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# QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES



**Annual Report 1976-77**

**Presented to Parliament by Command**





The Governor (Sir James Ramsay) (left) with the Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.) and Royal National Association president (Sir Douglas Wadley) at this year's Exhibition.

For the cotton farmer, the harvest is the reward for months of painstaking effort. Along the way, he can call on the skilled services of Department of Primary Industries staff which includes agricultural, irrigation, and pest and disease control officers.





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# Organization of the Department

as at 30 June 1977

<b>MINISTER FOR PRIMARY INDUSTRIES</b>	..	Hon. V. B. Sullivan, M.L.A.
<b>CENTRAL ADMINISTRATION AND CLERICAL AND GENERAL DIVISION—</b>		
Director-General and Under Secretary	..	A. A. Ross, M.Agr.Sc.
Deputy Director-General	.. ..	E. O. Burns, B.Com., F.A.S.A.
Chief Advisory Officer (Administration)	..	G. I. Alexander, B.V.Sc., M.S., Ph.D.
Assistant Under Secretary	.. ..	H. J. Evans, A.A.U.Q., A.A.S.A.
Assistant to the Director-General	.. ..	A. Winterton, B.Sc., Dip.Bus.Admin., Q.D.H.
Accountant	.. ..	J. D. Reardon, A.A.U.Q., A.A.S.A.
Executive Officer, Research Stations Section		G. H. Allen, Q.D.A.
Executive Officer, Extension Services Section		J. Gibb, B.V.Sc., Dip. Agric. Ext.
General Manager, Agricultural Bank	..	F. J. Strutton, A.A.S.A., A.C.I.V.
Director, Information and Extension Training Branch	.. ..	J. L. Groom, B.Sc.Agr., Q.D.A.
<b>DIVISION OF ANIMAL INDUSTRY—</b>		
Director of the Division	.. ..	L. G. Newton, M.V.Sc.
Deputy Directors	.. ..	J. W. Ryley, B.V.Sc., B. A. Woolcock, B.V.Sc.
<b>Animal Research Institute—</b>		
Biochemical Branch	.. ..	C. W. R. McCray, B.Sc., A.R.A.C.I. (Director)
Husbandry Research Branch	.. ..	L. Laws, M.V.Sc. (Director)
Pathology Branch	.. ..	W. T. K. Hall, M.V.Sc. (Director)
Beef Cattle Husbandry Branch	.. ..	M. R. E. Durand, M.R.C.V.S. (Director)
Veterinary Services Branch	.. ..	K. M. Grant, B.V.Sc. (Director)
Sheep and Wool Branch	.. ..	A. T. Bell, B.V.Sc. (Director)
Slaughtering and Meat Inspection Branch	..	B. Parkinson, B.V.Sc. (Director)
Pig and Poultry Branch	.. ..	F. N. J. Milne, B.Sc. (Director)
<b>DIVISION OF DAIRYING—</b>		
Director of Dairying	.. ..	V. R. Smythe, M.Agr.Sc.
Deputy Director	.. ..	W. D. Mitchell, B.Agr.Sc., Dip.Agric.Ext.
Dairy Cattle Husbandry Branch	.. ..	I. H. Rayner, B.Econ. (Director)
Field Services Branch	.. ..	—
Research Branch	.. ..	W. C. T. Major, B.Agr.Sc., A.S.B.M. (Director)
<b>DIVISION OF LAND UTILISATION—</b>		
Director	.. ..	J. E. Ladewig, B.Agr.Sc.
Deputy Director	.. ..	A. Hegarty, B.Sc., Q.D.A.
Development Planning Branch	.. ..	W. F. Y. Mawson, B.Econ., H.D.A. (Director)
Soil Conservation Branch	.. ..	H. W. Pauli, B.Agr.Sc., B.E.(Civil) (Director)
<b>DIVISION OF MARKETING—</b>		
Director of Marketing	.. ..	D. P. Lapidge, B.Com., A.A.U.Q.
Deputy Director of Marketing	.. ..	A. C. Peel, Dip.Ind.Chem., A.R.A.C.I.
Economic Services Branch	.. ..	R. B. Bygott, B.Econ., Dip.Agric.Ext. (Director)
Marketing Services Branch	.. ..	D. R. Lewis, B.Sc. (Econ.) (Director)
Standards Branch	.. ..	W. V. Mungomery, B.Agr.Sc. (Director)
<b>DIVISION OF PLANT INDUSTRY—</b>		
Director of the Division	.. ..	B. L. Oxenham, B.Agr.Sc.
Deputy Director	.. ..	N. F. Fox, B.Agr.Sc.
Agriculture Branch	.. ..	J. K. Leslie, Ph.D., B.Agr.Sc. (Director)
Horticulture Branch	.. ..	H. M. Groszmann, B.Agr.Sc. (Director)
Agricultural Chemical Laboratory Branch	..	T. J. Beckmann, M.Sc., F.R.A.C.I., F.C.S. (Director)
Botany Branch	.. ..	R. W. Johnson, M.Sc., Ph.D. (Director)
Entomology Branch	.. ..	T. Passlow, M.Agr.Sc. (Director)
Plant Pathology Branch	.. ..	G. S. Purss, M.Agr.Sc. (Director)



# Queensland Department of Primary Industries

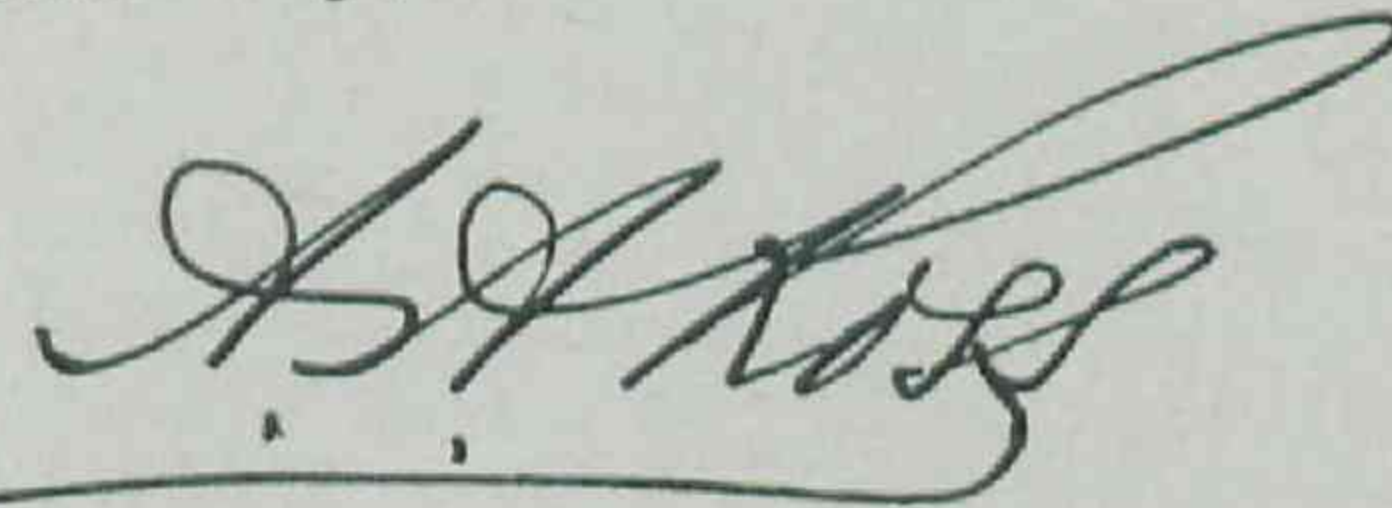
## Annual Report 1976-77

To the Honourable the Minister for Primary Industries.

Sir,

I have the honour to submit the following report on the operations of the Department of Primary Industries for the year ended 30 June 1977.

Yours faithfully,



A. A. ROSS,  
Director-General.

## General Comments

ALTHOUGH there were some heartening bright spots, Queensland's rural industries did not present a clear-cut picture of prosperity in 1976-77. Continually increasing costs and either static or falling real incomes were probably the dominating factors influencing rural industries.

Paradoxically, climatic conditions over virtually the whole of the State continued to be more than favourable for most industries, apart from some flooding and cyclonic damage in the early months of 1977.

Production of cereal and coarse grain crops declined significantly in 1976-77, with grain sorghum showing the biggest decline—down 15% from the previous year's level of 740 000 tonnes. Wheat, barley and maize production fell only marginally from the previous season's level.

Sugar-cane, on the other hand, recorded a 15% increase in production, due largely to an increase in assigned areas. A further bright spot was cotton, with a record production of 35 000 bales firmly expected when the harvest is completed.

The Queensland wool clip is expected to decline by about 8% from that of the previous year, but sheep and lamb slaughterings rose marginally from 1.4m to 1.5m head. Cattle and calf slaughterings, estimated at 2.9m head for 1976-77, increased by about 400 000 or 16% over the 1975-76 levels.

Egg production declined dramatically from 35.8m dozen in 1975-76 to an estimated 27.0m dozen this year, and this fall is seen as a vindication of the supply-demand management scheme introduced under the Hen Quotas Act.

The gross value of rural production in Queensland in 1976-77 is provisionally estimated at \$1 452.6m, an increase of about 14% over the previous year. This result, if finally achieved, will mean only a marginal real growth rate for Queensland's rural industries when the inflationary factor is allowed for. The improvement can be attributed mainly to better results in cotton, nearly doubled in gross value, wool up by an estimated 90% because of improved auction prices and, for cattle and calf slaughterings, values up by about 25% on the previous year.

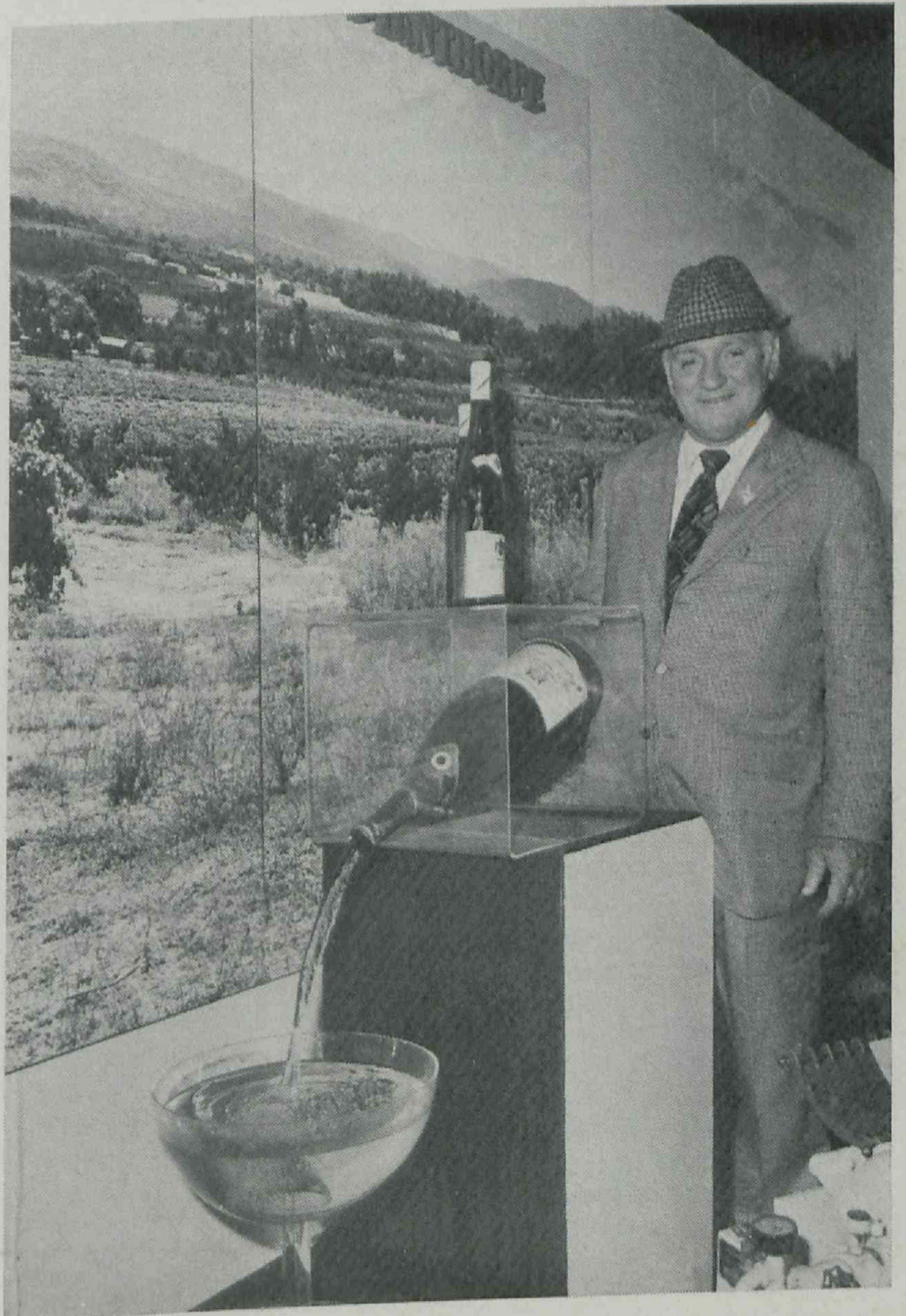
### Weather conditions

Dry conditions predominated in Queensland at the beginning of the year and nearly all districts reported below-average rainfall for the months of June, July and August 1976. The dry and cold winter conditions resulted in a rapid deterioration in the nutritive value of standover pastures. By the end of winter, bush and grass fire danger was high in most districts of the State.

Shower and thunderstorm activity in October brought relief rain to western and southern districts, but the weather pattern in the north-west and in much of the central interior was again generally fine with patchy light rain providing only little relief from the excessively dry conditions. Rainfall along the central and southern coast and adjacent inland districts enhanced pastoral and agricultural prospects.

November was a month of hot, humid conditions accompanied by frequent storms. Patchy storm rains throughout the wet tropical coastal area from Ingham to Mossman afforded some relief from the virtual drought conditions which had prevailed in the previous 6 months.

*Wine is an up-and-coming product on the Granite Belt. The Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.) inspects a wine display aimed at introducing Queenslanders to their newest industry.*







A shallow storage dam and irrigation area at Richmond has been used to study the practicability of growing supplementary feed to tide sheep over periods of nutritional deficiency.

The main feature of the weather for December was cyclone Ted which caused some damage to property and considerable stock losses in the Gulf country. On the credit side, the general rain following the cyclone provided much needed relief from the very dry conditions for a large part of the north-west and the central-west. Bush and grass fire danger in the area subsided. Further cyclonic influences in January brought flood rains to the Queensland-Northern Territory border areas and to the North Coast-Barron and Herbert. The southern half of the State remained hot and dry with high bush and grass fire danger persisting.

Nearly all meteorological districts recorded above-average rainfall for March. Most late-planted summer crops received considerable benefit as a result.

April was a quiet uneventful month for Queensland's weather. Generally dry with below-average rainfall was the pattern, apart from the far north coast sector, particularly around the Babinda-Innisfail strip, which had the wettest January-to-April period on record. Widespread general rain over virtually the whole State during early May came at a very opportune time for winter cereal and oilseed crops. With previous sub-soil moisture levels satisfactory, this late autumn rain gave the State its best start to winter crops for many years.

### Fodder crops and pastures

Most pastoral areas came through the winter of 1976 with a fair body of standover feed available, but the nutritive value was poor and the fire danger high. The overall feed situation through to the end of September 1976 was one of rapid deterioration and little improvement was evident in October. Large areas of native pastures were burnt out during November, leaving the north-west pastoral region in virtual drought condition.

The whole pasture pattern changed radically with the post-cyclonic rains in December and again in January 1977. Further intermittent, useful falls through to May ensured a constant availability of native and sown pastures and, although most of these were dying off by the end of the year, stock were expected to winter quite well.

Considerable increases in planting of oats for supplementary feeding were reported from a number of pastoral areas, reflecting a more optimistic outlook among the grazing community.

### Beef

Seasonal conditions, in general, were good throughout the State during the year with the few dry areas eventually receiving sufficient rain before the 1977 winter.

Cattle prices in the early part of the year were much better than in the corresponding time of the previous year with the best average monthly prices for 200 to 250 kg ox being paid in October. Prices were falling at the end of the year.

*Breed comparison studies at Brigalow Research Station, Theodore, include the use of Africander sires with high resistance to cattle tick.*





Estimated average monthly dressed weight prices for 200 to 250 kg ox ranged from 41.8c up to 56.6c per kg, for 251 to 300 kg ox from 43c up to 55c per kg, for 301 to 320 kg ox from 46.6c up to 58.2c per kg and for 200 to 230 kg cows from 27.8c up to 48.7c per kg.

Queensland's beef herd at 31 March was estimated to be 11 580 000 head, a 2% increase on the number at 31 March 1976. Although this rate of increase is lower than in the previous year, it still meant that there was an over-supply of cattle with consequent lower returns per animal to the producer.

The gross value of all cattle marketed in Australia in 1976-77 is estimated to reach \$952m. The increase since last year results largely from a projected 25% increase in average prices.

In June 1976, the Australian Meat Board introduced minimum export prices for some of Australia's export markets. The introduction followed concern that many exporters had been virtually 'dumping' beef on smaller markets, such as Canada and Sweden, to earn credits to supply the more lucrative United States market. Australia's export quota to the United States was increased from 287 000 tonnes in 1976 to 296 000 tonnes for 1977.

The Australian Meat Board announced a revised scheme for controlling exports to the United States in 1977. The basis of the scheme was the immediate allocation of 60% of the agreed United States quota of 296 000 tonnes by two methods—

1. The allocation of one-third of maximum credits carried forward by exporters.
2. The balance to 60% of the United States quota to be allocated on the basis of export performance to all markets in the twelve months ending 30 November 1976.

The remaining 40% of the quota was allocated in early May 1977. This allocation was on the basis of performance by exporters to all markets, excluding the United States of America and Canada, in the 12 months ending 30 April 1977.

Sales to the Middle-East increased dramatically as did sales to Russia and Eastern Europe. The European Economic Community lifted its ban on beef imports on 1 April 1977 and reintroduced a variable levy scheme. This is not expected to benefit Queensland's exports to any degree in the short term.

The Commonwealth Government endorsed proposals for an Australian Meat and Livestock Corporation to replace the Australian Meat Board. The new Corporation will have four producer representatives, one meat exporter representative, two specially qualified members, a Commonwealth Government representative and an independent Chairman.

Supporting the Corporation will be a Producers' Consultative Group and an Exporter/Abattoir Consultative Group to liaise in production and marketing problems. These groups will nominate panels of names from which appointments of the livestock producer representatives and the exporter representative will be made to the Corporation.

Carcass classification moved a step closer to reality with the wiring completed for the installation of computer equipment at the Cannon Hill abattoir. Trials were expected to be under way by the end of June.

On 9 September 1976 Cabinet approved the proposed beef stabilization scheme of the Queensland Beef Industry Committee and the scheme was submitted to the Australian Agricultural Council in October where it is still under consideration.

## Sheep

Predominantly dry weather prevailed over much of the sheep country throughout the winter of 1976 causing a deterioration in the overall feed situation. Chilling westerly winds kept conditions in the spring cold and dry, and all areas except a few favoured localities reflected these climatic conditions. Depleted feed supplies caused concern in some areas, and bush and grass fires posed a constant threat, especially in the dry inland districts.

Many sheep flocks were heavy in lamb and outbreaks of pregnancy toxæmia occurred frequently as a result of inadequate and poor quality feed. Some graziers resorted to the feeding of protein supplements to pregnant ewes, but the relatively high cost of the feed prohibited its use. Pasture response in southern Queensland was generally good following early summer rains.

November, in particular, was a month of hot, humid conditions accompanied by frequent storms of varying intensity. Fires ignited by dry electrical storms burnt out pastures in western areas, further aggravating the overall feed situation. Lambing percentages were generally poor, and a shortage of replacement sheep continued to trouble the industry.

In December, rainfall was light and sporadic until torrential rains, associated with cyclone Ted, occurred over much of the tropical north. Wet conditions attributed to the



Checking mycobacterium cultures in the tuberculosis laboratory at Yeerongpilly. As tuberculosis is progressively eradicated, the examination of lesions for causal organisms becomes more important.

cyclone were experienced in central and western sheep districts, and 500 000 sheep were estimated to have perished directly as a result of bogging and exposure.

By the end of February 1977, pastoral conditions had improved further in response to rain depressions associated with cyclones Lily, Miles and Nancy and sheep were generally in good condition.

Flooding occurred in the Channel Country during March, and the late summer rains disrupted shearing, resulting in operations being well behind schedule.

Pastures in the north west, central west and south west showed the adverse effects of dry autumn conditions and, with the approach of winter, over-grown grass, heavy with seed, posed a threat to sheep. The situation changed radically in May with good, general rain. Plentiful supplies of feed were available for winter, and most graziers were experiencing their best season for many years.

**STORE SHEEP MARKET.** Trading in the store sheep market remained subdued as many graziers were deterred by the high level of prices being asked for sheep, especially young woolgrowers. The relative rise in store sheep prices in the 1976-77 season resulted, in a large measure, from the continued high level of wool prices and the consequent keen demand for sheep. Graziers also were reluctant to pay high freight rates in addition to increasing prices for sheep. Trading, therefore, tended to be restricted to paddock sales. Young woolgrowers, two and four-tooth, were selling at \$6 to \$8 a head, with top quality lines to \$9 a head. Store sheep prices were strengthened by a shortage of young woolgrowers, and remained strong well into 1977.

Improved pasture prospects for the sheep country and the possibility of sustained wool prices next season stimulated activity in the store market. Graziers sought suitable lines of woolgrowers for re-stocking, but demand exceeded supply as few good quality sheep were available for sale. The supply situation has been materially affected by poor lambing percentages in the spring of 1976 and the scarcity of mature woolgrowers following the recent floods. Many graziers are keeping aged ewes for breeding and wethers for wool because of the general scarcity of store sheep.

The general attitude in the store sheep market regarding future prospects can be described as cautiously optimistic because of excellent feed conditions and continuing competition for sheep suitable for export. By the end of the year, there was expected to be an intensification of the competition for store sheep, attributable to poor lambing percentages last spring and the continued high level of wool prices.





Field officers of Sheep and Wool Branch have been examining the effectiveness of electric fences for sheep control. This flock is showing proper respect for the fence on their left.

**MUTTON AND LAMB.** Demand for sheep and lambs at auction sales held at Cannon Hill during the 1976-77 season focused on all descriptions suitable to the trade, with prime stock being in short supply. The market was often limited in its scope by relatively small yardings but recorded some sales at unusually high prices. In general, the trend in prices was towards high levels, gradually rising from around 30c per kg for best trade wethers and ewes at the beginning of 1977 to the end of year price of 53c per kg. Competition for plain types was generally restricted and prices of such sheep and lambs declined accordingly.

The value of sheep and lambs, less fellmongered wool and skins, slaughtered in Queensland in 1975-76 declined dramatically to \$4.5m from the \$8.1m recorded in the previous year. A preliminary estimate for the 1976-77 season indicated a marked improvement to about \$9m.

**WOOL.** The number of sheep and lambs shorn in Queensland in 1975-76 declined marginally by 1%, while total wool produced increased by 1%. However, the gross value of wool produced increased by 11% from \$81.3m in 1974-75. Preliminary estimates for 1976-77 indicate that wool production in Queensland could decline by 15%. However, with the improved market situation the total value of the clip is expected to reach \$159m.

The 1976-77 selling season began in the latter part of August with opening values fully firm on the closing values of the previous season. The normal hesitancy evident at the opening of most seasons was experienced, but there was a firm underlying demand evident among wool-consuming countries.

With the devaluation of the Australian dollar late in 1976, wool values continued to improve. However, prices began to decline from April 1977 onwards and, by late May, the market indicator was only 4.6% above the reserve price and 11% below its peak post-devaluation level.

This price decline resulted in the Australian Wool Corporation increasing its purchases at auction. However, the Corporation's stocks at the end of the 1976-77 season were expected to be 1m bales, some 300 000 bales below the level at the beginning of the season.

Auction prices were expected to average 290c per kg clean basis. This is 25% better than average prices received during the 1975-76 season.

The Commonwealth Government has agreed to the floor price for wool for the 1977-78 season remaining at the current level of 284c per kg whole clip average.

## Pigs

Queensland's pig population, estimated to be 451 000 at 31 March 1977, was an increase of 10% on the numbers at 31 March 1976. However, the population now appears to be levelling out.

Little major capital investment took place during the year because of credit restrictions and increased building costs.

An amendment to the Stock Act, known as the Licensing and Control of Piggeries Amendment, was passed by Parliament on 1 July 1976 and took effect from 1 October 1976. This amendment prohibits the feeding of any garbage containing a meat product, unless the product has first been dry-rendered.

