developed two rigs each of four rows with easy to change components which allow 100 combinations to be made available. Most of these components were imported and they embody all major no-till concepts from around the world.

These rigs are now being used by CSIRO in Katherine as part of their agronomic research work. It is expected that, because of similarities in areas of Northern Territory and of north Queensland, information gathered at Katherine will be directly meaningful for some parts of this State.

A bed former consisting of a triple disc assembly at each side of, and followed by, a soil shaping compression assembly has been designed, built and tested. This is for use in a new fresh market tomato production (without trellis) concept in which machinery forms raised beds, incorporates fertilizer and soil fumigants, lays plastic mulch and trickle irrigation piping all in a single pass.

The Queensland Grain Growers' Association sought assistance in developing a more consistent receival depot sampling method for determining sunflower and admixture percentages. Two testing methods have been selected as the most promising and prototype equipment for both methods is being constructed for field testing.

General

The establishment of a Co-ordinating Committee on Agricultural Engineering will, apart from establishing a forum for discussion, serve to acknowledge the engineering work presently being undertaken and prevent any duplication of effort. It is expected that major agricultural engineering projects will be proposed and co-ordinated through this committee.

There has been a growing demand this year for information and designs for farm buildings apart from the intensive livestock buildings and greenhouse designs that this Section's engineers have previously undertaken.

The possibility of assigning an engineer to devote much of his time to this area is being considered, along with the engineering needs of the dairying and sheep industries. There are interesting challenges ahead when work might include subjects like the use of optical fibres as sensors to size, grade and colour-sort tomatoes, and compressed air misting of spray droplets for ULV applications.

Drafting Services

DRAFTING Section prepares maps depicting land resources and plans to accompany reports submitted by the Division of Land Utilisation and the Division of Plant Industry. It also draws farm plans and provides for associated needs for Soil Conservation Branch.

There has been an ever increasing demand for the resource maps prepared by the Division and this year there was a dramatic rise in the number of maps prepared. A number of old maps was reprinted to satisfy requirements of users. These pressures are expected to continue. To date, improving techniques and introducing new equipment to improve efficiency of operations have countered the increasing number of jobs presented.

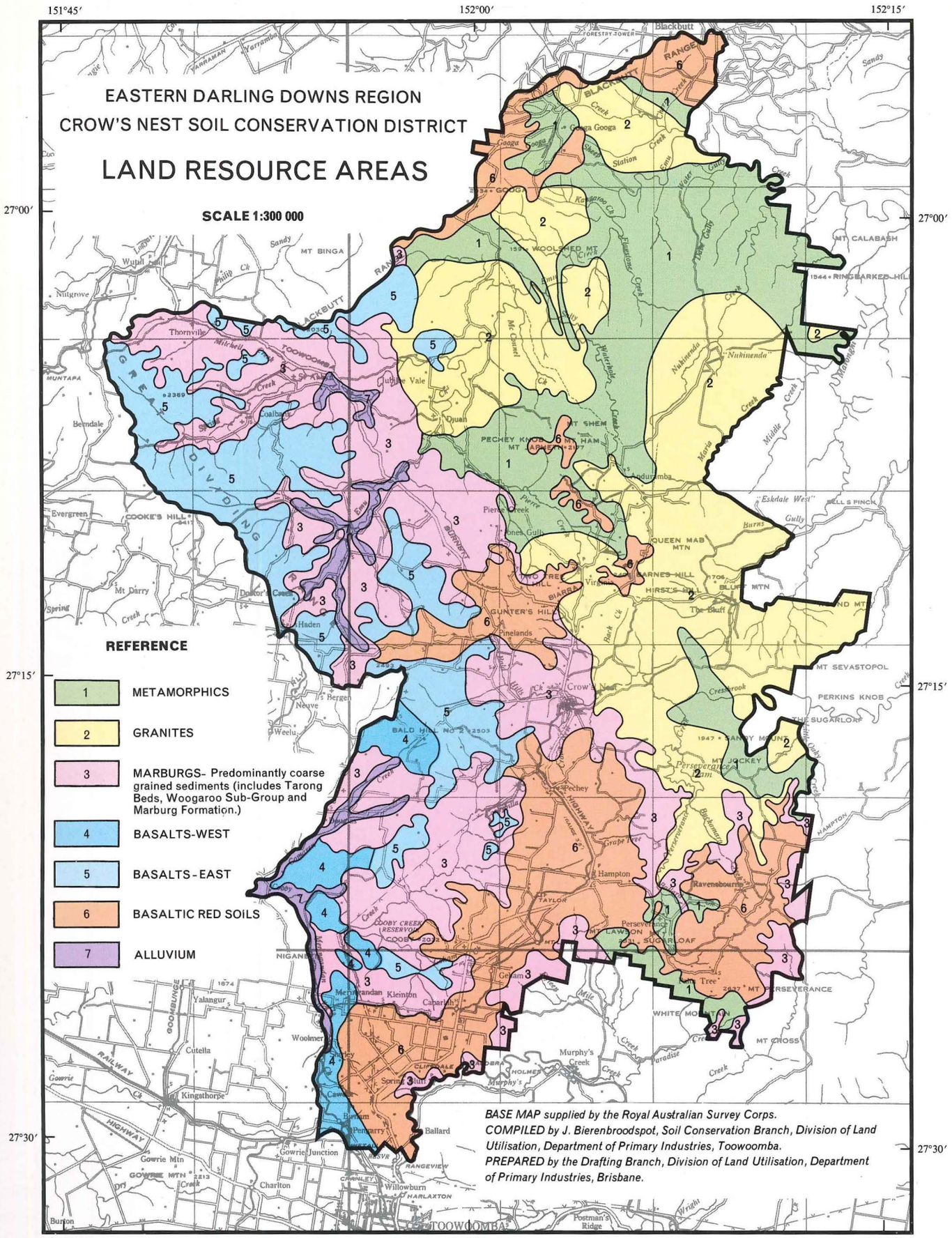
This year saw the introduction of the digitizer and this will help to assemble data for maps in the future. It will also make map data more freely available for interpretation and use. A new vertical process camera, a new dyeline machine and two new artiscopes have been purchased.

The Supervising Draftsman has been actively involved in the Queensland Surveying and Mapping Advisory Soil Committee which aims at evaluating the effectiveness of the Queensland State Mapping Programme. This Committee submitted its final report in March.

The time spent on Land Resource Mapping is a little over 60% of total. This year, 70 resource mapping jobs were undertaken compared with 39 last year. Technical Services work remained static at 288 jobs.

Major land resource maps completed this year were—Western Arid Region Land Use Studies Part III and V; Isis Mill Land Suitability; II Property Plans—BTB Programme: Crows Nest Land Resource Areas; Land Suitability Map—VCL Maryborough; Local Authority Maps—Nanango, Inglewood, Wondai; Miles Technical Guide (reprint); Left Bank Emerald Irrigation Area; Kairi and Delta Research Stations; Lockyer Valley Alluvia Bores; Noosa Shire Handbook Maps; Queensland Native Pasture Maps and Soil Map of the Proserpine Lowlands. One hundred and forty field plans were prepared for the Soil Conservation Branch.

By Authority: S. R. Hampson, Government Printer, Queensland



This map has been prepared for inclusion in the Land Management Field Manual for the Crow's Nest Soil Conservation District as part of the State wide Technical Guide programme being undertaken by Officers of Division of Land Utilisation. This programme was initiated in 1980 in the major cropping areas of the State. The objectives of the programme are to provide a resource base for farm planning purposes, to define specifications for soil conservation measures, agronomic practices and conservation management systems and to document this material in district field manuals.