Average prices for pigs dressed weight 65 kg to 70 kg declined from a peak of 116.2c per kg in December 1976 to around 97c in the latter part of May 1977. Feed prices, on the other hand, rose considerably in 1977 and some sources have predicted that these two factors will cause a decline in the pig population in the near future.

*Legible branding is essential for successful carcass classification and trace-back programs in pigs. The middle carcass of this group carries a legible tattoo.*





Queensland's pig producers moved a step further towards the establishment of a Statutory Authority by requesting a ballot of all producers on the question. At the end of the year, the outcome was not known.

## Dairying

Seasonal conditions for dairying were not as favourable this year compared with last year. Butter production declined to 7 710 tonnes compared with 10 992 tonnes in 1975-76. Cheese production declined from 12 320 tonnes in 1975-76 to 10 838 tonnes.

Little or no improvement occurred in the depressed export markets for dairy products. Skim-milk powder, casein and butter prices remained at low levels and there appears to be little likelihood of any firm recovery in the immediate future.

The low export returns over recent years have placed considerable pressures on existing marketing arrangements for dairy products.

In July 1976, the Industries Assistance Commission began hearing evidence for its inquiry into marketing arrangements. This Department and industry bodies in Queensland presented submissions to the inquiry.

The Australian Agricultural Council considered the findings of the I.A.C. report, and certain aspects of the proposals were agreed upon. The Commonwealth Government subsequently introduced legislation in late May 1977 for the introduction of Stage 1 of the I.A.C. proposals as agreed to by the Australian Agricultural Council.

Basically, the legislation provides for compulsory equalization of returns for prescribed manufactured products, involving a levy-disbursement mechanism.

Legislation providing for the protection of State markets from interstate movements of liquid milk was also introduced concurrently with the above. This legislation will enable a levy to be imposed on liquid milk which crosses State boundaries.

In the latter half of 1976, State Cabinet set up a Committee of Inquiry to report to Cabinet on matters affecting the production and distribution of liquid milk in Queensland. Submissions from all dairy areas in the State were received by the Committee. Cabinet subsequently acted to extend access to the Brisbane milk market to those milk suppliers in south-eastern Queensland who had had little or no access to this market in the past.

## Poultry

Eggs. The egg industry outlook in Queensland was influenced during the year by two main developments. The effectiveness of production controls increased substantially, and a quality improvement program was launched by The Egg Marketing Board at the beginning of 1977.

As a result of the hen quota scheme, commercial production declined significantly in 1976-77.

In south Queensland alone, production fell by 16%, while sales increased by 5% on 1975-76 levels. With the elimination of surplus production, the progressive net return to producers in south Queensland increased by more than 30% over the corresponding figure for 1975-76. The improved return has enabled many producers to invest in technological improvements and generally to improve industry efficiency.

Production was affected for part of the year by an incidence of proventriculitis among some laying flocks.

Since the hen quota scheme was introduced, there has been a gradual redistribution of flocks from southern areas to the supply deficient areas of north and north-west Queensland. In 1974 when quotas were first allocated, 10.2% of the State flock was allocated to north Queensland and the

A typical insulated milk vending vehicle used for retail household deliveries.



remoter areas. At the close of the 1976-77 season, the proportion had increased to 12.1%. In the same period, the proportion of the State flock allocated to south Queensland declined from 83.1 to 80.9%.

Following a 6-month trial period, the South Queensland Egg Marketing Board introduced a comprehensive quality improvement program on 1 January 1977. The scheme is designed to improve and maintain quality and freshness from the farm through to the consumer.

Under the scheme, eggs which are delivered to the Board are tested objectively for quality and freshness. Producers whose eggs fail to meet a certain standard incur penalties.

The Board also embarked on a voluntary 'open dating' program. Cartons are stamped with a 'use by' date at the time of grading and packing. The scheme ensures that the consumer is presented with good quality fresh eggs at the retail level.

POULTRY MEAT INDUSTRY. The poultry meat industry was under stress at the beginning of 1976-77 due mainly to low retail prices for beef. As beef prices rose, consumption of poultry meat increased. However, a situation of over-supply developed, resulting in a downward pressure on prices during the later months of 1976. As a result of increased demand and production cutbacks, prices began to increase during 1977.

The value of slaughterings during 1976-77 was estimated at \$27m compared with \$18m in 1975-76.

The Chicken Meat Industry Committee completed its first year of operations during 1976-77. The Committee, representing both producers and growers, is charged with the responsibility of mediating in disputes between the parties, especially in relation to prices paid to growers.

## Grain crops

There was some abandonment of winter grain crops because of adverse weather conditions in August and early September 1976. However, rain and mild conditions from mid September onwards resulted in production which was above earlier expectations. Wet conditions, however, resulted in the downgrading of considerable quantities of wheat to G.P.

Dry conditions in February and early March caused reduced plantings of grain sorghum and some crop losses.

WHEAT. The area planted to wheat in 1976-77 was estimated at 520 000 ha and resulted in an estimated production of 780 000 tonnes. This production exceeded early expectations but adverse weather resulted in considerable downgrading of grain.

The distribution of receivals at State Wheat Board depots by grades was as follows—

	Percentage
Prime Hard	7.1
No. 1 Hard	32.1
No. 2 Hard	3.4
Australian Standard White	27.5
General Purpose	28.3
Seed	1.6
TOTAL	100.0

Export prices declined during the season following increased world production and aggressive selling, particularly by Argentina. Returns to growers from the 1976-77 crop are expected to be below last season's estimated level of \$104 per tonne f.o.b. port.

With adequate soil moisture in all growing areas, prospects for 1977-78 production were bright but, by the end of the year, it appeared that there was a swing away from wheat towards barley and/or safflower.

BARLEY. Production from the 1976-77 barley crop was forecast at 380 000 tonnes from a sowing of 220 000 ha, slightly less than the record crop of 412 000 tonnes in the previous season. Adverse conditions at critical growing periods resulted in a very small percentage of top quality malting barley being harvested.

This season, it is estimated that 325 000 tonnes of barley will be available for export. The following table indicates the proportion of various grades of barley received by The Barley Marketing Board from the 1976-77 crop—

	Percentage
Malt 1	5.81
Malt 2	33.49
Milling	58.62
Seed 1	0.66
Seed 2	1.42
TOTAL	100.00

A large proportion of the Board's intake is sold on the export market which showed a price decline from last season and, as a result, returns to growers will be down on last year.





An entomologist collecting sorghum florets for the evaluation of midge-resistant hybrids.

**GRAIN SORGHUM.** At the beginning of the season, there were indications that the 1976-77 area sown to grain sorghum could be a record 465 000 ha. However, hot dry conditions during January and early February saw this reduced to 377 000 ha from which production of 630 000 tonnes has been forecast.

The Queensland Grain Growers' Association expects to export about 190 000 tonnes compared with 296 000 tonnes in 1975-76.

The Central Queensland Grain Sorghum Marketing Board expects to export 200 000 tonnes in 1977 from estimated receivals of 220 000 tonnes. This compares with an export of 231 000 tonnes in 1976, from receivals of 237 000 tonnes.

Although the export market weakened during the season, the f.o.b. price overall could be \$88 to \$90 per tonne.

**MAIZE.** Hot dry conditions early in the year resulted in some crop abandonment, especially in the Burnett. From an estimated sown area of 30 000 ha, production was forecast at 65 000 tonnes. Crops on the Atherton Tableland were expected to yield up to 4 tonnes per ha.

Early indications were that returns to growers will show a considerable improvement on last year's. By the end of the year, growers in south Queensland were receiving about \$70 per tonne at farm gate, but the crop had not been fully sold and final returns were uncertain.

## Sugar

Heavy rains in March and April 1977 on the coast between Cairns and Ingham caused major flooding and crop and property damage in that area.

Despite approximately 15% of the Bundaberg district's crop being seriously affected by Fiji disease, a near record harvest is predicted for this year. Large plantings of the resistant variety Q 87 are now under way to replace the susceptible NC 0310.

The 1976 crushing season, except for wet periods in some mill areas early and late in the season, was an unusually dry one. This had the effect of reducing crop estimates in practically all mill areas. In spite of this, the Australian sugar industry achieved a record cane harvest and a record production of raw sugar.

Crushing of the Queensland sugar crop finished on 10 January 1977 with 22.269m tonnes of cane being milled and 3.163m tonnes of 94 net titre sugar being manufactured. This was 15% more than the previous record in 1975.

The Queensland 1976 c.c.s. of 14.24 was slightly above the arithmetic average over the last six seasons of 13.94.

The record Australian harvest was 23.343m tonnes of cane from which were produced 3.295m tonnes of 94 net titre raw sugar.

Yields per hectare were about average with increased production coming from a 12.2% increase in area harvested from 256 806 ha in 1975 to 288 227 ha in 1976. Queensland's share in the increased assignments was 28 896 ha.

Gross industry income from the 1976 season could total \$676m compared with \$653m in 1975. The No. 1 Pool Price was \$210 per tonne n.t. while the excess sugar price was \$237.50 per tonne 94 n.t. The corresponding figures for the 1975 season were \$232.23 and \$277.90. The reduced prices reflected the lower world free market price which moved between £stg.197 in July 1976 and £stg.107 in January 1977 and then up to £stg.151 in April and down to £stg.121 at the end of May.

The domestic market is expected to require around 780 000 tonnes 94 n.t. raw sugar, leaving about 2.515m tonnes to be exported. This is about a 21% increase on last season's Australian exports.

Malaysia, as well as Japan, is still seeking substantial reductions in contract prices negotiated when sugar was at a much higher price than it is at present.

The United Nations Sugar Conference, which ended in Geneva on 27 May, failed to reach an agreement but an agreement may possibly be reached later this year.

## Oilseeds

As a result of adverse seasonal conditions and disease problems, production of safflower in 1976-77 was estimated at a low 690 tonnes from 1 900 ha. In 1975-76, 13 406 tonnes were produced from 27 999 ha. Returns to growers in 1976-77 are expected to average \$240 per tonne delivered processors' plants compared with \$156 per tonne in 1975-76.

Production of linseed in 1976-77 was estimated at 2 000 tonnes compared with 1 017 tonnes in 1975-76. Returns to growers are expected to exceed \$200 per tonne delivered processors' plants compared with \$183 per tonne in 1975-76.

From an estimated planting of 60 000 ha, production of sunflower was estimated at 35 000 tonnes in 1976-77, compared with 38 197 tonnes in 1975-76. Because of reduced supplies and increased demand for sunflower, prices are expected to exceed \$240 per tonne delivered processors' plants compared with \$175 per tonne achieved in 1975-76.

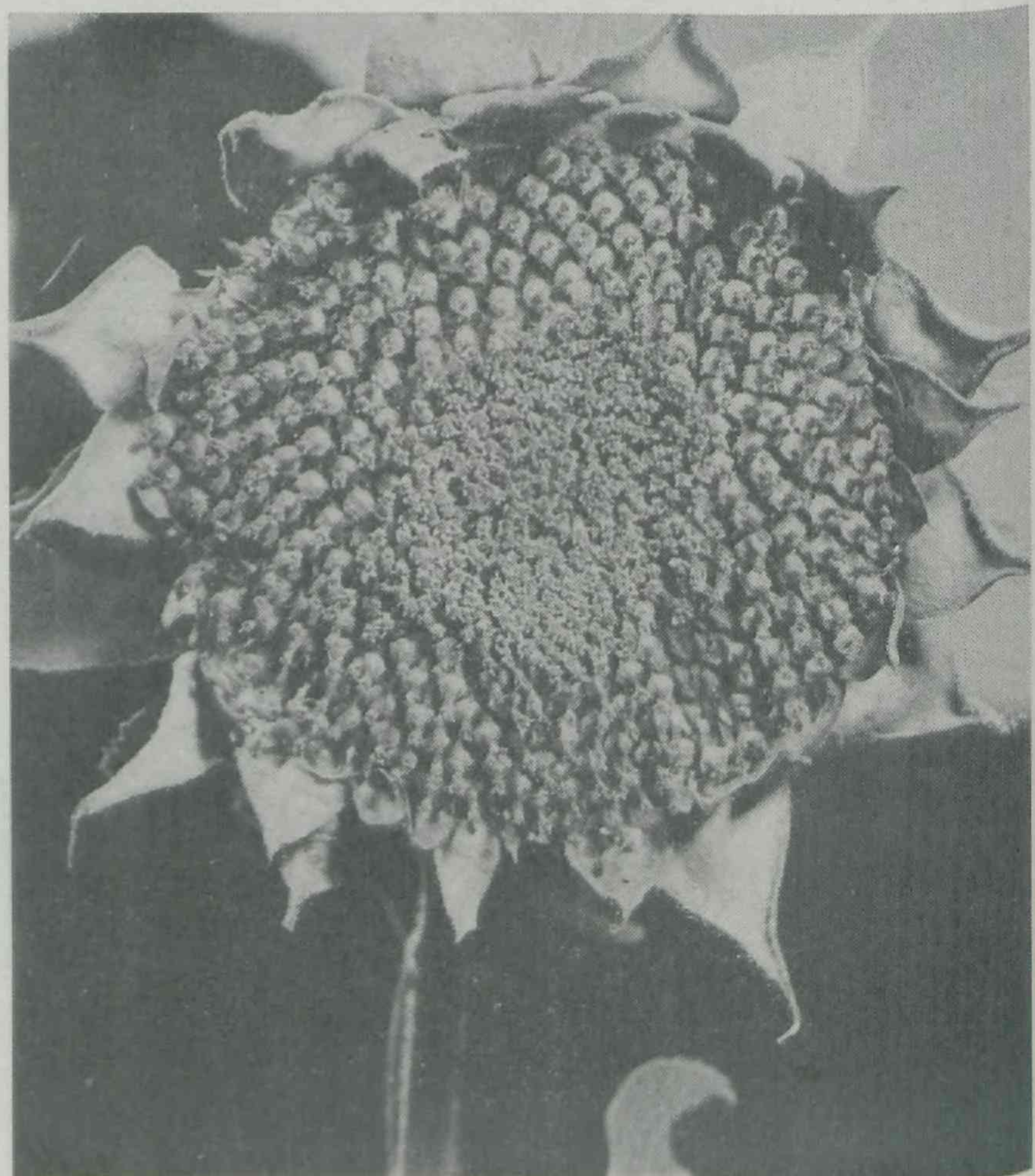
The area planted to soybeans in 1976-77 is estimated at 20 000 ha compared with 19 547 ha in 1975-76. Production is also expected to be higher at 35 000 tonnes compared with 33 194 tonnes in 1975-76.

As a result of the reduced world soybean harvest, returns to growers in 1976-77 are expected to average \$240 per tonne delivered processors' plants compared with \$160 per tonne in 1975-76.

## Peanuts

A resurgence of interest in peanut production was evident in the 1976-77 season, following an improvement in returns to growers from the 1975 crop. It was estimated that about 33 500 ha were planted to peanuts, including, for the first time, some substantial new areas outside the traditional growing areas of the South Burnett. The area on the Atherton Tableland increased by about 50%, thus indicating the increased popularity of the crop in that area.

*Sunflower has become a major oilseed crop in Queensland.*







Growing bean seed is an important industry in the Burdekin. During the year, Department of Primary Industries officers examined harvesting problems to reduce the amount of damaged seed.

The season began very well in all areas but this good start was spoiled, in the Kingaroy area, by a hot, dry summer and mould problems just before harvest. Unseasonable rains in May compounded the industry's difficulties and the quality of early deliveries to the Peanut Marketing Board's Kingaroy headquarters was best described as dismal. Severe downgradings resulted, and returns to growers will be well down on last year's.

A good crop of about 6 000 tonnes of nut-in-shell from north Queensland virtually 'saved' the industry this year. Total Queensland production from the 1977 crop is not expected to exceed 25 000 tonnes—well below earlier expectations.

The poor crop has temporarily prevented the Board from further developing the attractive export market, particularly in Japan. The Japanese are keen to take more of Queensland's Virginia type peanuts but want regularity of supply. The vagaries of our climatic conditions make it difficult to be sure of a good crop every year, and the Board is endeavouring to spread the industry over a wider geographic area to minimize the effect of climate on production.

### Navy beans

Plantings of 7 209 ha for the 1976 season yielded 5 807 tonnes, more than double last season's production. This increase reflected the growing interest in navy beans resulting from the higher price negotiated by the Board for the 1976 season.

The selling price for the 1977 season is 51.75c per kg, the same as for the 1976 season. Plantings for the 1977 season are estimated to have reached a record 9 500 ha. However, very dry conditions during February and March caused stress in most crops while wet and humid conditions at harvest time in early May caused sprouting in many early crops. It now appears unlikely that the early production estimates of 5 000 tonnes will be met.

### Rice

The 1976 winter harvest produced 1 963 tonnes of paddy from a planted area of 634 ha to give a yield of 3.10 tonnes per ha. This result represents a significant decline on the 1975 winter crop of 3 898 tonnes from 704 ha. The reasons for this decline were excessive rain and leaf hopper infestation.

Returns to growers from the 1976 winter harvest are estimated at \$130 per tonne compared with a return of \$124.04 per tonne from the 1975 winter crop.

The 1976-77 summer harvest is estimated to yield 6 258 tonnes of paddy from an area of 1 254 ha. This compares with 6 007 tonnes from 1 234 ha for the 1975-76 summer harvest. It also represents an increase in the yield from 4.87 to 4.99 tonnes per ha.

Returns to growers from this harvest are estimated at \$132 per tonne compared with a final payment of \$131 per tonne for the 1975-76 summer crop.

It is estimated that 1 109 ha have been planted for the 1977 winter harvest which includes 200 ha in the Mareeba area. This will be the first commercial production from Mareeba. Rice production from this winter crop is expected to be 3 300 tonnes of paddy.

### Tobacco

The Australian marketing quota for the 1976 selling season remained unchanged at 15 422 000 kg, with Queensland's share being 8 304 300 kg. However, in the light of falling consumption and increases in manufacturer's stocks, a decision to short-sell this quota was taken by the Australian Agricultural Council on a recommendation from the Australian Tobacco Board. The Australian quota was therefore short-sold by approximately 506 000 kg while the Queensland marketing quota was short-sold by 157 000 kg.

Total Queensland sales reached 8 146 700 kg for an average price of 340.3c per kg and a total value of \$27.7m.

During the 1976-77 growing period, most tobacco-producing areas experienced satisfactory seasonal growing conditions. In south Queensland, dry conditions were prevalent early in the season. All areas experienced mild outbreaks of blue mould but these did not seriously affect production. The quality of the tobacco offered for sale should be good.

The continuing downward trend in consumption and the resultant rises in excess stocks held by manufacturers once again posed a threat to the current level of the Australian marketing quota. To offset this situation, the Australian Tobacco Board recommended to the Australian Agricultural Council that the official Australian marketing quota for 1977 remain unchanged at 15 422 000 kg, but that a voluntary short-sell of this quota be undertaken once again.

For Australia, the short-sell figure for the 1977 selling season is 800 000 kg. For Queensland this means a short-sell of 430 777 kg or 6.33%. In addition, the minimum average reserve price for 1977 was determined by the Australian Agricultural Council at 353c per kg, an increase of 6c per kg over the 1976 reserve price.

### Cotton

Production of raw cotton in Queensland fell drastically in the 1976 season to 20 163 bales, each of 225 kg, from 26 426 bales in the previous season, because of significant declines in both area planted and yield. The area harvested in 1976 was 5 492 ha, moderately less than the 7 189 ha in 1975 and considerably less than the 7 342 ha harvested in 1974.





Excellent yields and quality have resulted from tea-growing experiments in the Millaa Millaa and Topaz areas of north Queensland. This mechanical tea harvester is at work on Nerada Plantation, Innisfail.

Aerial spraying of 2,4-D was undoubtedly instrumental in reducing production of the crop on the Darling Downs and was responsible, in some instances, for a diversion of land from cotton to alternative crops. To make the situation worse, crop yields in many growing areas were depressed by adverse weather conditions, insect damage and high incidence of boll rot in developing crops, especially those in the Callide Valley.

Total Australian consumption of locally produced cotton during 1976 remained stable at around 100 000 bales of staples up to  $1\frac{1}{16}$  in and, as a result of the reduced level of production, all of the Queensland grown crop was sold on the domestic market.

Details of grades and bales are set out in the table below.

Grade	Running Bales*	Percentage of Total Production
	No.	
Good Middling .. .. .	Nil	Nil
Strict Middling .. .. .	501	2.54
Middling Plus .. .. .	1 057	5.36
Middling .. .. .	5 000	25.35
Strict Low Middling Plus .. .. .	4 971	25.20
Strict Low Middling .. .. .	7 020	35.59
Low Middling .. .. .	1 091	5.53
Strict Good Ordinary and Good Ordinary .. .. .	85	0.43
Total .. .. .	19 725	100.00

\* The 19 725 running bales are equivalent to 20 163 bales, each of 225 kg, or 4 536 675 kg of raw cotton.

(SOURCE: The Cotton Marketing Board)

Reflecting the world trend, prices of cotton in Australia increased to 159.39c per kg by August 1976 from 113.27c per kg at the end of December 1975. Subsequently, prices again rose sharply and fluctuated around 177.82c per kg between August and December 1976. Flourishing export demand for cotton, together with the recovery of world demand for textiles and limitations of supply in the cotton-producing countries, were responsible for the continued high levels of world cotton prices throughout 1976.

The average return to Queensland growers during the 1976 season was 114.03c per kg, including 6.61c per kg from oil-milling proceeds.

The substantial increase in cotton production in Queensland in the 1977 season has been mainly the result of an expansion in cotton plantings, although yields also have improved marginally.

The 1977 season's plantings totalled 9 804 ha, including 663 sown to dryland crops, and this significant expansion in

area has been directly related to attractive cotton prices, vis-à-vis those for alternative crops prevailing at the time of planting. Queensland production of raw cotton for the 1977 season was expected to be a record 35 000 bales, each of 225 kg, valued at around \$11m, at an average price per bale of between \$320 and \$340 according to grade.

Much of this increase has occurred in the Emerald district where the crop, estimated at 9 000 bales, is more than five times greater than last season's 1 600 bales. Projections for 1978 indicate a further significant expansion in cotton plantings at Emerald. The production potential for the district is assessed at 40 000 bales of raw cotton when the second stage of the Irrigation Scheme is completed.

## Ginger

The 1976 ginger crop was larger than anticipated. The early harvest intake was 1 578 tonnes, with an average yield of 26.11 tonnes per ha. The late harvest is expected to yield 2 672 tonnes from 50 ha. The yield for the 1976 early harvest recovered from the low level recorded for the corresponding harvest in 1975.

Sales of the 1976 crop are expected to finish strongly. World market prices soared during the latter stages of the 1976-77 financial year and the Ginger Growers' Co-operative Association is having difficulty in meeting orders.

The United Kingdom market for crystallized and syruped ginger has recovered. At the same time, sales in Europe expanded, especially after the appointment of a European Marketing Director. Sales of other ginger products on the export market remained firm while domestic sales continued to show a satisfactory growth rate.

Ginger prices were increased for the 1977 crop. After remaining unchanged for some time, export prices were increased 10% on average and domestic prices by 12.5%. Final realizations for the 1976 crop are expected to show some improvement on the 1975 levels which averaged 20c per kg for early harvest and 12.05c per kg for late harvest.

## Fruit and vegetables

An investigation was carried out during 1976-77 into the rate of commission charged by Farm Produce Agents. This arose out of a request by the Queensland Chamber of Fruit and Vegetable Industries for an increase in the commission rate. The investigation's findings did not support an increase.

The Granite Belt experienced the driest summer since the 1965 drought and the dry weather reduced fruit size of all the main varieties. Prices for early-marketed fruit were especially good, although heavy supplies of Delicious and Granny Smith apples in the closing stages of 1976-77 depressed returns. The early estimate of 2.3m in cases of apples from Stanthorpe appeared to be a correct assessment of the crop. This compares with 1.5 m cases in the previous season.





*Irrigated potato crops in a frost-free area of the Lockyer Valley.*

The total number of cases of apples in storage at the end of May was similar to the storage levels for May 1975. Overall market returns for this season will not be as high as for the previous short-supply season of 1975.

Following a review of the funding of the National Banana Marketing Development Scheme, changes have been made to the scheme which, in effect, mean that each producing State will be responsible for financing its own clearances. Under the new arrangement, the basic levy will remain the same for each producing State and a variable levy will be imposed on growers supplying bananas in times of heavy clearances.

Extensive cyclone damage to banana plantations in north Queensland during February was estimated to have cost growers \$2m. This, in turn, was expected to cause some supply difficulties in southern markets during the 1977 winter season.

Competition from imports of orange juice have created a problem for the citrus industry in recent years. In response to this, a Temporary Assistance Authority recommendation was implemented by limiting to 28.3m litres imports of orange juice cleared for home consumption in the 12 months ending 30 June 1977. Imports in excess of the quota are subject to an additional penal tariff of 12c per litre.

Following that decision, the question of long-term assistance for the Australian citrus industry was referred to the Industries Assistance Commission. The Department submitted evidence to the I.A.C. inquiry requesting an extension of the quantitative controls and the setting up of a Government Authority with the responsibility for determining the level of imports.

In 1976-77 following the imposition of the tariff quota, imports in the first 7 months amounted to only 8.6m litres, compared with 33.2m litres in 1975-76.

*Entomology Branch has been engaged in a monitoring program to ensure that the Oriental fruit fly has not become established in Queensland. In the picture, an entomologist is checking a standard lure trap used in the program.*







A new bean variety, *Redlands New Pioneer*, has been developed for its tolerance to cold weather.

Pineapple production in 1976 recovered from the previous year's level. The processing intake of pineapples was a record 109 203 tonnes compared with 81 781 tonnes in 1975. The record tonnage processed was marred somewhat by the high incidence of internal blemish during the peak delivery time. In spite of this, record prices were declared for both pools. Returns for fruit delivered to the No. 1 and No. 2 pools were \$135.37 per tonne and \$96.95 per tonne respectively. Increased prices, along with an increase in per capita consumption of pineapple packs on the home market, were largely responsible for the increase in the value of sales for Golden Circle products.

Following the inquiry into potatoes and processed potato products, the Industries Assistance Commission recommended, in its draft report, that processed potato products under reference be dutiable at a rate of 10%. It also recommended that the embargo on imports of raw potatoes be discontinued.

During the year, Queensland gained representation on the National Vegetable Panel. The purpose of the Panel is to keep under continuous review the production and marketing of processing beans and peas and, if necessary, other processing vegetables.

## General and Clerical

TOTAL clerical staff at 30 June 1977 was 558 officers, 375 in Brisbane and 183 in country centres. Public Service Board approval was obtained for an additional five positions during the year, two in Brisbane and three at country centres.

A total of 109 officers, 62 in Brisbane and 47 in country centres, resigned or were transferred to other Departments during the year. All have been replaced or will be replaced in the near future.

The Department has continued its policy of transferring clerical staff to gain further experience, and 65 officers were either transferred or promoted to different positions during the year.

### Study Assistance Scheme

During the 1976 academic year, 334 officers were undertaking approved courses ranging from Senior to Doctor of Philosophy. Of these officers, 79 completed or discontinued their course. During the financial year 1976-77, reimbursement of fees totalling \$3 980 was made to 98 officers. A total of 70 officers amended their previously approved course.

An additional 62 officers submitted applications for course approval commencing in the 1977 academic year.

### Accommodation

A modern office-laboratory at the Oonoonba Animal Health Station was one of the major new works completed this year.

Other major projects completed include the Swine Research Centre at Wacol, office buildings at the Charleville Pastoral Laboratory and at Toowoomba, an Agricultural Engineering Workshop at Toowoomba, and a large stores building at the Animal Research Institute, Yeerongpilly.

Also during the year, many buildings, such as machinery sheds, stores, workshops and hay sheds, were built on Research and Field Stations.

Major projects under construction are the Biochemistry Building at Yeerongpilly, Stage I of the Office-Laboratory Complex at Mareeba, a Resources and Hydrology Building at Indooroopilly, and a Brucellosis and Tuberculosis Laboratory at Rockhampton.

### Finance

Departmental expenditure from the Consolidated Revenue Fund during 1976-77 as compared with the previous year is summarized in the following table.

Service	1975-76	1976-77
	\$	\$
Payments authorized by Special Acts—		
Grant in aid of Stock Fund ..	2 682 412	3 406 133
Grant in aid of Banana Industry Fund .. .. .	34 167	41 730
Department of Primary Industries—		
Salaries .. .. .	16,221,971	18 591,839
Contingencies .. .. .	9 702 063	13 238 232
	\$ 28,640,613	35,277 934

There was no increase in the staff establishment during the year and the increased salaries expenditure of \$2 369 868 was mainly due to award increases.

The increase of \$3 536 169 in Contingencies expenditure can be attributed to the payment of \$4 288 157 as a Supplementary Grant to the Stock Fund, which represented an additional \$1 699 135 above the 1975-76 Grant. This increased expenditure was necessary following the decision of the High Court of Australia declaring the payment of Stock Assessments, the main source of Industry revenue of Stock Fund, as invalid as from 1 February 1977.

The acaricide subsidy scheme, whereby 25% rebate of the wholesale price was granted to assist the cattle industry during depressed conditions, was continued during the year and the amount expended was \$1 172 621, as compared with \$1 002 403 during the previous year.



A total of \$571 574 was expended as compensation to milk suppliers to the Brisbane milk district following a reduction of 5% of their milk quotas.

Details of receipts credited to the Consolidated Revenue Fund in 1976-77 as compared with 1975-76 are—

	1975-76	1976-77
	\$	\$
Miscellaneous receipts .. ..	489 103	544 013
Recovery of expenditure—		
General .. ..	90 657	62 078
Sale of Q.G. cars .. ..	182 393	123 612
Commonwealth .. ..	213 046	145 669
	\$975 199	\$875 372

### Trust and Special Funds

The following table summarizes expenditure from Trust Funds in 1976-77 as compared with 1975-76—

	1975-76	1976-77
	\$	\$
Primary Industries Department		
Special Standing Fund .. ..	4,150 619	5 343 445
Banana Industry Fund .. ..	93 435	92 183
Commonwealth Agricultural Services		
Extension Fund .. ..	1 805 880	2 040 006
Commonwealth Poultry Industry		
Assistance Fund .. ..	2 074 812	705 833
Commonwealth Soil Conservation		
Fund .. ..	466 918	64 299
Dairy Pasture Subsidy Fund .. ..	227 078	185 495
Meat Inspection Account .. ..	1 393 071	1 695 994
Meat Research Trust Fund .. ..	328 935	395 926
National Pleuro-pneumonia Fund .. ..	47 629	..
Poultry Industry Fund .. ..	357 536	400 223
Stock Diseases Compensation and		
Stock Improvement Fund .. ..	8 233	12 549
Stock Fund .. ..	7 321 168	8 564 455
Sugar Cane Prices Fund .. ..	1 065 811	1 151 040
Swine Compensation Fund .. ..	..	87 541
Tobacco Research Fund .. ..	498 631	538 990
	\$ 19 839 756	21 277 979

Receipts credited to Trust Funds in 1976-77 amounted to \$22 292 414 as against \$21 375 289 in 1975-76.

### Retirements

A notable retirement during the year was that of the former Director-General, Dr. J. M. Harvey, who had held the position since 1965.

In his 43 years' service with the Department, Dr. Harvey made a significant contribution to the primary industries of Queensland, first as a scientist and in later years as an administrator.

He joined the staff of the Department's Chemical Laboratory in 1933 as a Cadet, and graduated in Science at the University of Queensland the following year.

An exhaustive study of fluorosis in sheep in western Queensland earned him a Doctorate in Science in 1955. This work gave Queensland woolgrowers guidelines to help them combat the condition in their flocks.

In 1956, Dr. Harvey was appointed head of the Biochemical Branch of the Department's Animal Research Institute.

After nearly 30 years of field and laboratory work in the interests of primary industry, Dr. Harvey was appointed Deputy Director-General in March 1965 and Director-General in December of that year.

As Director-General, he was responsible for a notable upgrading of Departmental services and facilities and guided the Departmental effort in major projects such as the Brigalow Development Scheme.

Dr. Harvey served on the University Senate and represented the Department on many committees set up to advise the Government on matters of importance to the rural industries of Queensland.

Twenty-four other officers who had given many years of loyal service to the Department also retired during the year.

They were: Messrs F. R. Payne and H. Bass (Administration); L. M. Wagland and P. C. van Rosendal (Agriculture Branch); M. A. Hannigan, G. W. J. Agnew, H. W. Boucher, J. E. Groome and A. C. Fraser (Horticulture Branch); B. L. Klowss, D. H. Sutcliffe and G. E. Atkinson (Research Stations Section); W. E. Hagger and J. Chambers (Standards Branch); P. McCallum (Dairy Field Services Branch); C. R. Grieve (Pig and Poultry Branch); W. E. M. Rothwell (Sheep and Wool Branch); P. J. Hally and H. Hassler (Agricultural Chemistry Branch); M. Smith (Plant Pathology Branch); J. Littleton, G. J. Ryan and C. Mischke (Veterinary Services Branch); and G. E. Cripps (Information and Extension Training Branch).

During the year, 12 officers made overseas study tours to investigate various developments in agriculture around the world.

## Information and Extension Training Branch

THE functions of Information and Extension Training Branch are to operate the Department's central information and library services; to provide the central editing, art, photographic and duplicating services of the Department; and to undertake training activities for the development of Departmental staff.

In the Information Section, greater emphasis was placed during the year on using the mass media to communicate with urban as well as rural sectors of the community. In the Extension Training Section, the emphasis was directed at evaluation of training activities.

### Publications

**EDITORIAL.** Six issues of the *Queensland Agricultural Journal* were produced during the year. This is the Department's major extension publication and goes to 8 000 rural families—to about one in six of the State's primary producers. Attention is being given to improving the readability and layout of this magazine.

Three issues of the *Queensland Journal of Agricultural and Animal Sciences* were brought out, including a special issue 'Resources Study in the Condamine-Maranoa Basin of Southern Queensland'. Another issue is in press and at an advanced stage of preparation.

The editorial staff co-operated with Branches in editing books for use by farmers. Two major undertakings were *A Handbook of Plant Diseases* and *The Weeds of Queensland*.

Another book *Wildflowers of South-eastern Queensland*, Volume 1, was prepared for printing. All of these books are expected to be available to the public early in the new financial year. This section also had commitments in the publication of the Department's Annual Report to Parliament, in submissions for the annual Treasurer's Statement in the Budget Speech and the Governor's speech at the opening of Parliament.

**PRESS.** The flow of press items has been low since the loss in 1975 of the journalist providing the service. A staff re-organization has cleared the way for this service to be resumed. The weekly *Press Items* service to metropolitan and provincial newspapers and radio and television stations is being restored, and the first releases will be made in July.

**RADIO.** A trained broadcaster has been transferred from regional information duties to take charge of the Department's weekly radio program. The weekly 15-minute taped program is being used widely and regularly by 17 commercial and A.B.C. radio stations in rural areas.

Special programs of interest to particular audiences are supplied to individual stations, and a start has been made on producing consumer-interest programs for urban audiences.



**TELEVISION.** During the year, as a trial, 18 television news stories were made by the Photography Sub-section. These were shown mainly by QTQ9 and the A.B.C., all in prime newstime.

Success of this trial established that the demand for this type of story is almost unlimited, and the setting up of a television news team is worth considering.

**REGIONAL INFORMATION.** Regional Information Officers at Rockhampton and Toowoomba continued to make effective use of the local news media to publicize the Department's work. Press and radio items were released daily in central Queensland and on the Darling Downs.

**PHOTOGRAPHY.** The Photography Sub-section was restored to full strength during the year. This enabled it to provide skilled professional services to Branches in field, studio, technical and cine work. Still photography output was 14 000 enlargements, 300 murals, 6 000 copies of colour slides and 540 line negatives.

Black and white and colour pictures were supplied to metropolitan and provincial newspapers and specialist magazines. The Department's display at the Royal National Association's 1976 Exhibition was a priority activity of the Photography Sub-section. The Audio-visual display alone would have cost in excess of \$10 000 if made commercially.

During the year, the Sub-section made seven 16 mm documentary films with a total running time of 78 minutes. The call on film-making services is heavy, and both industry and commercial firms gave financial help to specific films.

**IN-PLANT PRINTING.** The in-plant printing operation continues to be a major undertaking. Besides the staff of six in the Duplicating Room, it occupies at least 70% of the time of an art staff of three, 50% of the time of a journalist, as well as inputs from typists and other staff. The amount of printing handled in the year exceeded 2.4 million printed sheets.

In a major re-organization, the Duplicating Room came under the charge of a Supervisor from the Government Printing Office. This improved staffing permitted the backlog of work to be quickly cleared. Routine duplicating jobs can now be handled as a same-day service.

## Training

The on-going demand for basic training in communication skills, principles and practices of adult education, and decision-making was met through regular central or regional schools and workshops in these areas.

Training staff have become increasingly involved in developing staff skills in extension program planning, writing, managing time and supervision. Trainers have assisted Branches to identify training needs accurately and to develop Branch training programs to form an integrated Departmental training program.

There has been a continuing move to make the 'work group' the training unit and the work itself the focus of the training activity. Trainers have continued to respond to requests for assistance with programs of planned development from various regions, branches and divisions.

Emphasis on evaluation of training has increased. Most training activities now conclude with 'action planning' sessions where plans and commitments are made for the appropriate use of new skills, knowledge or behaviours, to be followed up during later review periods.

## Library

As in previous years, the demands on the resources of the Department's Library continue to increase.

Loans increased by 35% to more than 10 000, the number of items catalogued by 30% to 6 000 and circulation by 22% to 54 000. Requests processed by the reference staff increased by 24% to more than 1 300.

From January 1977, the Science Digest and Library List has been produced monthly and has been expanded to include an index of articles not likely to be seen by country officers.

The increased demand for photo-copying of technical articles has made it necessary to install a new photo-copier. Sheets of photo-copying increased by 13% to 244 000.

# Biometry Branch

THE functions of Biometry Branch are to provide a service in data processing and statistical analysis to all sections of the Department; to co-ordinate the activities of computer users within the Department, and to liaise between Departmental users and outside computing services.

Extension of statistical services to regional centres, initial moves towards forming a centralized group of programmers and continuing frustrations at the lack of clerical support for typing highlighted the activity of Biometry Branch in the past year. Work loads for all staff increased but no additional staff was appointed.

Two Biometricians and a Cadet were transferred to Toowoomba to establish the first regional unit of Biometry. Computer facilities attached to the C.S.I.R.O. computer network were installed to provide essential computing support. These facilities were welcomed by the eight officers who were subsequently authorized to use the equipment in its first 6 months of operation. Subsequent decentralization of staff and facilities to Townsville and Rockhampton was approved. Equipment purchases and provision of office accommodation were initiated and staff training continued.

Realization by Central Administration that development of a computer based accounting system was not progressing resulted in the training of 30 technical and clerical officers to utilize the new State Government computer. Of this group, nine officers will contribute towards developing the Departmental system. Of necessity, progress in developing the new systems will be slow due to the relative inexperience of these officers.

The doubling of work flows during 1975-79 and the continued increase in data processing activity in the past year mean that all non-technical staff except the Clerk are fully committed to data preparation or operation of the computing equipment.

The major concerns of the Biometricians during 1976-77 have been the planning and statistical analyses of biological and economic research data, and the training of Departmental research staff in basic principles of research design and statistical methodology.

Additional staff with training and experience in systems analysis and computer programming are still required to meet the remaining data processing needs of the Department, particularly those required for Departmental administration. Training of officers in a number of Branches to fulfill these needs has been initiated.

## Research design

During 1976-77, a total of 630 new research projects was submitted to Biometry for comment on experimental designs. Research officers from north Queensland submitted 22% of the total, 20% came from the Darling Downs, 10% from central Queensland and the remaining 48% were initiated from the Burnett-Moreton and Metropolitan regions.

A policy of consultation between research officers and Biometricians before project approval was implemented for most Branches during the year. As a result, use of complex and analytically intractable types of experimental designs by research officers is being minimized.



Decentralization of statistical services to Toowoomba by transfer of two Biometricians and a Technical Assistant with supporting computer facilities has met with widespread approval. These officers design and statistically analyse plant breeding and varietal trials for all grain crops except maize. They also assist in the design of experimental work for officers at the Wheat Research Institute.

Further decentralization of statistical services involving staff transfers to Townsville and Rockhampton are planned for 1977-78.

Simulation of a sheep breeding flock in north-west Queensland is assisting research into wool production and reproduction. Support from the Australian Wool Corporation during the year enabled simulation of soil moisture profiles for Mitchell grass pastures. An energy and nitrogen sub-model was developed to relate feed intake with wool production and body composition. Production of pasture, diet selection, reproductive cycles and the effect of pests and parasites remain to be developed.

The first in-service training workshop in modelling and computer simulation, sponsored by Biometry, introduced Departmental officers to the theory of dynamic systems and criteria necessary in a special simulation language. Main features of two languages ACSL (Advanced Continuous Simulation Language) and SIMULA (a discrete language) were summarized for the participants. Problems of combined discrete and continuous elements within simulation models and the need for a combined discrete-continuous simulation language was illustrated in a demonstration of the sheep grazing properties model. Use of ACSL by eight officers in three Branches subsequent to the Workshop indicated favourable response to the training.

### Biometrics training

During 1976-77, a further 124 Departmental research officers participated in four Biometrics and Research Design Workshops conducted by Biometry. A total of 310 officers who lacked previous formal training in statistics or biometrics have now attended these Workshops since their inception in 1972.

### Computer services

Direct access to the C.S.I.R.O. computer network was extended to Toowoomba in October 1976. Simultaneously, a unit of Biometry staff was transferred from Brisbane to provide local statistical services.

Existing computer equipment at the Agricultural Chemistry Branch Laboratories, Indooroopilly, was enhanced by installation of a new computer processor, disc driver and console unit. This equipment is being interfaced with the existing computer and both will be interfaced with laboratory apparatus to automate data recording and apparatus operation.

Twelve computer terminals were purchased during the year. Three visual display units were obtained to complete the equipment configurations at Toowoomba (one) and to enable monitoring of laboratory apparatus at Indooroopilly (two). One graphics display unit and a printing terminal with cassette recording facilities were installed in Head Office for demonstration purposes and operation by Departmental users. Another identical printing terminal was purchased for the Biometry unit in Townsville and a third was obtained for the Charleville Pastoral Laboratory. The last five terminals were initial equipment for connection to the State Government Computer Centre.

## Research Stations Section

RESEARCH stations section is responsible for the management and operation of research stations within Queensland and for the co-ordination of multi-disciplinary research programs based on these centres.

Emphasis is placed on projects requiring integrated studies of soils, plants, animals and environmental factors, under controlled conditions.

The individual Stations operate under a charter determined by the Research Stations Board, which is responsible also for the broad objectives and programs of research in relation to regional and State requirements.

The Board, consisting of a chairman nominated by the Director-General, the Director of each Division and the Executive Officer, met on 11 occasions to consider policies and programs. There was a need to review critically work priorities in relation to available finances and some curtailment of field investigations was inevitable.

In determining areas of need and to recognize fully the opinions of producers, formal meetings with Industry Consultative Committees were held twice during the year at each of the main Stations. These conferences with producers ensure that programs are oriented to significant problems and that results are capable of practical application.

The current programs at research stations include 408 projects directed at the improvement of rural industries or resources.

The Section has a field staff of 147 in management, clerical services and labour and there are 170 scientist and technical grade staff based on the Stations. Some 95 visiting personnel were committed on a part-time basis during the year.

The Research Stations provided facilities for co-operative studies with other organizations including C.S.I.R.O., University of Queensland, Irrigation and Water Supply Commission, Bureau of Meteorology and a number of commercial firms.

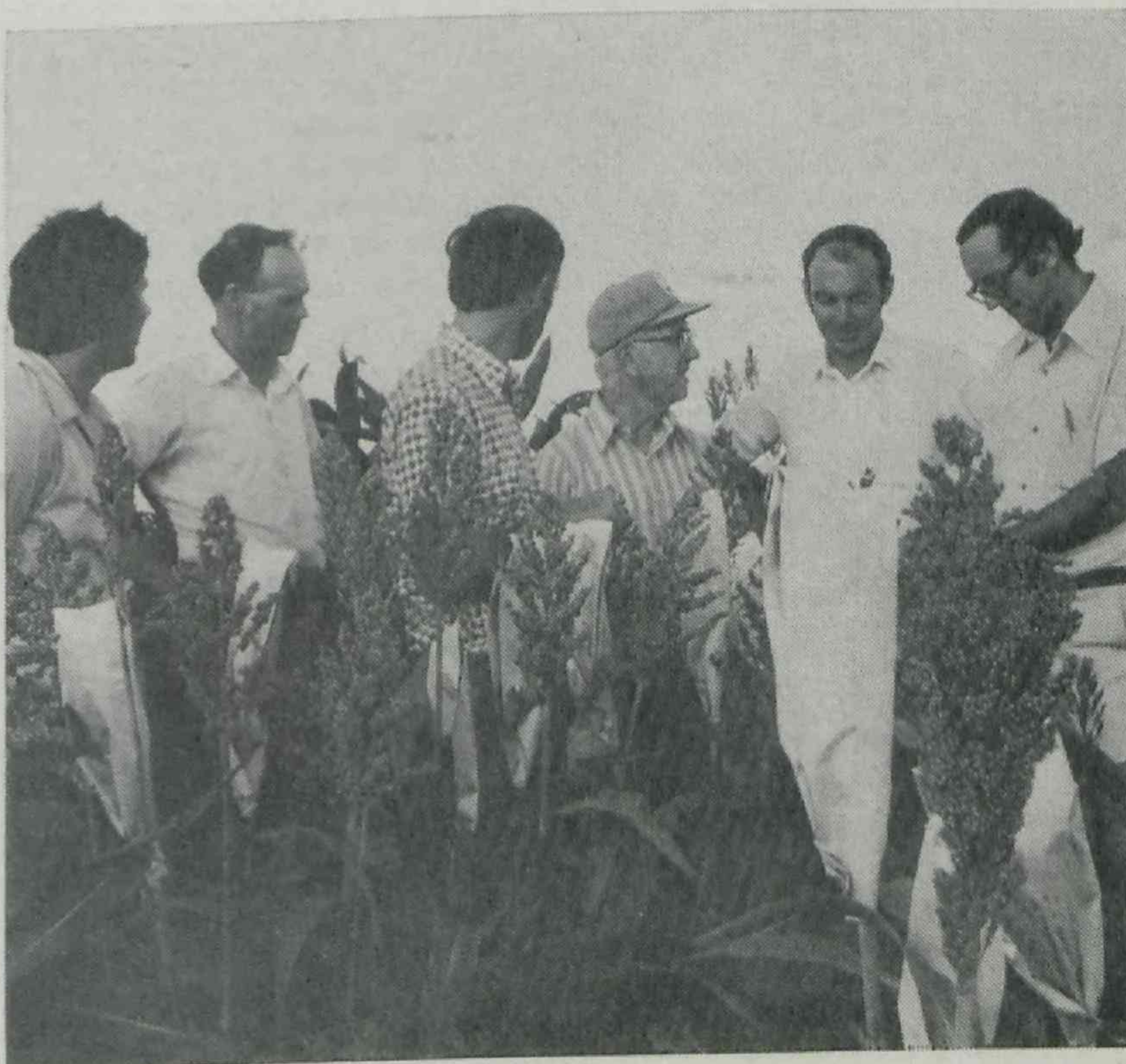
The progress reports and technical results of the research programs are presented under the industry or Divisional headings in this report.

It was found necessary to terminate the limited dairy research activity at Biloela to give additional support to the Australian Friesian Sahiwal dairy breeding program based in northern Queensland. An additional area of land was acquired adjoining the Kairi Station to consolidate this tick-resistant breeding work in dairy cattle.

The maize breeding program based at Kairi was expanded to provide for State-wide assessments. This project continues to yield outstanding results. Maize production on the Atherton Tableland in 1976-77 was the highest since 1936-37, using Kairi hybrids, and current experimental hybrids have given record yields with increases of 58% over the present commercial lines.

Although the beef industry remains in a critical condition, considerable progress has been made in the development of agriculture in the brigalow areas of central Queensland to provide an alternative means of livelihood. There are also prospects of better pastures and some soil fertility improvement in this region by using several new *Stylosanthes* spp. now under test in grazing trials and crop rotation studies.

In the southern region, the Hermitage Station near Warwick has produced considerable benefits to agriculture and releases of new crop varieties including Corvette feed barley, Stout oats, Collie and Flegler soybeans were made. Other proposed releases include a high yielding wheat, virus resistant sorghum and selections of small grain crops.



Professor C. Gardiner (centre), of Nebraska, U.S.A., discussed sorghum breeding with the staff during his extended visit to the Hermitage Research Station.



The program in support of the malt barley industry has been strengthened by provision of complete micro-malting laboratory equipment from Commonwealth Funds for rapid evaluation of malt quality and extract.

In the winter program of 1976, some 6 500 individual plots were planted at Hermitage and in district trials. The expanded testing undertaken in 1977 involved 9 000 plots which were the limit with existing resources.

Commercial production projects were conducted on the south bank Burdekin River, for assessment of cropping systems in an expanded irrigation project. The local rural industry is based primarily on sugar-cane but future developments could be supported by rice, maize, soybean and bean production.

The Section has continued to assess and develop new machinery and to study the use of new or potentially valuable crops for Queensland conditions.

Production of mung bean reached satisfactory commercial levels while trial areas of cassava, chick pea, guar bean, kenaf and fenugreek were further studied.

Cassava (tapioca) could be of considerable importance, first as stock feed but subsequently for starch and alcohol production. In conjunction with growth studies, the section developed efficient washing and chipping equipment for tubers and provided assistance in developing harvesting procedures for tubers and foliage.

Sharp increases in world prices revived public interest in tea and coffee and information was available from studies conducted at South Johnstone and Kairi Research Stations respectively.

During the year, the land forming the Gatton Research Station was gazetted as a reserve for experimental purposes, thus effecting a formal excision from the Queensland Agricultural College.

All Stations conducted field days for discussion and demonstrations relevant to primary production and facilities were made available for many group meetings, interstate and overseas visitors and student training.

There has been a marked increase in special functions and attendance at field days by groups of students from schools and colleges of secondary education.

*Cassava (tapioca) production studies and variety trials are in progress at five Research Stations. The foliage and the tubers are shown in these two pictures.*



## Extension Services Section

STAFF in Extension Services Section are responsible for co-ordinating the extension undertakings of the Department's field officers and for liaison with industry on a continuing basis on issues that are of concern to both parties.

Eleven officers are stationed in 10 provincial centres. Through direct counselling of individual staff members and through the activities of district committees, industry working parties and project teams, they assist approximately 500 officers to plan the extension aspects of their work, especially those calling for co-operative action. This extension work concerns not only that provided for the benefit of primary producers and their kindred organizations, but also that which aims at helping agri-business firms, students, educational institutions and the public generally.

During 1976-77, some 683 individual extension projects were developed and implemented. Many were a continuation of extension undertakings initiated in previous years, while others were undertaken as an integral part of specific technical undertakings associated with particular Branch responsibilities.

However, the year under review did see three interesting developments—1. A growth in the number of officers who expressed a wish to work at district level on industry problems rather than Branch or Departmental problems. 2. A growth in the number of extension undertakings that were planned as co-operative ventures by men with very different technical backgrounds. 3. An indication that, in some groups, the opportunities and problems facing our rural industries (producers) were being systematically reviewed and allocated priorities for future action.

In many instances, the planning groups were assisted by individual producers and, in some, producers, officers and interested persons from other organizations met to co-ordinate their operations instead of having a series of independent extension undertakings by their separate bodies.

Some of the more notable extension activities undertaken during the year which arose from co-operative action between Departmental officers were—

- The extension activities on beef production systems for the wet tropical coast in far northern areas.
- The combined C.S.I.R.O.-D.P.I. extension work undertaken in central and south-east Queensland areas on the control of cattle tick by the judicious use of acaricides and tick-resistant strains of cattle.
- The low key extension work undertaken in association with agricultural and veterinary chemical firms and producer organizations to ensure the responsible use of these chemicals and the appropriate disposal of their containers.
- The campaign, mainly in south-east Queensland, to inform consumers about correct food storage procedures in the home.
- The combined operations of producers, aerial operators and D.P.I. staff designed to limit the occurrence of spray drifts during the aerial application of agricultural chemicals.
- The extension work undertaken near Brisbane to promote better and easier handling of bananas with particular reference to the use of a new mechanical process for 'dehanding' bunches; and
- The symposium on 'The Future of the Family Farm' organized by the Maranoa Graziers' Association, D.P.I. officers and other interested persons to take place at Roma in early July 1977.



All these activities have drawn considerable favourable comment, at times from unexpected quarters.

This year saw the development and implementation of at least one initiative to help extension operators in problem evaluation. A special Extension Planning Workshop on this subject was conducted in October last for about 30 experienced officers who were striving at that time to work

as members of task forces on particular problems. They are currently implementing the plans they developed at this workshop and will report late in 1977-78 on their achievements and the usefulness of the procedures used in planning. This undertaking is consistent with the principle that evaluation is recognized as an integral part of extension operations, and that greater attention will be given to it in future extension planning.

*A field day at Peak Crossing to discuss control of ticks and worms in different breeds of cattle attracted an attentive audience.*



## Agricultural Bank

**DURING** the 1976-77 financial year, advances approved under the various Acts administered by the Bank totalled \$24 182 632.

Included in this figure is \$2 180 518 approved under Natural Disaster Relief Assistance Schemes in terms of agreements between the Commonwealth and Queensland Governments which provide for assistance, at concessional rates of interest, to eligible primary producers in western and northern areas of the State who suffered loss as a result of Cyclones Ted and Keith and other weather influences. As at 30 June 1977, advances totalling \$2 013 177 and \$167 341 have been approved under these respective Schemes. Further advances under the Flood and Cyclone Damage Assistance Scheme of 1976, totalling \$61 542, were approved up to its termination on 20 September 1976.

The rate of interest applicable to advances in the normal course of business was increased from 9.625% to 10.325% on 1 November 1976.

Due to the increase in the statutory limit of advance to \$40 000, a general tightening of credit by other lenders, and the carry-over of an advance commitment of in excess of \$10m from the previous financial year severe restrictions on the Bank's lending have been in force since September 1976.

There is an ever-increasing demand from primary producers faced with escalating costs of farm machinery and improvements for loan advances, and the question of the Bank resuming normal lending operations in 1977-78 depends on the level of new money to be allocated in the forthcoming Budget.



## Dairy Pasture Subsidy Scheme

DURING 1976-77 the Scheme entered its eleventh year of operation. As a consequence of a government decision related to restructuring of the milk sector of the industry, and the funding of compensation for quota milk acquired for a redistribution pool, the Dairy Pasture Subsidy Scheme was terminated on 9 February 1977. Progress of the Scheme from inception to termination is summarized below.

Year	Total Registered Dairy Producers	Total No. of Claims Paid	Total Area Approved for Payment hectares	Total Subsidy Approved for Payment \$
1966-67	12 146	2 144	13 472.3	404 257.22
1967-68	11 080	3 138	19 043.8	600 053.64
1968-69	9 650	2 926	16 969.2	530 661.64
1969-70	8 826	2 909	20 739.1	613 710.38
1970-71	8 125	2 205	16 737.9	477 749.63
1971-72	7 420	2 996	22 199.3	623 059.15
1972-73	6 602	2 002	14 547.2	429 446.67
1973-74	5 494	1 580	11 433.3	338 321.08
1974-75	5 104	1 170	7 908.0	238 976.66
1975-76	4 694	1 015	7 250.2	206 005.43
1976-77	4 290	271	1 604.1	48 221.14
<b>Total</b>	..	22 356	151 904.4	4 510 462.64

The number of annual applications and the percentage of total suppliers making use of the scheme had continued to decline over the last 3 years of the Scheme. During 1976-77 applications were approximately 14% of registered dairy producers.

It is considered that the Scheme during its term provided a significant contribution to the increased farm production of dairy produce throughout the State. While the total number of dairy farmers has decreased dramatically since 1966, there has been a complementary continuing increase in total production per farm over the years. The Scheme significantly increased farmer knowledge and skill in pasture establishment and management and in understanding the relationship of fertilizers and pastures. The concept of the Scheme was first raised in the Report of the Queensland Dairy Industry Advisory Committee (November 1965) and the members of this Committee can feel well satisfied with the implementation of this recommendation.

As acknowledged in previous reports, the excellent service of Departmental field staff and industry representatives serving on District Committees was instrumental in the smooth functioning of the Scheme. The sustained contribution from officers of the Accounts Section is also gratefully acknowledged, especially during the early years when the number of participants was particularly high.

*Pastures like this productive stand of green panic-Siratro in the South Burnett have been made possible through the Dairy Pasture Subsidy Scheme.*





# Division of Animal Industry

THE Division's responsibilities and functions are illustrated by the detailed functions of the eight branches that comprise the Division of Animal Industry.

The branches and their functions are:—

## VETERINARY SERVICES BRANCH

- (1) To investigate and control serious disease outbreaks affecting commercial animals and birds.
- (2) To effect control over stock movements to control disease.
- (3) To eradicate major diseases including exotic disease outbreaks.
- (4) To undertake field investigations into livestock disease problems.
- (5) To develop extension activities with a view to promoting efficient disease prevention and control.
- (6) In co-operation with the Commonwealth Government, to maintain animal quarantine services to prevent the introduction of exotic animal disease and to facilitate the export of livestock and animal products.

## SLAUGHTERING AND MEAT INSPECTION BRANCH

- (1) The inspection of stock and poultry in respect of disease and hygiene standards from pre-slaughter to retail sale. This includes supervision of standards of all premises where meat is processed for human consumption.
- (2) The inspection and supervision of all activities associated with the slaughter of animals and stock intended for use as pet food and the supervision of standards of premises where such meat is processed and offered for sale.
- (3) The recording of diseases detected at slaughter and traceback to the property of origin, including the confirmation of tuberculosis-like lesions and the collection of blood samples from breeding cattle for testing for brucellosis under the national eradication scheme.
- (4) The promotion of meat quality by classification and grading of carcasses and extension to the trade and the consumer.

## BEEF CATTLE HUSBANDRY BRANCH

- (1) Extension of research findings in beef cattle husbandry and management and for undertaking applied research in these fields. The Branch conducts 'Swan's Lagoon' Cattle Field Research Station on the lower Burdekin River and has research projects at Kairi, Brigalow, 'Brian Pastures' and Coolum Research Stations.

## SHEEP AND WOOL BRANCH

- (1) The provision of extension and advisory services to the sheep and wool industry.

The Branch aims at developing programs which will assist producers to alleviate their current problems. These programs include the investigation and promotion of labour saving devices, promotion of objective clip preparation and sale by sample, the field testing of chemical mulesing and ringing, and the implementation of improved breeding management.

## PIG AND POULTRY BRANCH

- (1) To provide an advisory service to the commercial pig and poultry industries, to offer a least-cost ration formulation service, to conduct surveys to define industry problem areas and to develop appropriate extension programs.
- (2) To take an active interest in product acceptance in the market place, to advise the respective industries of consumer attitudes, and to ensure that quality products reach the consumer.
- (3) To improve pig carcass quality and growth efficiency by on-farm performance testing using growth rate and back fat measurement as the main criteria for selection.
- (4) To work closely with highly intensive producers to improve the environment, health and general husbandry and to develop an awareness of the environmental implications of highly intensive systems.

## HUSBANDRY RESEARCH BRANCH

To foster improvement in animal production using scientific husbandry principles.

Research is undertaken on all farm animals at the Animal Husbandry Research Farm, Rocklea; Toorak Sheep Field Research Station, Julia Creek; Hermitage Research Station; Biloela Research Station; and the Charleville Pastoral Laboratory.

## PATHOLOGY BRANCH

The provision of an efficient diagnostic service for animal disease to the livestock and poultry industries of Queensland.

Within this service it is necessary to maintain a conscious watch for diseases new to this country and to assist with national campaigns for the eradication of specific diseases such as tuberculosis and brucellosis.

An area of increasing importance is the involvement in the processing side of animal products, through service and research functions. A continuing role is the preparation and distribution of babesiosis and anaplasmosis vaccines for cattle, research into these diseases and improvement in the vaccines. Applied research is also conducted into animal diseases and in improvements to the efficiency of diagnostic tests.

The Branch conducts laboratories at Yeerongpilly and Oonoonba.

## BIOCHEMISTRY BRANCH

- (1) The provision of analytical services to all other branches of the Division of Animal Industry and special chemical services to other Divisions.
- (2) Research functions in the fields of clinical and nutritional biochemistry and toxicology.

The Branch serves also as a reservoir of resource personnel in specialist areas of nutrition, metabolic disorders, toxicants and the regulation of agricultural chemicals in feeds, animal products and the environment.

## Finance

On 1 February 1977, the High Court handed down a decision declaring the levying of stock assessment on stock owners, under Section 7 of the *Stock Act* 1915-1976, to be invalid, with the limited exception that assessment could still be valid in respect to horses not used for production. Stock assessment is the basis of the Stock Fund from which most of the Division's operations are funded.

Assessments paid in respect of 1977 were refunded to stock owners and it was necessary to seek a special grant from the Treasury to maintain the Division's services for the remainder of the year under review. The future source of funding of the Division is as yet not determined.

It was necessary to increase slaughtering and meat inspection fees early in the financial year to cope with inflationary trends in costs of providing these services. As a result, the position in the Meat Inspection Account, which funds the Division's meat inspection services, has remained satisfactory throughout the year.

Precepts collected under the *Poultry Industry Act* 1946-1975 were also increased and were, for the first time, extended to include producers in areas outside Marketing Board areas. As a result, the Poultry Industry Fund was able to cope with the increasing costs of services, and provided much needed funds for essential capital purchases.

The Division continued to receive support from the Commonwealth Extension Services Grant and from several Industry Research Trust Funds. The Commonwealth Government and the State Treasury increased their contributions to the operating and compensation costs of the Brucellosis and Tuberculosis Eradication Scheme, thus enabling a major expansion in this activity.

## Amendments to Legislation

The Identification of Cattle Regulations under the *Stock Act* 1915-1976 came into operation on 1 July 1976.

The Stock Regulations of 1935 were amended to provide for the licensing and control of piggeries. Principal provisions related to a ban on the feeding of pigs on waste food containing animal matter unless it had first been treated by dry rendering.

Amendments were also made to the regulations concerning the hygiene and maintenance of piggeries, including conditions for the feeding of pigs. Poultry slaughter house and knackery piggeries were also included on the same basis as slaughter house piggeries.

Amendments to the regulations under the *Stock Act* 1915-1976 provided a new scale of compensation values for cattle destroyed for tuberculosis, and introduced a compensation scheme for cattle and horses affected with brucellosis. More extensive amendments prescribed the tests for the disease of bovine brucellosis, for use of PPD tuberculin for tuberculosis testing, and for the positive identification of cattle affected with tuberculosis and brucellosis, including the use of a fire brand on the loin.



Conditions for use of earmarks to identify cattle vaccinated with either Strain 19 or Strain 45/20 vaccine were amended and provision was made for the use of approved ear tags as an alternative to earmarking.

When funds became available during 1976 from Commonwealth and State sources for compensation for brucellosis reactors, an area of north-eastern Queensland involving 16 Shires was declared the North Queensland Bovine Brucellosis Protected Area. The area was also declared an 'Eradication Area' in terms of the Rules and Definitions, set down by the National Tuberculosis and Brucellosis Sub-Committee.

Late in the year, a brucellosis eradication area was created, following the gazettal of the Shires of Allora, Glengallan, Inglewood, Rosenthal, Stanthorpe and City of Warwick, as the South Queensland Bovine Brucellosis Protected Area. At the same time the North Queensland Protected Area was enlarged with the inclusion of Flinders, Richmond, Belyando and Nebo Shires. The Brucellosis Infected Area boundaries were amended accordingly.

Further Amendment to the Stock Regulations of 1935 revised the conditions of entry of stock to Queensland, particularly in regard to the conditions pertaining to tuberculosis and brucellosis of cattle. The Health Certificate (First Schedule) was amended accordingly.

The provisions under the Brands Act concerning the identification of cattle vaccinated against brucellosis were amended to accord with previous amendments to the Stock Regulations of 1935.

The regulations relating to artificial insemination were amended to provide a common date of expiry for A.I. Licences and certificates; to amend conditions for private bulls at A.I. Centres; to require licensed and unlicensed semen to be stored separately; to specify the equipment required by an A.I. distribution centre licence holder; and to amend the annual report form submitted by licence and certificate holders. Subsequently provision was made for appointment of a member representing the Cattlemen's Union of Australia to the Artificial Insemination Advisory Committee.

Japanese quail and partridges were declared to be stock for the purposes of the Stock Act by Order in Council.

Notification concerning stock assessments was revoked on the 9 April 1977.

The South Burnett Regional Meat Area was declared and came into operation on the 1 May 1977.

## Animal quarantine

The Division of Animal Industry undertakes the very important function of providing animal quarantine services within Queensland on behalf of the Commonwealth Government. Increased staffing in the previous year has improved quarantine surveillance at Brisbane Airport and general services to the public.

However, increasing demands are being made on staff in this area because of increased traffic in foreign trawlers and small sea craft particularly in northern Queensland waters. Such traffic across Torres Strait poses a threat of introduction of screw worm from Papua New Guinea.

The risk from ocean-going yachts has been re-emphasized in recent weeks by the seizure of two illegally introduced dogs at Cairns and Brisbane. Both originated from countries with a high rabies risk and both were destroyed.

During the year, approximately 400 kg of meat and meat products, 80 kg of dairy products including cheese and butter, and more than 200 eggs were seized from incoming passengers at the Brisbane International Air Terminal. Two people were convicted and fined for illegally introducing meat and meat products.

The incursion into Australian waters by overseas fishing vessels poses some quarantine risk to this country. During the past year, seven such vessels were arrested off the coast of Queensland by Navy patrol boats and escorted to ports such as Weipa, Thursday Island and Mackay. Special quarantine precautions were observed with these vessels as food items on board included pork, eggs and chickens.

Since 1973, all accommodation at the Lytton Quarantine Station has been reserved for dogs and cats introduced from Papua New Guinea, Hawaii, Fiji and Norfolk Island. During the year, a section of the station was made available for dogs imported from the United Kingdom. Totals of 123 dogs and 16 cats were quarantined at Lytton, including 50 dogs from the United Kingdom.

Dogs arriving by air from the United Kingdom in approved containers undergo 90 days' quarantine while dogs and cats from the Pacific region (excluding New Zealand) are quarantined for 9 months. At no time during the year was any exotic disease-like condition seen in any of the quarantined animals.

During the year, 197 dogs and 100 cats were imported into Queensland from New Zealand. These are not subject to quarantine provided the consignors meet prescribed requirements.

Meat imports, both fresh and tinned, to Queensland totalled 86 472 kg during the year. New Zealand, which is the only country from which fresh meat can be imported, supplied 34 269 kg.

Other countries which supplied meat include United Kingdom, China, Canada, Ireland, Italy, Holland, and Switzerland. Products from all of these countries must be heat treated to Australian requirements and packed in hermetically sealed cans.

Live cattle exports during the year totalled 10 969. Five thousand two hundred of these were for slaughter in Hong Kong while the remainder was for breeding purposes. Other importing countries include Indonesia, Malaysia, Hong Kong, Samoa, Brunei, Philippines, and Trinidad.

## Notable events

Eradication of brucellosis began early in the year following the introduction of the brucellosis compensation scheme. Area eradication in the North Queensland Brucellosis Protected Area has proceeded satisfactorily and, later in the year, the Area was extended to embrace all of the Cairns and Townsville Veterinary Divisions. At this time, a South Queensland Protected Area embracing five Shires in the Warwick, Stanthorpe and Inglewood Areas was proclaimed and eradication started.

In addition, eradication testing under the Department's Brucellosis-Free Herd Accreditation Scheme was expanded rapidly throughout the State. Eradication programs were approved in a number of extensive herds undertaking simultaneous brucellosis and tuberculosis eradication. Veterinary practitioners were engaged to carry out eradication procedures under the supervision of Departmental veterinary staff. The introduction of a system of identification of cattle at the point of slaughter through the use of approved tags bearing the registered number of the property of origin has improved the traceback of tuberculosis and facilitated the brucellosis testing of a greatly increased proportion of breeding cattle slaughtered.

An experienced veterinary officer has been allocated specialists duties associated with the eradication of outbreaks of exotic diseases within Queensland. The officer will be responsible for all aspects of planning for such an emergency, and the appointment has filled an important gap in the Division's activities.

A significant development was the identification of *Babesia equi*, one of the organisms causing equine babesiosis, in a horse for the first time in Australia. The initial case detected was a polocrosse horse from New South Wales which had attended a carnival at Nerang.

Testing of all contact horses at that carnival and checking of recently imported horses has revealed that carriers of the disease have been imported from southern Europe through the normal quarantine screen applied to horses entering this country. To date, there is no evidence that the disease has been transmitted in this country by any vector ticks which transmit the infection in endemic countries.

Following this incident, quarantine authorities prescribed a test for equine babesiosis before importation of horses.

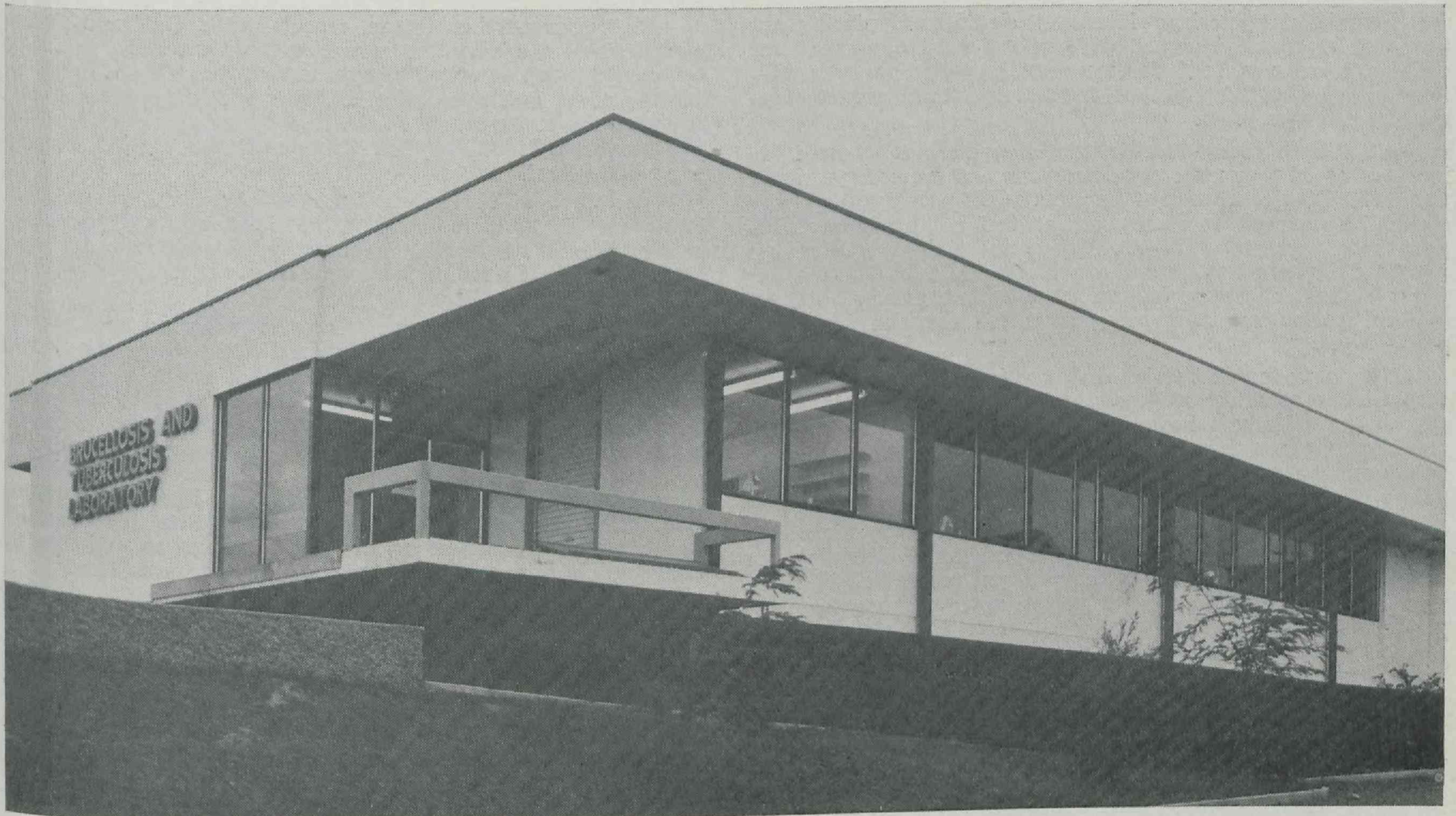
Several major livestock mortalities were reported. An unusual occurrence in December 1976 was the heavy losses of sheep and cattle in a large tongue of country in north-west Queensland extending south from the Gulf of Carpentaria to the Winton area. It was estimated that 150 000 cattle and 500 000 sheep died from flooding and exposure either directly or indirectly through piling up against fences during a period of unusually cold winds following heavy rains associated with Cyclone Ted. Other causes of heavy losses included botulism in north-western cattle resulting from failure of stock owners to maintain vaccination programs. Heavy losses in *Bos taurus* cattle in the Charters Towers district were attributed to tick worry and anaemia because of owners' inability to muster for treatment. There was a further increase in blackleg deaths, including a number in vaccinated cattle.

Some 30 outbreaks of proventriculitis in chickens were investigated. This is a new disease entity which has been attributed to a virus contaminant in certain batches of Marek's disease vaccine. It causes light to moderate losses in young chickens in addition to retarded growth and feathering abnormalities.

A feature of the year in the animal production field was the development of a co-ordinated extension program on restricted feeding of replacement pullets. The advantages and economies of this practice were clearly defined by a research program at the Rocklea Research Farm and the results, being immediately applicable by the industry, were disseminated widely to producers in a well organized extension effort.

Another important development was the further refinement of chemical crutching, one of the cost-saving techniques being researched at Toorak Sheep Field Research Station. Chemical mulesing is now being thoroughly tested in extensive field trials and shows promise of being a satisfactory alternative method to traditional mulesing.





A major building program to cater for the National Brucellosis and Tuberculosis campaign and to update the Division of Animal Industry's laboratories began a few years ago. The building pictured is the Brucellosis and Tuberculosis Laboratory at Yeerongpilly, which began operations in July 1976. It is designed to undertake 1 million Rose Bengal tests a year.

There was a further expansion during the year in beef cattle breed evaluation studies, particularly in southern areas of the State which had previously been somewhat neglected. These studies now occupy a major proportion of the resources of Beef Cattle Husbandry Branch, but would not be possible without the continuing co-operation of many producers.

### Development of laboratory facilities

The original laboratory at Yeerongpilly was constructed in 1909 and, since that time, much of the expansion at the Yeerongpilly site has been into buildings vacated by other organizations. The main veterinary laboratory building at the Animal Health Station, Oonoonba, which had been built in 1914, was destroyed by fire in July 1972. This exacerbated a situation where the Division's laboratories were inadequate in both space and design to cater for the sophistication in scientific methods that has developed in the last 50 years or so. These considerations, together with the needs of the brucellosis and tuberculosis campaign, have resulted in a rebuilding programme to upgrade the laboratory support for the activities of the Division.

The new veterinary laboratory at the Animal Health Station, Oonoonba, was occupied in May 1977.

The new Brucellosis and Tuberculosis Laboratory at Yeerongpilly was occupied in July 1976. Its cost of approximately \$500 000 was funded by the National Tuberculosis and Brucellosis Eradication Campaign. The laboratory is now playing a major role in the eradication campaigns for these diseases. The Biochemistry Building at the Animal Research Institute has recently started. It has been named the J. M. Harvey Biochemistry Laboratory to honour the recently retired Director-General who was the first Director of the Biochemistry Branch. A new store is also under construction at the Institute.

At the Tick Fever Research Centre, alterations were made and a laboratory extension, built with funds provided by the Australian Meat Research Committee, was occupied in March 1977.

The construction of a Pig Research Centre at Wacol, which was supported by a grant of \$70 000 from the Australian Pig Industry Research Committee, was completed as the year drew to a close. The unit is capable of housing 60 sows with the necessary number of boars, replacement stock, and progeny of a batch breeding program.

At Rockhampton, the construction of the new Brucellosis and Tuberculosis Laboratory is proceeding on schedule and should be completed by the end of 1977. The unit is being funded by the National Tuberculosis and Brucellosis Eradication Scheme at an estimated cost of \$860 000.

Towards the end of the year, a Siemens electron microscope was installed at the Animal Research Institute, Yeerongpilly, using Commonwealth Extension Services Grant Funds. This instrument has many applications in the ultra-microscopic study of disease processes in tissues and in the examination of the morphology of micro-organisms, particularly viruses.

### Beef Industry Committee

The Committee has continued to investigate price stabilization as a means of assisting recovery of the beef industry. As a prerequisite to any pricing arrangements, an effective system of carcass description is necessary and the Australian Meat Board proposal for objective classification has been agreed upon as the most appropriate. Approaches have been made to the Federal Minister for Primary Industry to expedite the implementation of beef chains with the objective of speeding up its introduction.

The immediate objective is to carry out trials in one or more abattoirs in each State to enable the system to be evaluated and to gain acceptance by all sectors of the industry. To this end, the beef chain at the Cannon Hill abattoir is to be equipped and instrumentation is almost complete.

The decision has been taken to continue the acaricide subsidy among the other forms of assistance being provided to the industry.

### Cattle industry

The beef and dairy industries faced another very difficult year. While pastoral conditions were again favourable, dairy farmers' terms of trade moved further downwards and the depressed economic state of the beef industry continued.

While average market values for all classes of slaughter cattle increased by about 20% over values in 1975-76, there was also a corresponding increase in production costs and the net result was that producers were little better off. The most significant improvement in values was for cows which realized average prices some 45% above those of the previous year.

A survey was made of more than 600 beef producers in May-July 1976 to obtain factual information on the effect depressed beef prices had on management, employment, finances and future intentions with regard to cattle numbers and property development. Preliminary results showed a dramatic drop in employment on beef cattle properties and showed that a substantial number of owners were seeking outside employment.



Female slaughterings increased significantly during the year and represented almost 45% of the total kill, compared with an average of 35% for the preceding 4 years, suggesting that a higher culling rate of females has been implemented than in previous years.

At 2.2 million, total cattle slaughterings showed an increase of 13% on the previous year and were 55% above the 1971-72 figure of 1.4 million. Calf slaughterings also showed a marked increase and at 0.5 million were 57% above the level in 1971-72. Since the dairy industry has regressed in recent years and would therefore be contributing fewer slaughter calves, indications are that greater numbers of beef calves are now being marketed for slaughter than previously.

The store cattle market has continued in the doldrums with values significantly lower per unit of weight than for fat cattle. Fatteners have been reluctant to pay high prices for stores because of the unstable fat cattle market and store producers have been equally reluctant to accept the low values offering.

However, the disparity in store and fat prices has brought some feedlots back into operation. Fattening for a few operators appears to have been profitable, if risky. Good seasons and poor store prices have encouraged many producers to revert to turning off fats instead of stores. Sales by auction have fallen off markedly and most store sales have been transacted in the paddock, thus reducing marketing costs.

At Cannon Hill, more than 80% of cattle are now sold by liveweight and the interest in this has led to a number of local authorities making plans to install scales.

The renewed interest in spaying that began in the previous year has continued unabated, and it is estimated that nearly 450 000 breeders were spayed during 1976. This is more than a fourfold increase over the numbers 2 years ago. Staff have been active in conducting spaying schools in all districts. The schools have helped to generate interest in the practice and have also been useful in promoting discussion of many other important aspects of cattle husbandry.

The interest in the large European breeds has passed the speculative phase, helped by the depression in beef prices, and has settled down to a more rational evaluation by producers. Their main contribution will be in conditions that are conducive to rapid growth rate. In favoured areas such as the Darling Downs, their crosses may have a permanent place in the beef industry.

### Brucellosis-tuberculosis Eradication Program

Significant steps were taken during the year towards the ultimate objective of eradication of tuberculosis and brucellosis from Queensland. The availability of compensation funds early in the year permitted the commencement of brucellosis eradication by test and slaughter. By the close of the year, considerable progress had been made in north-eastern Queensland, in many studs and bull breeding herds throughout the State which have entered the accredited brucellosis free herd scheme, and in several large extensive herds undertaking concurrent brucellosis and tuberculosis eradication programs.

Another important development was the phasing in of the legislation providing for the identification by tagging of cattle at the point of slaughter. This identification system has already facilitated the traceback of tuberculosis lesions to properties not previously recorded as infected and has enabled the brucellosis testing of an increased number of breeding cattle.

**TUBERCULOSIS** The prevalence of tuberculosis animals found at slaughter appears to have stabilized around 0.15%.

Since the inception of the T.B. eradication program in 1970, more than 6 million cattle have been tested with the removal of 0.38% reactors. Because testing has been confined to infected herds throughout the State since April 1976, the volume of testing during the current year to the end of April 1977 has shown a further decline.

Taking into account the severely depressed beef market, the volume of T.B. testing reflects a good level of continued support by the beef industry. However, in the lower Channel Country areas, owners, particularly pastoral companies, are reluctant to begin eradication programs. Without some form of financial incentive, the present apathetic attitude of some owners is likely to continue. Added to this problem is the rapidly diminishing available station labour force. Mustering costs have risen sharply in these areas, but light aircraft and helicopters have been used in an attempt to overcome some of these problems.

Isolation of young tested stock and the accelerated culling of the adult untested breeders appears to be necessary before worthwhile progress can be expected in the remote areas. Problems facing owners in the Channel Country include extensive flooding resulting in fences being damaged frequently and in the breakdown of a segregation program.

In the far northern areas, especially the Gulf and Peninsula regions, the very low prevalence of infection in herds makes it difficult to convince owners that they should invest in improvements and manpower to achieve a clean herd status. In these circumstances, the adoption of an approved eradication program is unlikely, at least until the market returns to a viable level.

The Bovine Tuberculosis Protected Area was expanded in October 1976 to include all of the State with the exception of the Shires of Boulia, Diamantina and Mount Isa and portions of the Shires of Barcoo, Bulloo and Quilpie, west of the Dingo Barrier Fence.

The T.B. protected area is now classified as an Eradication Area in terms of the Standard Definitions and Rules adopted by National Tuberculosis and Brucellosis Sub-committee. Conditions of movement within and into this area from infected properties have been made more stringent to ensure that the *status quo* within the protected area is maintained. Breeding cattle from T.B. infected properties in other States have been excluded from entry into the protected area. The declaration of an eradication area also implies an obligation on owners of infected properties to maintain or establish an approved program leading to eradication.

Throughout Queensland, there are 260 infected properties. Within the eradication area, 202 or 0.56% of properties are infected. Unfortunately, due to the depressed state of the industry and a lack of co-operation in some instances, about 40% of infected properties in the protected area have not started an approved eradication program.

Within the infected area, 58 or 35.5% of all herds are infected. This area includes most of the heavily infected problem herds within the State.

With a view to maintaining a closer contact with owners of T.B. infected properties in the Boulia, Diamantina, Barcoo, Quilpie and Bulloo Shires, a senior inspector has been appointed to Windorah, where he will serve from July to the end of the cattle season. In addition to maintaining a contact with owners, this officer will be responsible for co-ordinating a testing program between properties to ensure the most effective and economical use of veterinary practitioners.

In north Queensland, the occurrence of tuberculosis-like granulomas was studied and resulted in the isolation of 10 *Nocardia-Streptomyces* group organisms. While these lesions resemble tuberculosis when examined by eye, they can be distinguished from tuberculosis lesions by microscopic examination.

Considerable progress has been made in the identification of mycobacteria. From the many isolates obtained from bovine tissues, most are identified as *Mycobacterium bovis*. However, other mycobacteria are isolated. *M. fortuitum* and *M. flavescens* as well as a typical mycobacteria of the *M. avium* complex have been identified. The serological identification of 27 *M. avium* complex isolates obtained over the period 1973-77 has shown that 7 out of 31 serotypes are represented.

Knowledge of the distribution of serotypes of the *M. avium* complex is important in understanding the occurrence of false positive skin reactions in cattle tested with intradermal tuberculin to detect bovine tuberculosis.

A need exists for a rapid diagnostic method that can be applied to lesions found during routine meat inspection. The rhoadmine auramine fluorescent staining technique has been evaluated for this purpose. The results indicate that, while a positive result is significant, a negative result does not ensure that the lesions do not harbour living *M. bovis*.

*At the Brucellosis and Tuberculosis Laboratory, Yeerongpilly, 3 500 Rose Bengal tests are carried out each day.*





**BRUCELLOSIS.** Field surveys were concentrated in areas in which tests and slaughter was imminent. These were selected from those areas with a known low prevalence. The aim was to establish the status of most herds before the declaration of protected areas to allow the implementation of movement restrictions without major disruptions to local trade. The resources needed for eradication measures could be assessed also. Major emphasis was placed on the Shires adjoining the N.Q. Eradication Area, namely Flinders, Nebo, Belyando and Richmond. A great deal of work was done also in those central western Shires particularly Peak Downs, Emerald, Longreach, Aramac and Ilfracombe, bordering the enlarged North Queensland Eradication Area. The south-eastern Darling Downs Shires were surveyed before the declaration of the South Queensland Eradication Area.

In the latter half of 1976, short interval eradication testing was commenced in lightly infected herds in the North Queensland Eradication Area and subsequently in the South Queensland Eradication Area. Progress with eradication has been satisfactory in these areas.

In herds where a high prevalence has made immediate eradication impractical or unacceptable, a whole herd vaccination program using Strain 45/20 vaccine in adults and Strain 19 vaccine in heifers has been adopted as an interim measure. This policy has assisted the local acceptance of the test and slaughter programme.

Monitoring of dairy herds by the Milk Ring Test (M.R.T.) at intervals of 4 months continued. Arrangements for monitoring cream suppliers on a routine basis were improved during the year by the introduction of the cream ring test (C.R.T.) in place of the M.R.T. done on whole milk samples, collected on the farm.

During the year, private veterinary practitioners were engaged to undertake accreditation, eradication and selected survey testing instead of appointing and training a large body of temporary lay staff.

A total of nine 'refresher' courses for participating veterinary practitioners was conducted by veterinary officers during the year in strategic centres.

With the advent of compulsory tail tagging on 1 January 1977, the meatworks monitoring of properties showed a substantial increase.

The general policy to reduce the volume of Strain 19 vaccination continued by restricting vaccinations in beef cattle to heifers in herds 'at risk' or in infected herds. The

number of doses of vaccine used continued to decline from 327 000 in 1973-74 to 150 000 during the current year. Strain 45/20 vaccine is used in previously unvaccinated infected herds and in anamnestic testing in weaner segregation programs. The level of usage was comparable to 1975-76 at 120 000 doses.

Brucellosis infection is well established in the Channel Country. Fortunately, weaner testing and isolation programs are possible in conjunction with tuberculosis control programs. This has been adopted successfully on a number of properties in the north and central west. Such programs are formally approved as eradication programs and compensation is made available.

The accreditation scheme for stud herds and herds supplying bulls, gained impetus during the year throughout the non-eradication areas, where it is regarded as the vanguard of the program. A list of accredited herds is published in each issue of the *Queensland Agricultural Journal*.

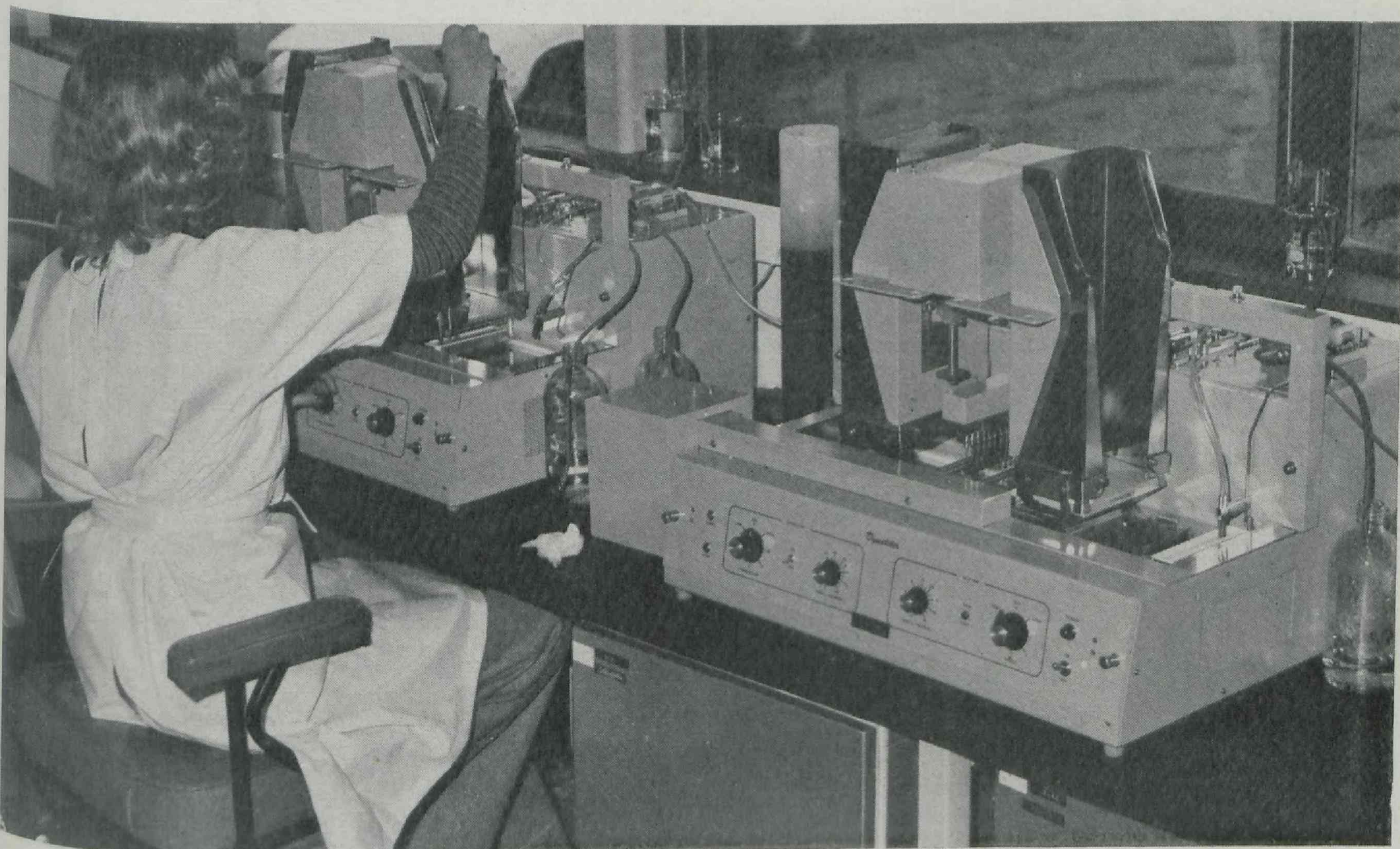
A large number of studs with low to moderate levels of infection is under approved eradication testing with provision for compensation for reactors.

Legislation under the Dairy Produce Acts requires that all herds supplying warm milk be certified as free of brucellosis and tuberculosis. Testing and approved eradication schemes have commenced on such herds, both within and outside the licensing area.

Many show societies throughout the State agreed to upgrade their entry requirements so that animals from accredited free herds can be exhibited without prejudice to their status. From non-accredited herds, vaccinates over 20 months of age and non-vaccinates over 12 months of age must be subjected to two tests at a specified interval, the second being within 30 days before entry to the showgrounds. Similar conditions have been applied to stud sales on a voluntary basis.

Although general agreement on the procedure for handling brucellosis reactors at meatworks has now been reached between meatworkers' unions and management, the additional killing charges imposed prevents the economic slaughter of such animals. Consequently, brucellosis reactors identified during eradication testing are being destroyed and disposed of on the property, and owners are reimbursed for disposal costs. In non-eradication areas, where compensation is not available, spaying is adopted in lightly infected herds.

*An automated microtitre system is being used for complement fixation tests for brucellosis. These tests are used for testing animals moving into declared areas, for introduction of cattle into tested herds, for anamnestic testing and for checking where the Rose Bengal test is positive.*







Collecting blood samples from the slaughter floor. This is a convenient and economical way of sampling cows and heifers sent for slaughter. It has been made effective by the Cattle Identification Regulations of 1976 which permit the trace-back of reactors to the property of origin.

The Brucellosis and Tuberculosis Laboratory at the Animal Research Institute, Yeerongpilly, began operations in July 1976. Automated complement fixation equipment is now working to capacity and the laboratory is playing a major role in the eradication of tuberculosis and brucellosis.

The new laboratory facilities at the Animal Health Station, Oonoonba, near Townsville, were occupied during May 1977. A semi-automated complement fixation test for brucellosis is being used, as service facilities for fully automated equipment are not available in Townsville. Mobile testing facilities for use in remote areas have been mounted in an industrial type caravan based on Oonoonba.

Construction of a laboratory with facilities for brucellosis serology has begun at Rockhampton and is expected to be available towards the end of 1977. The feasibility of providing modular or ambulatory laboratories at Toowoomba and Roma or Charleville is under examination.

Trials have been conducted at the Animal Health Station, Oonoonba, and at the Isis Junction research site on the serological responses in calves following Strain 19 vaccination. Results to date suggest that vaccines produced in Australia behave similarly to the European vaccines.

Because of management difficulties in mustering animals in remote areas, the potential efficiency of Strain 45/20 vaccine in infected herds is likely to be seriously impeded. A project aimed at assessing the effectiveness of Strain 19 vaccination in controlling brucellosis under extensive conditions is well advanced in a south-western holding. Strain 19 vaccination is carried out twice a year at strategic musterings. At the time of vaccination, approximately 60% of heifers are 3 to 6 months old, 35% are 7 to 9 months, and the remainder are older.

Observations to date include an increased calving rate, absence of premature calves and a reduction in the number of young cows culled as being barren. Approximately 10% of heifers show residual serological titres. The conclusion so far is that the spread of brucellosis between heifers appears to have been halted in the vaccinated groups. It does appear that Strain 19 vaccination is an effective tool eradicating brucellosis from herds in remote areas.

The aim of a project on a Rockhampton district property was to assess the feasibility of eradicating brucellosis from an actively infected herd of 500 breeders with a prevalence of 11.6% using the anamnestic test. The herd had no prior

vaccination history. Initially the herd was vaccinated with two doses of Strain 45/20 vaccine approximately 5 weeks apart. At the second vaccination all animals were bled and submitted to the complement fixation test. Altogether, 16.7% of the herd gave a positive reaction but this included 11.6% which were reactors before vaccination. All reactors were removed. The herd was retested approximately 7 months after the first test. The reactor rate at this test was 7.2% and again all were removed. The remainder of the herd was bled again after another 5 months. There were no reactors.

Approximately 12 months later, the herd was retested again. This time, a number of Strain 19 heifers (211) was included. Three positive and nine suspicious animals were detected out of 566, but these were all Strain 19 vaccinates. The project demonstrated that, given reasonable conditions, eradication of brucellosis at levels of 10% prevalence is feasible using the anamnestic test.

On present indications, the objective of provisional freedom by 1984 is attainable, except possibly for the remote far western districts in which the industry is at present barely viable and cannot sustain the costs of improved management and subdivision. Incentives and financial assistance are under consideration at a national level.

Depending upon the progress of eradication and the effects of movement control into and within the protected areas, the North Queensland Bovine Brucellosis Protected Area should be enlarged by the addition of the Shires of Aramac, Jericho, Peak Downs and Emerald and the South Queensland Bovine Brucellosis Protected Area by the addition of the Shires of Waggamba and Balonne, during 1977-78. During 1978-79 it may be possible to include the Shires of McKinley, Carpentaria, Croydon and Burke. It may also be possible in 1978-79 to enlarge the South Queensland Area to include the Darling Downs west to Dalby and the far south-west to include the Paroo shire.

It is proposed to enlarge the existing brucellosis protected areas before the declaration of an eradication area to allow for the introduction of movement control into and within the area before eradication by test and slaughter is undertaken. By this means stockowners will be made aware of eradication policy in advance of its implementation.

### Cattle tick

Conditions during 1976-77 continued to be favourable for the propagation of cattle ticks in the normally free areas of the eastern Darling Downs and the southern Burnett. In 4 years, the number of properties under quarantine has doubled.

During the year, a total of 245 tick samples was tested for resistance, with this pattern little changed from the previous year. However, multi-resistance continues to spread and is now reported from the Roma district, the Central Highlands and Far North Queensland.

Resistance to the formamidine group of acaricides has been detected at Glastonbury and Calliope, but the number of resistant individuals is extremely low and its practical importance difficult to assess.

Because of alleged carcinogenic metabolites chlordimeform had been taken off the market by the manufacturers and some doubts have been raised in relation to other members of the series. Removal would be disastrous to the economy of the cattle industry.

Because of relatively moist warm conditions during the autumn and winter of 1976, heavy tick populations occurred in many areas during that time. The Roma division reported the most serious autumn rise for many years. In fact tick hatchings were recorded in the Taroom tick plot during June and even July.

Ticks encroached into previously free areas in the Arcadia Valley and south of the line from Julia Creek through Gilliat to Camooweal. Tick outbreaks occurred on properties in normally free areas of Central Queensland near Alpha. This has prompted the construction of dips on two properties, and there has been an attempt to remove all goats which commonly roam the area.

Heavy tick infestations, especially during periods of nutritional stress, have caused numerous losses from tick anaemia.

As in the previous 2 years, producers have continued to defer development and drop management practices that are in any way labour intensive. It is surprising therefore how difficult it has been to get owners of Zebu crossbred cattle to realize that they can reduce the number of dippings quite drastically without suffering any appreciable or serious loss in production. A major extension program has been devoted to reducing dipping costs in existing crossbred herds, and to bring to the notice of the owners of British breed herds the high cost of control and the inevitable development of resistant ticks.

As labour and dipping costs increase and the effective life of new tickicides diminish, officers continue to emphasize the advantages of *Bos indicus* crossbreds in tick areas. In doing so, a number of new trials has been commenced to assess the effect on growth of not dipping. To date, the slight liveweight advantage with dipping would not justify the costs.



At 'Swan's Lagoon', Droughtmaster heifers dipped every 21 days to keep them free from ticks gained 87 kg on native pastures over 12 months. Undipped ticky heifers gained 76 kg or 11 kg less. Tick counts were highest between September and December with counts ranging from 16 to 31 engorged ticks ( $\geq 4$  mm) per side.

The growth of dipped and undipped cattle was also compared on a property in the Brisbane Valley. Over a 220-day period from November 1975 to June 1976, F<sub>1</sub> Brahman x Hereford yearlings grazing native pastures gained 116.8 kg when dipped regularly and 108.4 kg when not. Tick counts were highest during April and May, reaching a mean peak of 87 engorged adult female ticks per side for the undipped cattle. Mean counts at other times were below 20 per side.

Between October 1976 and May 1977, dipped steers gained 76 kg and undipped steers 80 kg when grazing native pastures on a property at Peak Crossing. Surprisingly, the liveweight advantage with dipping has been greatest for Belmont Red x Brahman cross steers (7.7 kg), then Belmont Red and Braford steers (5.3 kg). Dipping has improved gains made by Herefords by only 1.4 kg.

All cattle develop some degree of resistance to cattle ticks, although Zebu cattle become markedly more resistant than European breeds. It had been believed that the level of resistance achieved by an animal is genetically determined and, as a consequence, there appeared to be little hope of inducing strong resistance artificially. However, in two experiments undertaken at the Tick Fever Research Centre, Wacol, a primary infection with *Babesia* resulted in the final level of acquired resistance to ticks being set lower than in uninfected controls. The demonstration that the immune response to the ticks can be modified by extrinsic factors provides some hope that immunising regimens against this parasite might be developed.

In a separate study, it was shown that sheep develop a similar hypersensitivity to that of very resistant cattle. This will aid investigations of the immune response to ticks.

### Tick fever

**FIELD OUTBREAKS.** *Babesia bovis* (previously *B. argentina*), *B. bigemina* and *Anaplasma marginale* were confirmed in smears submitted to the laboratories on 116, 26 and 15 occasions respectively.

**VACCINE PRODUCTION.** A major proportion of the work of the Tick Fever Research Centre, Wacol, is preparing and improving vaccines against the tick fevers. A total of 757 823 doses of vaccine was distributed in the year ending 30 June, which represents a fall of over 12% on the previous year and probably continues to reflect the depressed economic conditions in the beef industry. A feature of the vaccine sales for the last 2 years is the increased demand for *Anaplasma centrale* vaccine to protect against anaplasmosis.

**RESEARCH.** *Babesia bigemina* is not a common cause of tick fever in Australia, but the demand for vaccine containing this parasite is increasing because of an increase in the number of Australian cattle being exported to countries where the disease status of *B. bigemina* is uncertain. A problem in producing *B. bigemina* vaccine was that the parasite could not be attenuated by the method used for *B. bovis* and often caused severe reactions following vaccination. A successful method has now been developed at the Tick Fever Research Centre at Wacol, so that a highly infective *B. bigemina* vaccine of reduced virulence can be prepared within 2 weeks of a request.

A major disadvantage with blood vaccine is risk of contamination by unwanted blood parasites, other infectious agents and blood group substances. C.S.I.R.O. and overseas workers had shown that an alternative to the use of parasitized blood as infective material for cattle is to inoculate infective forms isolated from ticks. An obstacle to the use of the method for vaccine production was that infected larvae were fed on host animals for 3 to 5 days to stimulate parasite development, and then had to be harvested for the preparation of infective larval extracts. It has now been shown by Tick Fever Research Centre staff that infective forms of *B. bovis* can be stimulated in unfed larvae in the laboratory by incubating them in warm moist conditions. Problems associated with purifying the larval extract and controlling virulence of the parasites have yet to be overcome.

Research on anaplasmosis undertaken at the Animal Health Station, Oonoonba, showed that there was no difference in the susceptibility of Brahman-cross and Hereford steers to the disease. In an experiment, also carried out at Oonoonba, to study the effect of plane of nutrition on the severity of the disease, it was demonstrated that the better fed animals had more severe signs of infection.

### Buffalo fly

Climatic conditions enabled buffalo fly (*Haematobia exigua*) to encroach further into areas of Queensland previously free of the parasite. Apart from northern areas where the fly is ubiquitous, buffalo fly appeared to overwinter

last year in areas as far south as Tiaro in the Maryborough Division. Spring and early summer brought a rapid build up from north Queensland, through the Central Highlands to the Central Burnett and westward to the Taroom Shire.

Some areas of Queensland experienced a dry period in midsummer which appeared to have a holding effect but, with the onset of more moist conditions in February-March, the southerly and westerly spread accelerated. Parts of the Roma and Maryborough Divisions experienced a record build up of fly in autumn while buffalo fly was confirmed at Toogoolawah in May 1977. Activity increased in the northern parts of the Toowoomba Division with properties to the north of Chinchilla and Miles regularly treating stock. Fly activity penetrated to 80 km south of Charleville, extending into the Quilpie district.

The use of dust bags as a control measure appears popular in some areas. Many properties which experienced infestation for the first time had to muster their herds regularly for treatment. By the end of May, fly activity had declined, presumably with the onset of cooler conditions.

### Other diseases

As mentioned in last year's report, the second case of Johne's disease recorded in Queensland was diagnosed on the Atherton Tableland in 1975. The affected animal, plus a number of others, had originated from a Victorian property some years before. Movement restrictions were placed on the affected property as well as those properties receiving cattle from the affected property over the previous 3 years. All animals considered at risk were subjected to various testing regimes. Those reacting positively or suspiciously were either retested or slaughtered.

A total of 14 properties was involved in quarantine restrictions at some stage. Some 25 animals were submitted to voluntary slaughter on the originally infected property, thus reflecting the degree of co-operation generated between producers and Veterinary Services Branch staff. It is pleasing to report that movement restrictions now have been removed from all properties on the Atherton Tableland.

During 1975-76, one property at Wandoan suffered severe losses (130 dead out of 600 total) resulting in movement restrictions being imposed on this and in-contact properties. Since then, a viral agent was cultured from affected animals and confirmed as Infectious Bovine Rhinotracheitis Virus (I.B.R.). Subsequently, a similar syndrome (with the exception of scouring and death) was reproduced by inoculation of this strain of virus into two animals at the Animal Research Institute.

Movement restrictions on the originally affected property have since been removed. Subsequent to the original outbreak, a similar syndrome but of lowered morbidity and mortality continued to smoulder in the Wandoan-Taroom-Injune area.

A herd of 200 at Thornton experienced an outbreak of mucosal disease. Thirteen yearling cattle died and another 28 were affected.

Suspected outbreaks of botulism occurred in Hinchinbrook and Thuringowa Shires while 44 head died on two properties near Dayboro.

During 1976-77, ephemeral fever quiesced. In June 1976, only minor sporadic outbreaks were observed in the Ingham district. During July, sporadic cases were reported in the Julattan and Bowen areas. Very low activity occurred during the spring and early summer of 1976. Paired sera from a clinically affected animal at the Ayr Research Station showed a fourfold rise in titre. A minor outbreak occurred in young cattle at Camooweal during November. At one stage, 15 animals were recumbent and two died. One cow at Dalrymple Heights gave a positive fluorescent antibody test.

During January, a positive sero-conversion occurred in the Toowoomba area. Sporadic cases were reported during February including some activity in the Channel Country. During late summer-early autumn, one case was confirmed at 'Swan's Lagoon', and some sub-clinical sero-conversions took place in the Flinders Basin project, while sporadic reports were received from the Charters Towers region. One property reported one dead and three sick during April.

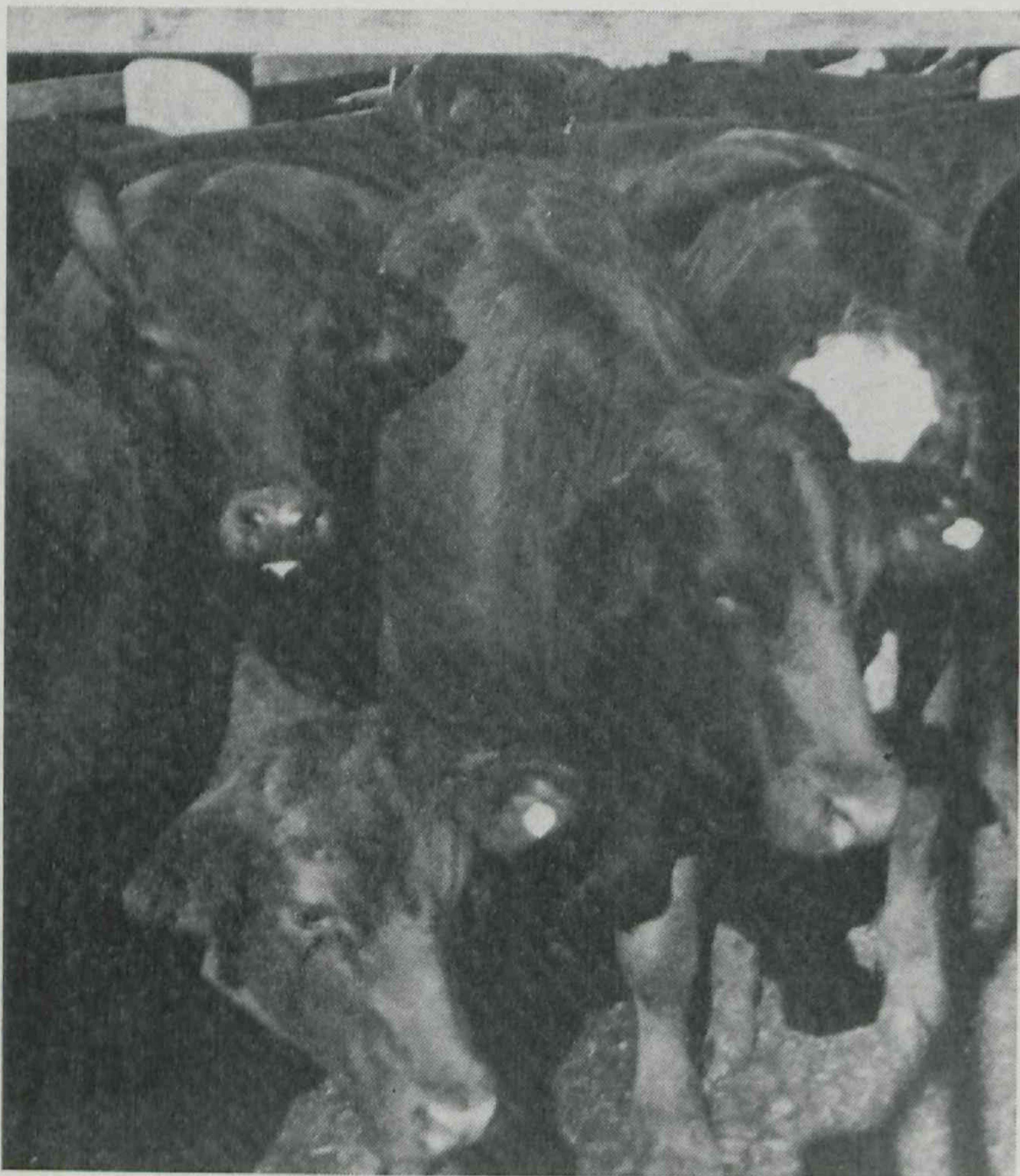
The Flinders River Project was designed to test the hypothesis that all southerly moving ephemeral fever epizootics originated in the Flinders River Basin of northern Queensland. Further supporting evidence came from a nearby C.S.I.R.O. sentinel herd where serological evidence suggested that ephemeral fever and other insect-borne viruses such as Murray Valley Encephalitis were active every year, thus suggesting an enzootic pattern for this area.

The project which is a collaborative effort between C.S.I.R.O., Queensland Institute of Medical Research and this Division is based on regular samplings of sentinel animals on seven different properties in the area plus periodic monitoring of insect populations and recording of meteorological data. The planned period for the project is 3 years, ending in the winter of 1977. Valuable data on the epidemiology of ephemeral fever, Akabane virus, Murray Valley Encephalitis and other viruses have been collected to date.



## Bruising

Bruising continues to exact a substantial toll on the cattle industries. Much of it is inevitable but a significant reduction could be achieved by dehorning, and attention to handling when loading and transporting, and at the meatworks. To aid extension a start has been made on a film that will demonstrate the various causes of bruising, and how these might be avoided. However, there are a number of practices whose effect on bruising can, at this stage, only be surmised, and,



*During the past year, buyers have been favouring polled or dehorned cattle over horned types.*

for this reason, research has continued by Beef Cattle Husbandry Branch in conjunction with Slaughtering and Meat Inspection Branch, C.S.I.R.O., the Australian Meat Board and several pastoral companies and producers.

A series of trials which investigated the effects of mixing cows and bullocks and of fasting bullocks before transport for slaughter was completed. Cows bruise more than bullocks, whether transported short or long distances to meatworks. Mixing of cows and bullocks at loading or 96 hours before loading did not increase bruising. Cows travelling with bullocks had the same level of bruising as those transported separately. Mixing strange mobs of steers at loading and 24 and 96 hours before loading also did not increase bruising.

These results have important implications, particularly for extensive properties, at a time when the emphasis is on low cost management. Bullocks off improved pastures fasted in yards for 24 or 48 hours before transport for slaughter by rail were more bruised than unfasted bullocks. Length of fast was not significant. It is planned to repeat these trials using cattle off oats.

Aspects of transport in relation to bruising are currently being studied, principally in relation to modified stock crates and also loading density. Overall examination of trial results with double deckers indicates greater back bruising among tall cattle travelling on the top deck. By law, double deckers should not exceed 4.42 m in height. Consequently, the height of the top deck is reduced relative to the bottom deck.

During earlier trials, investigating the effects of horns and of mixing the sexes, the bruised tissue trimmed from each carcass was weighed. This necessitated four to six additional assistants on the slaughter floor and prohibited trials in some abattoirs. During this time, the Australian Carcass Bruise Scoring System was developed by Mr B. Anderson, of Slaughtering and Meat Inspection Branch, and Mr J. C. Horder, of the Australian Meat Board. This system is now used for all trials.

The extension campaign to encourage producers to dehorn cattle at an early age appears to be bearing fruit. Surveys at Cannon Hill saleyards suggest that, over the year, there has been an increase in dehorned cattle of about 10%. At a number of saleyards buyers have apparently favoured dehorned cattle and the Royal Agricultural Society, Toowoomba, has adopted a policy requiring all entrants for 1978 to be dehorned. Demonstrations of the various methods of dehorning have continued to attract interest.

*Departmental trials have shown conclusively that polled cattle, like the polled draft in the top picture, would dress out with only half the bruising of the horned mob.*





## Reproduction

For the industry as a whole, a reduction in cattle numbers would be highly desirable but the aim for the individual producer must be to turn off more beef at the same or less cost. Improving reproductive levels still provides an opportunity to achieve this and continues to be one of the main extension objectives of the Beef Cattle Husbandry Branch.

The management principles involved in improving reproduction, principally weaning, controlled mating, and culling, have been well researched and in every district there are some producers who continually achieve very high branding rates by using these principles.

Trials in earlier years at 'Swan's Lagoon' Cattle Field Research Station showed that, if cows calve early in the season, they may require supplementation to achieve satisfactory branding levels. Recent experiments, in which the commencement of calving has been delayed until November, have shown that supplementation is unnecessary, at least in reasonably favourable seasons.

One aspect of reproduction that is of particular importance in southern Queensland is the losses in maiden heifers due to difficulty in calving (dystocia). The incidence of this condition in the Roma region of southern Queensland increased markedly from 1969 to 1973, with 35% of herds having more than 10% dystocia in 1973 and 10% of herds more than 30% dystocia. As a result, the Beef Cattle Husbandry Branch has increased its research efforts in this field.

In an attempt to define more precisely the possible causes of dystocia in the Roma region, an interview survey was conducted in 1975. Forty-five producers owning low dystocia herds (10% or less dystocia) were interviewed and 56 with high dystocia herds (more than 10% dystocia). The survey findings implicate genetic factors as contributing to the increase in dystocia through the very different calving management policies adopted by high and low dystocia herds.

A total of 82% of producers with high dystocia herds inspected their heifers once a day or more during calving and 59% found it necessary to use obstetrical aids (for example, a calf puller) when assisting heifers. In contrast, 84% of producers with low dystocia herds inspected their heifers less than once a day. Furthermore, 56% accepted their losses and gave no assistance, while only 9% used obstetrical aids. With very little culling, dystocia-affected animals survived in high dystocia herds, thereby rapidly increasing the proportion of these animals in the breeding herd, whereas natural selection presumably helped to counter any substantial build up in low dystocia herds—the dystocia-affected heifers and calf usually dying.

Dystocia was higher for heifers calving at 2 rather than at 3 years of age (24% against 15%). September and October were the worst dystocia months in 1973. Of the high dystocia herds, 54% control mate yearling heifers to calve from August to October, whereas only 18% of low dystocia herds use controlled mating. It is possible that, by repeatedly calving at a time when nutrition is good, high dystocia herds have accentuated their level of dystocia.

Further evidence that genetic factors are involved comes from an experiment comparing the calving performance of heifers from a low and a high dystocia herd. Hereford heifers from both herds grazed together on the high dystocia property from weaning until after their first calving as 2-year-olds in 1976. The low dystocia herd has, in the past, used single sire matings and rigorously culled dystocia-affected animals. Heifers from the high dystocia herd required more assistance at calving (38% against 18%) and twice as many of their calves died (14% against 7%). Four of the six dystocia-affected heifers in the low dystocia herd were the progeny of the same sire.

## Nutrition

Apart from a dry period in southern Queensland in January and February, this has been one of the most favourable seasons in a series of generally good years. Most producers will have had a satisfactory level of nutrition, despite high stock numbers. Nevertheless there is still some interest in supplementation.

Extension officers have generally emphasized that supplementation, at present prices, is likely to be uneconomic. Supplementing can be a useful method of raising production at short notice to take advantage of a rise in prices. For this reason, it is deemed worth while to continue research on the benefits of various types of supplements and to find ways of making them easier and cheaper to feed.

Even in good seasons, inadequate nutrition is probably the major limitation to animal performance in Queensland, and the research activity of the Beef Cattle Husbandry and Husbandry Research Branches includes a large component of nutritional studies. These investigations aim at

improving reproductive rates and growth rates by raising nutritional levels, resulting in an improvement in both the level and efficiency of production.

The studies undertaken have involved the use of improved pasture species and crop, the feeding of various forms of supplements—energy, nitrogen and mineral—and survival feeding.

**IMPROVED PASTURES AND CROPS.** Studies on improved pastures have ranged from the introduction of Townsville stylo into spear grass pasture—with and without application of superphosphate fertilizer—to the complete replacement of native pasture with high density irrigated rye grass fertilized with nitrogen.

At 'Swan's Lagoon', fertilized Townsville stylo continued to support better animal performance than predominantly native pasture. In the major reproductive study, conception rates in lactating Brahman cross cows grazing Townsville stylo were higher than in those grazing native pasture (90% against 82%). Comparable figures for 1974 were 86% to 61%, and for 1975 were 96% to 95%. However, pre-natal calf losses have continued to be higher on the fertilized Townsville stylo pasture (6% to 3%). Investigations to date have failed to reveal the reasons for the higher level of foetal loss on the legume-based pasture. Cows grazing the fertilized pasture were heavier and in better condition throughout the year than those on the native pasture and, as a result, produced heavier weaners (187 kg against 164 kg).

In the Central Burnett, irrigated ryegrass fertilized with nitrogen produced in excess of 1 200 kg liveweight gain per ha per annum.

On a mixed pasture of Narok setaria, glycine, Siratro, and Hunter River lucerne at Gatton, grazed from November to June, mean liveweight gain was similar for animals on set-stocked and rotationally-grazed treatments (87 versus 91 kg). However, set-stocked animals had to be removed from the area for 28 days in February–March because of shortage of feed. While the rotationally-grazed area has always carried an adequate body of feed with a significant legume component, the set-stocked area has been grazed very short and the legumes have virtually disappeared.

**ENERGY SUPPLEMENTS.** Feeding of steers with molasses *ad libitum* is being studied at several locations throughout the State as a cheaper energy source than grain.

On green panic-glycine pastures at Kairi Research Station, feeding of molasses plus a phosphorus source to steers at stocking rates of 3.0, 3.75 and 4.5 beasts per ha resulted in improved liveweight performance on both basaltic and granitic soils. Highest liveweight production per ha from May 1976 to March 1977 of 810 kg per ha occurred on basaltic soil at the highest stocking rate with a total consumption of 5 346 kg molasses per ha. The unsupplemented treatment produced 483 kg per ha. At the same stocking rate on granitic soil, supplemented steers produced 734 kg liveweight gain per ha while unsupplemented steers had to be withdrawn from July–December. At slaughter, steers produced carcasses suitable for the local trade with 8 to 14 mm fat cover over the eye muscle.

At 'Swan's Lagoon', molasses fortified with 3% urea and 1% monoammonium phosphate was fed *ad libitum* to steers grazing native pastures from May to November. Supplemented steers gained 39 kg more than controls over the feeding period with a conversion ratio for kg molasses consumed per kg additional liveweight gain of 12.6:1.

**NITROGEN SUPPLEMENTS.** Feeding of molasses-urea to Brahman cross cows in 1973, 1974, and 1975 at 'Swan's Lagoon' has failed to have any effect on conception rates. During the 1976 dry season, supplemented groups lost less weight than unsupplemented groups but conception figures for the subsequent mating are not yet available. Supplementation has not led to any improvement in calf growth rates or weaning weights. The failure of urea supplementation to produce production responses has been attributed to the mild dry seasons experienced and the generally high level of body condition maintained by the cows.

Responses in steers fed molasses-urea supplements from May to October ranged from 14 kg to 29 kg. Reduction of the molasses level fed from 220 g to 110 g had little effect on performance except when additional sulphur was fed. Addition of sulphur to a molasses-urea supplement produced a marked improvement in animal performance when 220 g molasses were fed but not when 110 g molasses were fed. Compensatory growth had greatly reduced the liveweight advantage by March.

At 'Brian Pastures' Pasture Research Station, Gayndah, allowing weaner steers access to an area of *Leucaena leucocephala* for a 55-day period in October–November resulted in an increase in liveweight gain from 0.4 kg per head per day to 0.8 kg per head per day. Further studies are to be carried out this year to examine performance of steers when the nitrogen supplement is provided by either *Leucaena*, non-protein-nitrogen or a combination of the two. Patterns of rumen fermentation will be monitored and an attempt made to relate them to animal performance.



**MINERAL SUPPLEMENTS.** In studies designed to better understand the effects of phosphorus deficiency undertaken by Husbandry Research Branch staff at the Animal Research Institute, three groups of heifers were fed a diet based on barley straw, cottonseed hulls, molasses, sorghum grain and tallow for 57 weeks. The diet supplied approximately 1.86 Mcal per kg metabolizable energy and contained 0.09% phosphorus. The control was group fed *ad libitum* and two groups received phosphorus supplementation. One phosphorus adequate group (12 g per head per day) was fed *ad libitum* whereas the other phosphorus adequate group's intake was restricted to that of the control group.

The low phosphorus intake resulted in a lowered rate of gain over the last 10 weeks of the experiment.

Although the intake of the control group and one of the phosphorus adequate groups was similar, there was a 60 kg mean difference in liveweight probably due to a longer retention time of food particles in the reticulo-rumen which is due in turn to a lower activity of the rumen micro-organisms either by a reduction in the number or to a change in their specificity.

Two surveys to monitor changes in faecal phosphorus levels in stock grazing various pasture types throughout the year have been completed, one in the Balonne Shire and the other at Bowen. Both studies revealed a seasonal pattern of change with peak levels in January-March and lowest levels in spring. Differences in phosphorus levels between the pastures and soil types were greatest during the summer, with differences being small in the winter-spring period.

In a preliminary investigation into 'ill-thrift' of weaners grazing green panic-Siratro pastures in the Bundaberg area, animals given a cobalt bullet plus scraper orally gained 83 kg between November and February while untreated controls gained 22 kg. Injections of copper glycinate gave very little improvement in performance. Vitamin B12 injections of animals receiving cobalt did not enhance their performance. A follow-up study began in May.

On a property north of Taroom sampling of weaners, which showed signs of stiffness and ill-thrift, for blood and liver copper analyses revealed some of the lowest values ever recorded by the Biochemistry Laboratory at the Animal Research Institute. In a subsequent study, steers injected with 120 mg copper glycinate gained 25 kg between February and May compared with 15 kg in the untreated controls. The initial mean liver and blood copper levels in 76 animals sampled were 4.3 mg per kg and 0.027 mg per 100 ml respectively. Blood copper levels have risen to a limited extent in treated animals, but it is considered that higher dosing levels may be desirable.

At Coolum Research Station, some steers in groups that are grazed on pastures of *Narok setaria* for periods of 6 months or longer develop a condition of 'ill-thrift'. The condition normally develops in autumn. Analyses of plant and animal samples have revealed high oxalate and low calcium

levels, and oxalate is suspected of interfering with calcium absorption. A similar condition has been reported from other properties in the region.

**SURVIVAL FEEDING.** Survival feeding recommendations for cattle in Australia are presently based on grain or roughages, which are currently expensive and likely to remain so for some time. An experiment, which is the first of a series, was therefore undertaken at the Animal Husbandry Research Farm, Rocklea, to investigate the use of molasses as the basis of a survival feed for maiden heifers.

Eleven groups each of 10 yearling Hereford heifers with a mean initial liveweight of 230 kg were used. They were held in yards and molasses was fed at levels ranging from 1.2 kg per head per day to *ad libitum*. The molasses contained either 3.75% urea or meat meal at an equivalent level of nitrogen. Other factors examined were once weekly versus twice weekly feeding, and the supplementation of minerals. Poor quality roughage was fed daily at 20% of the molasses intake except for one group which received no roughage.

During the first month, the heifers were adapted to their diets. Deaths began occurring in groups fed 1.2 kg per day molasses after 4 months and when 20% of these animals had died the intakes of the survivors were increased. No further deaths occurred thereafter in these groups. In groups receiving 2.0 kg molasses a day deaths began after about 6 months, at which time the recovery phase for all animals was commenced.

Other features of the results were: (a) weight loss was slightly less on twice weekly than weekly feeding; (b) molasses-meal meal reduced weight losses considerably but the mixture was about twice as expensive as molasses-urea; (c) there was no apparent detrimental effect of eliminating roughage from the diet at sub-maintenance levels; (d) there was no response to a comprehensive mineral supplement; (e) on an energy-intake basis, results appear comparable with published studies using grain.

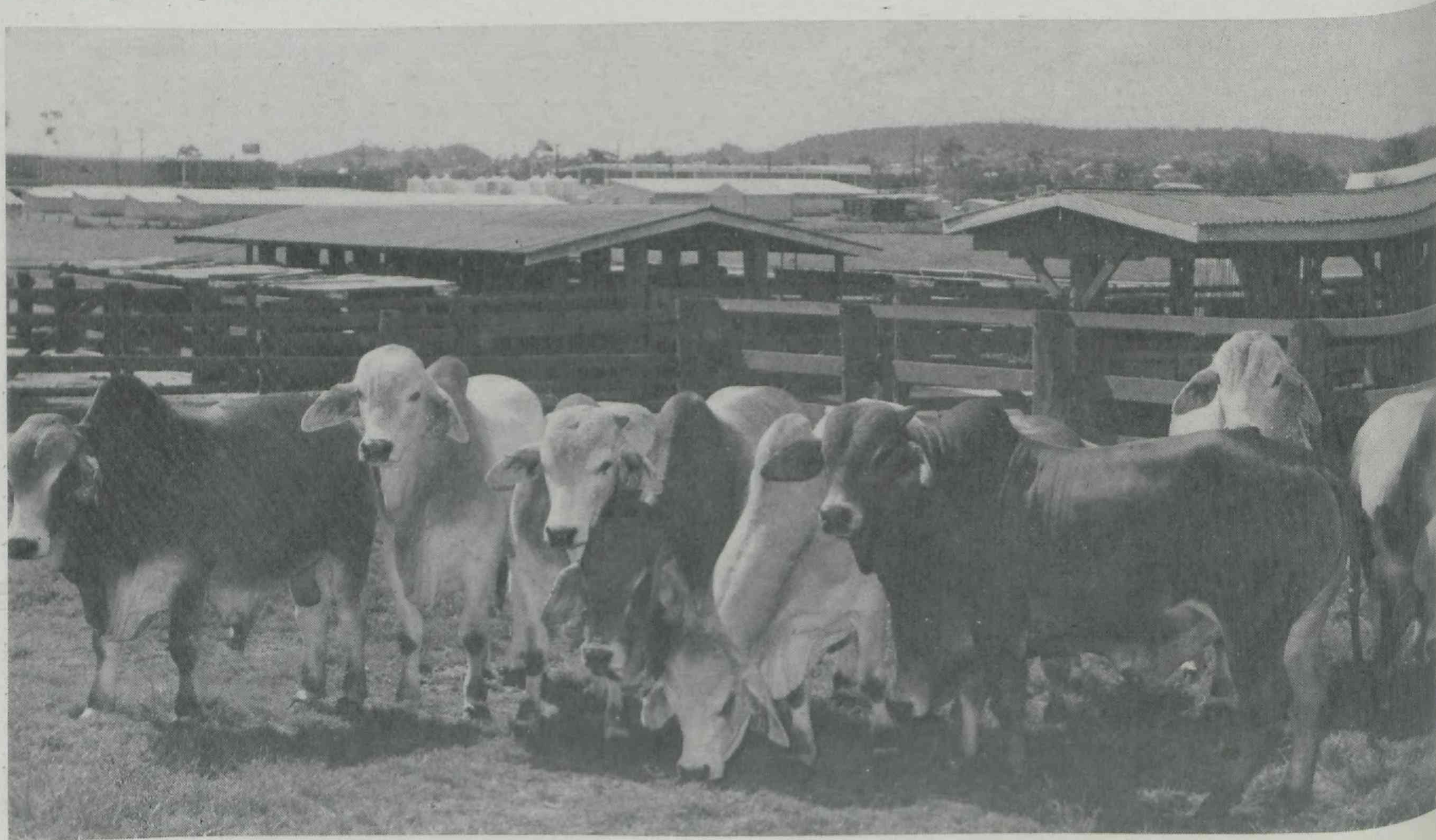
### Genetic improvement and breed evaluation

Enrolments in the National Beef Recording Scheme (NBRS) continued to increase slowly. By the end of the year, Queensland had 72 herds enrolled in the 'basic unit'. In the companion 'performance-pedigree' system, the number of performance recorders should take the Queensland total to more than 200 herds.

Interest in the performance-pedigree system continues to grow, but additional participation in the scheme has been suspended because of inadequate computer facilities. There are now more than 2 000 herds enrolled in the NBRS and the present facilities are working to capacity.

To improve the capacity and service of the NBRS, Federal and State Governments have agreed to provide funds for the installation of a specialized computer facility. The new facility will be installed during October 1977 and should be working with an updated program soon after installation.

*Brahman bulls undergoing performance testing at the Animal Husbandry Research Farm, Rocklea. The highest performing bulls, judged on growth rate and feed conversion, are selected for the Artificial Insemination Centre, Wacol.*





A group of 31 Brahman bulls is being performance tested at the Animal Husbandry Research Farm, Rocklea, to select superior sires for the Artificial Insemination Centre at Wacol. Selection criteria are—1. Growth rate from 300 to 450 kg. 2. tick resistance. 3. conformation. 4. physical soundness. 5. carcass leanness. Of the 25 bulls which have completed their growth tests, the best gained 1.2 kg a day.

Breed evaluation research, both on and off research stations, has continued, with the main emphasis on the tropical breeds. However, some aspects of recently introduced European breeds including the Simmental and Limousin are being assessed and some interesting data on Chianina crosses have been recorded from the Arcadia valley.

At Kairi Research Station, the development by the Division of Dairying of the Australian Friesian Sahiwal (A.F.S.) as a tropically-adapted dairy animal continues. Earlier research showed the Friesian to be superior in growth to Shorthorn and Brahman cross cattle. In the present study, growth rates to 600 kg liveweight of A.F.S. and Friesian steers are being compared. Growth rates to 500 kg have been very similar in the two genotypes. Carcass assessments will be undertaken at 500 and 600 kg liveweight.

At 'Swan's Lagoon', growth rates of first cross Brahman x Shorthorn and Sahiwal x Shorthorn animals were comparable, but dressing percentage favoured the Sahiwals as did degree of finish on the carcasses. In a study with  $\frac{3}{4}$  Brahman  $\frac{1}{4}$  Shorthorn and  $\frac{3}{4}$  Sahiwal  $\frac{1}{4}$  Shorthorn steers, growth rates and dressing percentage both favoured the Brahman crosses. The slower growth rate of the Sahiwals is possibly a function of smaller mature weight in these animals. Conception rates in Brahman cross females have tended to be comparable with those in Sahiwal crosses, but  $\frac{3}{4}$  Brahman calves have been heavier at birth, have grown faster and weaned heavier than comparable Sahiwal calves.

The first calving of the Africander crossbreeding programme at Brigalow Research Station was in 1976. Grazing improved pasture, F<sub>1</sub> Africander cross Hereford calves averaged 159 kg compared with 154 kg for Hereford calves at approximately 180 days of age (April). Both genotypes averaged 30 kg at birth. Overall pregnancy rates for 1976-77 favoured those cows mated to Hereford sires at 71.5% compared with 68% for cows mated to Africander sires.

At the Animal Husbandry Research Farm, Hereford cows were inseminated either with semen from Limousin or A.I.S. bulls in order to compare the performance and carcass composition of the progeny. The mean birth weights (kg) of the female and male calves were 34.5, 36.8 (Limousin) and 32.2, 35.3 (A.I.S.). The corresponding growth rates (kg per day) to weaning (180 days) were 0.62, 0.60, 0.58 and 0.64. Three male progeny from each of seven sires per breed are being fed high-grain diets from 300 kg to either 360, 400 or 440 kg liveweight when they are slaughtered. Interim results suggest that, at each slaughter weight, the Limousin cross steers are leaner than the A.I.S. cross steers.

Evaluation of breeds under commercial conditions continues to be an important part of Beef Cattle Husbandry Branch's research program. During the year, new experiments were commenced in all parts of the State. The reproductive performance and growth of Africander and Brahman crosses will be compared at 'Lassie Creek', Charters Towers. Africander and Sahiwal crosses will be compared with Shorthorn bullocks at 'Rocklands', north of Camooweal. At 'El Rocco', Moura, high grade Brahman cows will be mated to  $\frac{1}{2}$  Charolais,  $\frac{1}{2}$  Chianina and  $\frac{1}{2}$  Limousin bulls, and their reproductive performance and the performance of their progeny compared. At the Emerald Pastoral College, in conjunction with the College and C.S.I.R.O., the performance of Brahman and Africander crosses will be compared. Belmont Red crosses will be included in this work at a later stage.

At 'Cubbaroo', north of Cloncurry, Africander and Brahman crosses are being compared. At the commencement of mating in April 1975, all lactating cows were empty. When mating concluded in late September, 88% of the cows mated to Brahman bulls were pregnant and 74% of those mated to Africanders. Forty-four per cent of the dry cows calved during the mating period. In this category, 58% of those mated to Brahman bulls became pregnant compared with 54% of those mated to Africanders. Overall, pregnancy rates favoured Brahman at 69% compared with 61% for Africanders. Forty-six Africander-sired calves were weaned in October 1976 at an average fasted liveweight of 137 kg. The 66 Brahman-sired calves averaged 132 kg.

In 1974-75 pregnancy rates slightly favoured Africanders at 'Kunapipi Springs', Mackay, in the wet tropics. Seventy-two per cent of the  $\frac{1}{2}$ - $\frac{3}{4}$  Brahman cows mated to  $\frac{3}{4}$  Africander bulls were pregnant, 70% of those mated to Brahman and 64% to Herefords. In 1975-76,  $\frac{3}{4}$  Africanders recorded 63% compared with 69% for Brahman and 75% for Herefords. Paddock differences are suspected. Pre-weaning gains were lowest for the Africander-sired calves at 0.82 kg a day. By comparison gains were 0.95 kg a day for both Brahman and Hereford-sired calves.

The age of the dam, as well as breed, has an effect on calf weaning weights, but this effect tends to disappear with age. From 'Mt. Eugene' (Jambin), 243 steers of various

*Bos indicus* x *B. taurus* combinations (Brahman-Hereford cross, Santa Gertrudis cross, Droughtmaster cross and Belmont Red) were sent for slaughter at an average age of 37 months and average weight of 554 kg. There was no difference in age or weight at slaughter of the various genotypes nor any age of dam effect. This suggests that differences in growth rates between 'tropical' genotypes is small in that environment. Data from the same property, however, have shown differences in conception rates in favour of those dams with a higher Hereford content ( $\frac{5}{8}$  Hereford  $\frac{3}{8}$  Brahman) and those with half Africander.

The growth of Hereford and Brahman cross steers is being compared with Chianina crosses when grazing buffel grass pastures at 'Sunnyholt' in the Arcadia Valley. All Chianina crosses are the progeny of the same sire. Chianina crosses gained 345 kg from 9 to 28 months of age, while the Brahman cross steers gained 333 kg, Herefords 287 kg and Hereford x Brahman cross 289 kg. Ten steers from each breed have been slaughtered. At carcass weights of 194 to 243 kg, the Chianina cross carcasses were acceptable for the local trade and had less fat than the other breeds.

### Carcass composition studies

With the assistance of funds provided by the Australian Meat Research Committee, the yield of saleable meat was determined in 395 carcasses. Most of this work was done in the experimental abattoir at the Animal Research Institute, Yeerongpilly, and was designed to provide prediction equations suitable for use in beef classification schemes and carcass competitions.

The nutritional background of 212 of the animals was known and the remainder were entered in carcass competitions. Prediction equations suitable for a beef classification scheme are being determined for both percentage and actual yield using hot carcass weight (kidney knob channel fat out), fat depth over the tenth rib and carcass length. Such equations could be adapted for use on hot, unquartered carcasses. More comprehensive equations suitable for carcass competitions are being developed using the above mentioned measurements together with eye muscle area.

### Economics

Using a simulation model based on a Beaudesert herd, an investigation by Beef Cattle Husbandry and Economic Services Branch into the economic implications of a number of breeder management strategies has been completed. Some of the more important results are—

Reducing the age of first mating heifers from 24 months to 15 months resulted in a maximum increase in gross income of 11.7%. A number of research results on yearling mating was tested. When calving percentages decreased from 81% to 61%, combined with an increase in calf losses of 3.0% and heifer deaths of 1.0%, yearling mating still yielded an increase in gross income of 8.6%. When calf losses increased by 65.5% and heifer deaths by 6.0%, mating at 15 months caused a decline in gross income of 0.8% compared with mating at 24 months of age.

The gross value of increases in branding percentage at various ages of turn-off was calculated for the same herd and is tabulated below.

PERCENTAGE INCREASE ON GROSS INCOME OF INCREASES IN BRANDING PERCENTAGE

Age of Turnoff (years)	Increase from 61% to 71%	Increase from 61% to 81%
1	16.0	28.7
2	10.5	22.0
3	8.1	15.3
4	8.0	14.8

A study of cattle sold through the auction saleyard system at Cannon Hill has begun. The effects of various animal characteristics including breed, sex, age, horns and condition, on final relative price will be determined. The study will also examine particular aspects of the auction system including the market reporting system, the source and destiny of various classes of cattle and the method of sale. In addition, by following a percentage of auction cattle through to slaughter, the effects of various factors on dressing percentage will be determined.

### Sheep industry

Labour and material costs continue to rise and costs of production to increase. Stability has been introduced into the market with the reserve price scheme. The floor price was adjusted to cover fully the effect of devaluation and the market indicator was set at 284c per kg. The indicator has remained at this level despite revaluation.



Producers still have a waiting period after shearing until their wool is sold and they receive payment. Alternative systems of early payment within the existing marketing system are being proposed and examined. The amount of wool sold privately by wool producers on their properties has increased in recent years, with the early payment system used by private buyers being a factor in this increase.

Sheep prices have risen in the latter part of the 1976-77 financial year. There are a number of reasons for this, but an important one is the Middle East live sheep trade. With the weakening of supply in the southern States, buyers for the Middle East market have been purchasing wethers in Queensland and transporting them to Portland, Victoria, for shipment. Some exporters are giving serious consideration to exporting through Queensland ports.

Sheep numbers continue to increase on the coastal areas. Most of these are British breeds and their crosses and are used to supply localized prime lamb markets.

Home spinning and weaving have gained popularity in recent years and this has created a demand for black wool. Some producers have actively cultivated this market and are breeding black woolled sheep to supply the demand.

The Angora goat and mohair industry is growing, and more producers are looking to it as an alternative to the sheep and wool industry.

The emphasis of sheep research has been the nutrition of weaners, selection for adapted animals, ram breeding programs, chemical mulesing and crutching, wool harvesting and investigations into the nutritive value of Mitchell grass pastures. The officer-in-charge of the Toorak Sheep Research Station, Julia Creek, spent 7 months in the United Kingdom to undertake research in sheep foetal endocrinology, the mechanisms of wool growth and on the metabolism, mechanism of potentiation and cytotoxic effects of a chemical defleecing agent.

### Labour-saving devices and techniques

Producers continue to substitute mechanization for labour, and the Australian Wool Corporation, producers and research workers are giving high priority to the development of labour-saving devices. Some of these are commercially available in Queensland. Officers discuss the advantages and disadvantages with producers and give advice on alteration in management systems that are necessary with some of them.

Research into yard design is being continued by Sheep and Wool Branch officers. Preliminary work has been completed on the testing of electric fences for sheep in the grain growing areas, with encouraging results.

*A sheep after chemical mulesing with phenol. This technique was developed at the Toorak Sheep Field Research Station, Julia Creek, and is now under trial in the field.*



### Objective clip preparation and sale by sample

The concept of sale by sample has been accepted by the majority of the industry but some producers continue to class wool traditionally and so do not take full advantage of the savings that objective clip preparation has to offer.

Officers of the Sheep and Wool Branch and the Australian Wool Corporation conducted field days on this topic at Hannaford, Surat, Roma, Mitchell, Bollon, Dirranbandi, Goondiwindi and Dalveen during April 1977.

### Parasites

The control and prevention of parasite infestation is a continuing program. Labour shortages and the high cost of available labour make this task more difficult. Mulesing is an effective method of controlling crutch strike in sheep and it is being successfully promoted by officers of the Sheep and Wool Branch. However, there have been two reports of squamous cell carcinomas associated with radical mulesing in the Longreach area. On one property 150 ewes have been lost over a period of 18 months.

All strains of flies examined by the Pathology Branch were resistant to organo-phosphorus (OP) insecticides. The highest resistance factor recorded for diazinon was 19 times compared with a factor of over 100 times in the laboratory selected strain. Body strike has been a problem during late autumn to early winter; the fly wave being later than usual.

Research on the control of sheep blowflies is conducted in three broad areas by the Husbandry Research, Sheep and Wool, Pathology and Biochemistry Branches of the Division. These relate to the use of chemicals to defleece permanently susceptible areas of the sheep, chemical crutching and the possible use of fungal extracts as insecticides. These three projects receive support from Wool Research Trust Funds.

**MULESING.** This study, initiated at the Toorak Sheep Field Research Station, investigated the possibility of permanently defleece those discrete areas of sheep which are predilection sites for blowfly strike. The use of cryogenic, irritant, fixative and protein denaturing agents was studied. Painting the area with 15 to 30 ml of 40% phenol or a mixture of 20% phenol and 50% orthocresol were the most successful original treatments tested. A thick, non-purulent encrustation of wool and cutaneous tissue formed within 10 days of treatment. This subsequently fell off leaving a bare area of healthy skin on the breech or belly regions of lambs and weaners 4 to 6 weeks after treatment.

Tests to examine potential residue problems were done at the Animal Research Institute, Yeerongpilly, on the excretion rate of phenol in the urine of sheep following an application of up to 35 ml of a 40% phenol solution. In the first 24 hours after application, a maximum level of phenol was found in the urine and concentrations decreased to pre-treatment levels after 4 days. This rapid excretion of phenol in the urine suggests that tissue residues will not be a problem.

The phenol preparations have been improved by the inclusion of a thickening agent, co-solvent and dye. It is being successfully applied with a roll-on type applicator. Field studies are currently being carried out in co-operator flocks in several sheep raising centres in Queensland and other States. A chemical company is also carrying out its own research and development to evaluate the commercial prospects of the preparation as a chemical mulesing, ringing and wiggling agent.

**CRUTCHING.** A method has been developed at the Toorak Sheep Field Research Station for chemically crutching sheep and, as such, offers a new approach to fly control.

The basic aim of the procedure is to spray a hydro-sulphide solution onto the skin of the sheep with minimal wetting of the staple. This is carried out with a misting machine while the sheep is held in an appropriate handling device.

Two men can effectively crutch sheep at a rate comparable with the traditional crutching procedure. The operator applies the chemical and 30 to 60 seconds later the treated wool can be removed by the assistant. The crutched area is made completely devoid of all wool after treatment. Treated wool should immediately be placed in water as the hydrosulphide solution will progressively dissolve the fibres of the staple. A manufacturer has considered that this treated, somewhat tender, wool is suitable for blending purposes.

Further work is being carried out on concentrations of the chemical and on the sheep handling device. The technique should allow the producer to crutch sheep economically with unskilled labour at a pace to suit overall management strategies and offers the industry a possible alternative means of blowfly control.

**FUNGAL EXTRACTS.** Because fungal extracts have been the basis of many antibiotics for controlling bacterial diseases of man and animals, fungi from animals and feedstuffs isolated at the Animal Research Institute, Yeerongpilly, have been extracted and screened for a number of years to determine their activity against the larvae of the sheep blowfly.



Sixteen metabolites were sufficiently high in toxin to warrant retesting. The solid culture method produced the most active extracts. The highest levels of toxin were produced by four isolates of the same fungus. The toxins appeared similar when compared by chromatographic techniques. By elimination testing with the sheep blowfly, a single compound common to all four isolates was found to contain the major part of the activity. This compound has been isolated in a fairly pure state and work is under way to identify the compound by chemical techniques. The preliminary data would suggest that the compound is not one of the known metabolites of the fungus.

Control of the body louse (*Damalinia ovis*) continues to be hindered by the high labour costs. Officers of the Sheep and Wool Branch have been extending lice control methods that require minimal labour.

Internal parasites have been reported in all areas. Barber's pole (*Haemonchus contortus*) is the main one and high faecal egg counts have continued to be recorded, mainly in weaners with ill-thrift. Infestations of black scour (*Trichostrongylus* spp.) and nodule worm (*Oesophagostomum columbianum*) have been reported and, in specimens from two properties submitted to the Pathology Branch, pure larval cultures of *Trichostrongylus* were recorded.

Buffalo fly irritation was seen in various flocks of sheep in the Longreach area. The favoured sites for Buffalo fly attack were the wool-free areas of the head and axillary regions. The major infestations took place during late summer and early autumn.

## Breeding

ACTIVITIES OF THE WOOL BIOLOGY LABORATORY. The Sheep and Wool Branch has undertaken an extension program to promote measurement of fleece characteristics as a technique to help selection for breeding and sale of rams. The Wool Biology Laboratory has reorganized its testing procedure and has computerized operations.

Producers now receive computer printouts on small convenient sheets. Information provided includes fibre diameter and its deviation from the mean, greasy fleece weight, clean fleece weight, clean fleece weight percentage and clean fleece weight order. Each set of results contains a flock summary (average) and explanatory information.

A second program is available which will grade the animals by fibre diameter and clean fleece weight into up to 15 grades. Studs using this grading system are selling rams according to production performance. The stud which was involved with the development of this system was unable to meet demand. A number of additional studs is now using this system.

The Wool Biology Laboratory has measured 7 451 fleece samples, 17 mohair, and 4 carpet wool samples in 1976-77. This is nearly double the number measured in the previous year.

Sheep and Wool Branch officers in association with a number of studs organized a field day at 'Bullawarrie', Mungindi, on 4 December 1977. At this field day, rams from 16 studs were exhibited. Public response to the field day was remarkable.

Wether production competitions are being conducted in a number of centres in the State. Branch officers are associated with these. The Wool Biology Laboratory measures fleece samples so that production can be assessed objectively.

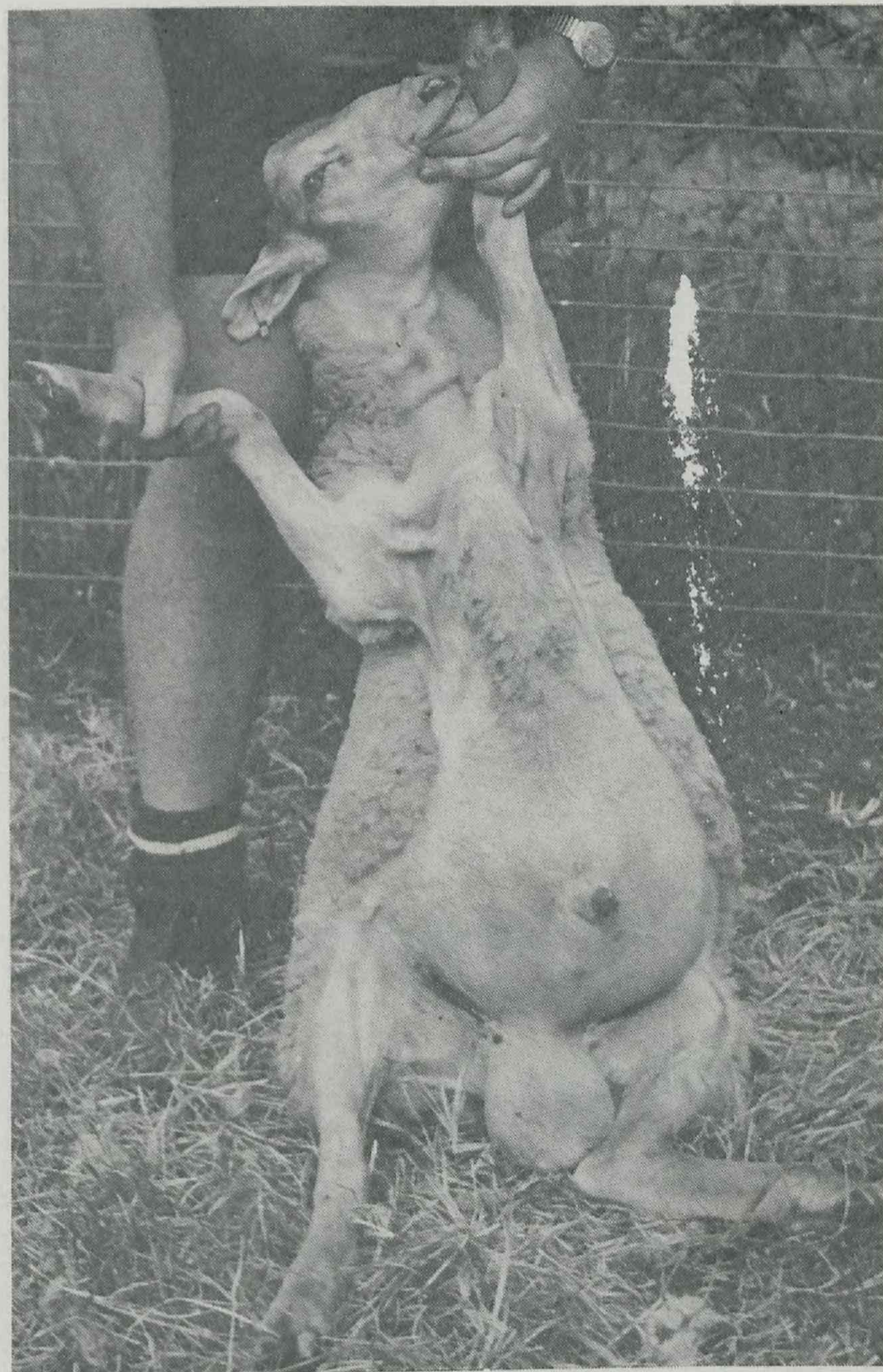
The Wool Biology Laboratory is developing closer contact with ram breeders of the State and its services are being promoted actively to these producers.

SELECTION STUDIES IN NORTH-WEST QUEENSLAND. Sheep flocks in north-west Queensland consist of adapted and non-adapted animals. From trials conducted at Toorak over the past 2 years, it appears that adapted animals have superior production performances in this environment. If selection towards these animals can be achieved, then an increase in production may be possible.

A group breeding scheme has been established at Toorak with 18 co-operator producers. The scheme is aimed at producing rams with adapted qualities for the semi-arid tropical environment. This has been promoted by the necessity to improve productivity of Merinos in an area known for low wool cuts, low lamb marking percentages and relatively few commercial studs. Criteria which have been required of flock sheep before inclusion in the scheme are above average wool production, proven fertility and traditional classing standards.

All ewes selected for the scheme had 1 kg more wool produced annually than the flock averages of about 3 kg. Selected commercial stud rams which had spent 12 months in the tropics were used for the initial joining. The flock ewes lambed during March and April. The lamb drop of 1 200 for 1977 will be increased to 1 800 in the second year. First rams from the scheme will become available to co-operators in July, 1978.

E



A Wiltshire Horn x Merino ram showing an area of wool shedding seen in more than 90% of the sheep at the end of the shedding season in February. A breeding program to evaluate the potential contribution of Wiltshire Horns to an 'easy care' sheep is being undertaken by Husbandry Research Branch officers at the Hermitage Research Station, Warwick.

A project was designed to determine whether it might be possible, by using suitable strains of rams, to produce a large-framed sheep suitable for the Middle-East market while still maintaining an acceptable Merino-type fleece. Three strains of rams are being evaluated. In the initial year, lambs sired by South Australian strain rams survived better to 4 weeks of age than lambs sired by locally bred rams (80% against 61%). Growth of these sheep to 12 months of age has been recorded and fleece data will be recorded at their two-tooth shearing.

## Nutrition

NUTRITION OF WEANER SHEEP. Within flocks of weaner sheep in north-west Queensland, there is a death rate of 25 to 30% between weaning and first shearing. Lambs are commonly weaned in this area from July to September when the pasture is at its poorest. Pen studies have shown that supplementing these weaners with small amounts of plant protein results in increased body growth and survival.

A miniature shallow water storage area has been established at Toorak with the aim of growing forage crops in the ponded area to supplement newly weaned lambs. Measurements of production and survival are being made on this system and compared with a control flock on native pasture.

NUTRITIONAL EVALUATION OF MITCHELL GRASS DOWNS PASTURES. The objectives of this analytically intensive trial based at the Charleville Pastoral Laboratory are: to measure the nutritive value of pastures on a Mitchell grass site; to obtain botanical composition and nutritive value of animal diets by use of oesophageal fistulated sheep; to evaluate the effect of digestive processes on this diet by use of intestinal and rumen cannulae; to measure faecal output of dry matter and nutrients and to measure the response of animals to this diet in terms of weight gains and wool production.



Samplings have been completed in late winter-early spring when the pasture is frosted off, on fresh growing pasture, and at seeding. However, little data are available from these samplings as few of the chemical analyses have been completed. Initial results show that, from September to November-December, there was a drop in the nitrogen (N) and phosphorus (P) concentration of the ingested pasture which was reflected in the N and P concentrations in faeces and in rumen ammonia nitrogen concentrations.

The sheep lost weight in early summer but no conclusion as to the cause of this weight loss can be suggested without further analytical data. A fall in digestible energy intake could explain this weight loss rather than lowered N and P intakes. This project, which is receiving support from the Wool Research Trust Fund, will continue for the next 2 to 3 years.

**NUTRITIONAL CONDITIONS RECORDED IN THE FIELD.** Laboratory examinations confirmed a diagnosis of copper deficiency in a flock of sheep on flooded river country at Toobeah. Ram lambs showed posterior ataxia when driven and black sheep developed bands of white wool, a classical sign of copper deficiency. The whole flock appeared unthrifty.

Osteoporosis and ill-thrift developed in lambs at Stanthorpe and pregnancy toxæmia was prevalent during the winter of 1976.

## Reproduction

Low lamb marking percentages remained a disturbing feature on many properties during 1976-77. The area most affected was again the central west.

The co-ordinated trial work involving a number of Branches of the Division and described in the 1975-76 report was completed. The results show that on the trial properties where autumn joining-spring lambing was practised, conception rates were high or at least adequate; the ewes lost body-weight during pregnancy; perinatal lamb losses were high; internal parasites (worms) and disease were not a significant problem.

In the spring-summer joinings, there were indications that in the spring the incidence of oestrus was low, but that joinings towards the end of December and later achieved satisfactory levels of oestrus and pregnancy.

An attempt was made on one property to quantify the losses caused by feral pigs. Perinatal loss of lambs was high, but there was no clear cut evidence that it was contributed to by feral pigs. Work done in northern New South Wales shows that pigs can and do cause heavy losses on some properties.

Supplementation with small amounts of non-protein nitrogen and molasses did not alleviate the loss of lambs in the 1976 spring lambing trials. A loss of body-weight during pregnancy in both the control and treated groups indicated that the level of supplementation may have been too low to remedy the poor quality feed selected from the pasture.

Preliminary data from studies on one of the co-operating properties at Blackall, using oesophageal and abomasal cannulated sheep and timed to coincide with the beginning of lambings, indicate that in October the nitrogen intake would have been just adequate, but that by December it may have been marginal. The phosphorus intake would have been insufficient for lactating ewes at estimated consumption levels of pasture.

Extensive serological studies on blood samples obtained from ewes after mating, before lambing and after lambing indicate that the common infectious diseases of sheep causing reproductive failure were not factors in the low lambing performance.

The most likely cause of the perinatal lamb losses in the 1976 spring was inadequate nutrition during gestation and at lambing.

Some autumn lamb markings from the central west have shown a marked improvement on 1976 figures, but insufficient figures are available on which to base a broad estimate for this year's autumn lambings. However, while increased herbage has been reported from some areas, much of the country is heavily grassed and conditions for herbage growth are not good. It is forecast that, unless unusually good climatic conditions occur in the spring, many properties will again have low lamb marking percentages.

## Infectious diseases

The Queensland sheep industry is fortunate that many of the infectious diseases causing death and production loss in sheep are not present in Australia and some occurring in other States are either absent or of relatively minor importance in this State. However, some isolated instances of disease were recorded by officers of the Veterinary Services Branch and confirmed by the laboratories of the State.

Eperythrozoonosis, caused by a blood parasite, was diagnosed on a property near Quilpie where 100 weaners died and a comparable number showed ill-thrift. Of 4 000 ewes, 200 died on a Blackall property from a clostridial infection, 2 to 3 days after being shower-dipped. Tetanus caused the loss of 58 of a group of 860 weaners and ewes, 2 weeks off shears at Hodgson, and salmonellosis caused the loss of 40 sheep at the Rockhampton abattoir. The consignment had travelled from New South Wales.

## Pig industry

Throughout the year, producers were faced with rising costs of production without any overall increase in prices paid for pigs. Feed costs rose by 30% to 40% and, at the end of the year, pig prices dropped by about 5%. Building costs have also shown substantial increases.

A shortage of meat and bone meal and locally-produced soybean meal led to a general shortage of protein meals and steep price rises, meat and bone meal prices more than doubling during the year. The pig population increased by 10% during the year and reached 451 000 by 31 March 1977. This compares with a national increase of 2.3%. By the end of the year, the reduced profit margins caused some established producers to cease production, while others were reacting by planning an increase in numbers and weight of pigs produced. Overall, a decrease in production is expected during the next few months.

During the year, officers of the Pig Section have maintained close contact with the industry by property visits and attendance at Queensland Pig Industry Producers' Association meetings. Performance recording and testing and advice on pig housing and equipment, with particular emphasis on better insulation and flushing of wastes; effluent disposal, and marketing were major activities of the Section.

Two prominent United Kingdom workers, Dr D. J. A. Cole, University of Nottingham, and Professor I. A. M. Lucas, University College of North Wales, spoke to meetings of pig producers in the State during the year under review. Both visits were supported by the Australian Pig Industry Research Committee.

## Disease

Diagnoses of parvovirus involving mummified foetuses were made and confirmed in many herds throughout the State in spite of the fact that serological testing has demonstrated that there are few parvovirus-free herds. The epidemiology of the condition is therefore somewhat unusual.

In one outbreak at Mundubbera during a 5 week period, 89 sows farrowed and another 14 sows were culled for failure to produce litters. Of the 89 sows, 36 produced grossly abnormal litters, averaging 2.19 alive, 0.47 stillborn, and 5.81 mummies per litter with an average gestation length of 119.1 days. Of the affected sows, 80% were on their first, second or third litters.

Previous serological testing had shown the breeding herd to be infected. The possible epidemiology in this outbreak is that there was insufficient contact between gilts (after losing their maternal antibody) and pigs shedding the virus, or that gilts were served before they had lost the colostral immunity. When they were later infected by the virus their foetuses were highly susceptible, died, and became mummified.

Swine dysentery continues to be a major disease in pig herds. During the year, the condition was diagnosed for the second time in north Queensland. Feed medication in combination with management changes such as reduced stocking density and improved ventilation can control the disease.

Many units satisfactorily control the disease using arsanilic acid, one of the least expensive drugs. However, supplies of this drug are becoming more difficult to obtain, apparently due to the closure of a factory in the U.S.A. by environmental protection authorities. If arsanilic acid becomes totally unavailable, alternative drugs that are used in some herds will have to be adopted more widely at considerably greater expense.

One owner is attempting to eliminate swine dysentery by continuous medication of the whole herd for a minimum of 3 months followed by the progressive withdrawal of medication from various classes of stock.

Intestinal adenomatosis has been diagnosed in several herds throughout the State. It generally occurs sporadically, however, in one herd on the Atherton Tableland two or three heavy bacon pigs were affected each week and a procedure of emergency slaughter was adopted. This continued for approximately 10 weeks and apparently disappeared after the re-inclusion of tylosin in the ration.

Many outbreaks of scouring and colibacillosis were investigated in young piglets throughout the year. Improvements in the housing and management of litters and a more rational approach to treatment produced dramatic results in some cases. In other herds with good housing, hygiene and management, the problem persists.



Greasy pig disease (exudative epidermitis) caused considerable losses of baby piglets in piggeries in the South Burnett, Biloela and Darling Downs. It caused retarded growth in older pigs in many units.

Cystitis, sometimes associated with nephritis, is an emerging disease among sows, especially older sows.

A neurological condition characterised by Wallerian degeneration of peripheral nerves and certain tracts of the spinal cord, medulla and cerebellum was seen in specimens from several piggeries. The cause of this condition is not yet determined.

In a co-operative project with other States and C.S.I.R.O., Parkville, Victoria, sera from 163 breeding sows in 16 widely scattered herds throughout the State were collected for testing for influenza antibody. None of the pigs had antibodies to swine influenza, but a high proportion of swine had antibodies to Hong Kong and Victorian strains of human influenza virus. This result was similar to that in other States.

## Breeding

Emphasis on programs and activities designed to improve the highly heritable characters of growth rate, food conversion efficiency and carcass quality continued. This included on farm performance testing; central performance testing, research and general advice on selection of breeding stock.

**ON-FARM PERFORMANCE TESTING.** The Australian Pig Industry Research Committee continued support for the pilot study, which is designed to measure likely genetic improvement as a result of on farm performance testing. During the year, a further 1 700 boars and 1 800 gilts were tested in this study. A final report is being prepared.

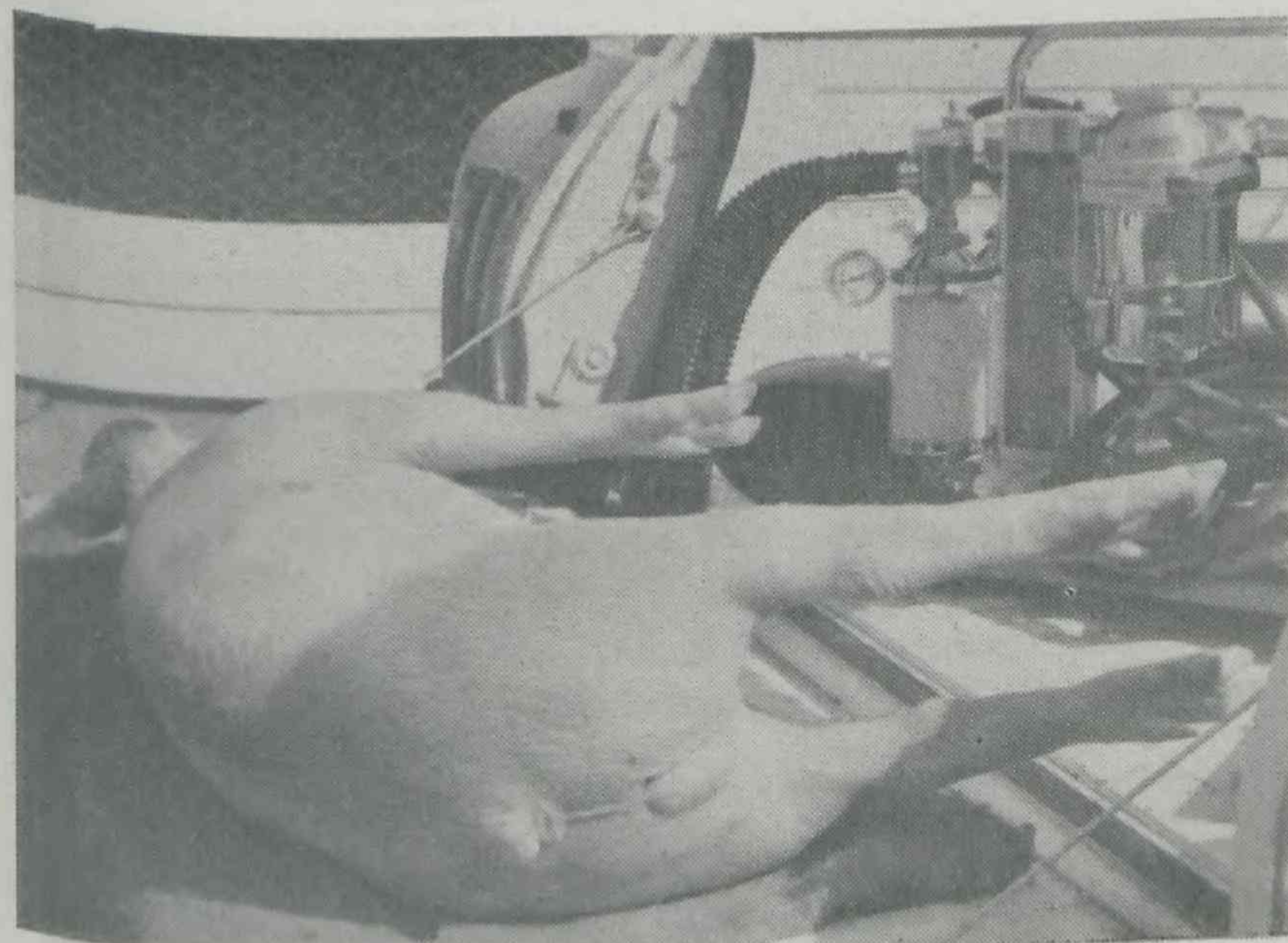
In addition to the project outlined above, all district staff in the Pig Section were involved in the State program. All producers involved have noted an improvement in performance. Some of this is seen as true genetic gain, but there is often a more rapid improvement in nutrition and husbandry as a result. Many co-operating producers and commercial stock in their locality and, in consequence, the sell commercial stock are more widely spread. A keen demand now exists for tested boars.

It is hoped to encourage producers to take over the work themselves and it is encouraging to note that a number have already done so.

**CENTRAL PERFORMANCE TESTING.** The Boar Performance Testing Station, Rocklea, evaluated the breeding values of 250 Large White and Landrace boars. Most of these boars were the progeny of the best sires identified by the Station in previous years. An influential group of co-operating herds is steadily being improved by using as sires the best Station-tested boars. In addition to an assessment for growth rate, feed conversion efficiency and carcass leanness, boars are now being screened for heritable susceptibility to death from stress and poor muscle quality.

**SELECTION FOR ECONOMIC GAIN.** The herd of mixed breed origin at Hermitage Research Station has now been subject to a program of genetic improvement by selection for five generations. A comparison with genetically constant control pigs indicates an improvement in the selected herd of 0.01 kg a day growth rate, 0.18 feed conversion ratio and 3.2 mm average fat depth. At current costs and prices, this improvement is worth about \$6 per pig. The herd will now be outcrossed to superior stock from the industry and a second cycle of improvement will commence.

*The halotone test being used on a boar to assess its susceptibility to pale soft exudate pork and porcine stress syndrome. The test was introduced during the year to test pigs at the Central Performance Testing Station.*



## Nutrition and reproduction

The difficulty in obtaining traditional ingredients has encouraged more producers to seek advice on suitable alternatives and to formulate diets on the basis of least cost calculations using computers. Rapid increases in the price of feedstuffs have also stimulated enquiries.

A series of on-farm trials was undertaken by the Veterinary Services Branch to evaluate different methods of iron supplementation for housed, newborn piglets. The trials showed that the piglets receiving iron galactan orally grew substantially faster than those receiving iron dextran or iron galactan by injection.

A controlled on-farm trial was conducted by Veterinary Services Branch to evaluate the effectiveness of a commercial gonadotrophin hormone mixture for overcoming a seasonal decrease in fertility (summer infertility) in a piggery in the Moreton region. The average weaning to oestrus interval of the untreated sows was more than double that of the treated sows and this difference was highly significant. However, fewer of the treated sows farrowed and they produced smaller litters.

The improvement in fertility in the treated group achieved by reducing the weaning to oestrus interval was more than cancelled out by an overall reduction in the number of weaners produced.

## Management

Performance recording, which has been conducted in almost all districts for a number of years, continues to assist co-operating producers. It allows them to set a meaningful production standard or target and to measure their progress. It also enables weak areas to be defined for follow up action. During the year, there have been changes in the system of recording in one region. If this continues to be successful it will be introduced in other regions.

A school on building materials held at Boonah with a total attendance of 300 people created considerable interest in improved methods of construction and better insulation of buildings. As a result of this successful venture, further schools were organized by the Pig Section at Toowoomba and Dalby.

A field trial of flank tattooing of pigs was conducted. This indicated that the system was not as satisfactory as body tattooing for post slaughter identification. Following the withdrawal of a widely used tattoo dye, various commercial compounds were compared and suitable alternatives can now be recommended.

Producers have been encouraged to sell heavier pigs that have been more generously fed where this has had no adverse effect on subsequent grading. The Queensland average slaughter weight is 56 kg compared with an Australian average of 53 kg.

Work on flushing of piggery wastes has attracted considerable interest and the method is being widely adopted in new piggeries as it reduces corrosion inside the building.

## Poultry industry

Field staff in the Poultry Section have been encouraged to develop specialist expertise in particular areas of poultry technology. As a result, the Section can now offer specialist consultant type services in the fields of poultry nutrition, egg quality, housing and environment, hatchery hygiene, 'other species' production, poultry behaviour and poultry reproduction. Development of specialist interests has been as an adjunct to and not as a replacement of the 'generalist' advisory capacity of field staff.

A recent appointee with a post graduate degree relating to studies on animal behaviour will strengthen the ability of the Poultry Section to deal with complex management problems. Such problems often result from a lack of understanding of the reaction of poultry to some new management technique, type of equipment or housing method.

The sixth Poultry Information Exchange since 1969 was conducted at Broadbeach. More than 170 people attended the 2-day Exchange which was organized by a joint committee of industry representatives and the Poultry Section. The major topics discussed were the future of demand supply management in Australia and importation of overseas stock.

Mr R. V. Byrnes, Senior Husbandry Officer, visited North America, the United Kingdom and Hong Kong to study (1) current production methods and new developments in commercial poultry production; (2) the organization, planning and conduct of poultry extension services; and (3) progress in several fields of poultry research.

Many of the recommendations made as a result of this study tour have already been implemented and Mr Byrnes has addressed a number of industry meetings throughout the State to report on his findings and impressions.



Dr T. M. Grimes, who has been specialising in poultry pathology since appointment to the staff of the Pathology Branch in 1968, returned from approximately 3 years post-graduate study on poultry diseases at the University of Georgia, U.S.A.

## Egg industry

The past year has been one of the best that the egg industry has experienced for many years. Net returns to producers for the 11 months ended April 1977 have averaged 65.22c per dozen. This compares with 50.21c for the same period 12 months earlier.

The dramatic upturn in net returns shows how effective the demand-supply management program has been in Queensland. Producer morale is at an all-time high and many who previously saw no future in the industry are now planning to remain in it. It is expected that there will now be an upturn in the rate of replacement of sheds and equipment which were allowed to deteriorate during the period of low profitability which preceded the introduction of hen quotas in 1973.

During the period reviewed, egg production was reduced by an estimated 14%. The number of leviable hens in Queensland is now 1 688 500.

Liaison between the Poultry Section and Marketing Boards has been strengthened in an attempt to keep Boards better informed about production problems likely to affect the egg supply significantly. One such problem, proventriculitis, was apparently responsible for low productivity and reduced egg size in a number of laying flocks during the year. This affected the supply of eggs in the larger weight grades and some shortages in these grades were experienced. This was contrary to expectations of an increased supply of large eggs due to widespread adoption of controlled feeding of pullets.

During the year, the Egg Marketing Board adopted bold new policies in relation to egg quality incentives and opening of egg cartons. The 67 Haugh Unit standard set for internal quality of producer eggs at receipt has resulted in a general improvement of egg handling and storage procedures on farms. This is supported by figures which show that the percentage of growers whose consignments meet the standard has increased from 54% in April 1976 to 82% in February 1977.

The introduction of a 'use-by' date on egg cartons has increased awareness of retailers of the need to rotate stocks. Consumers tend to reject eggs which are close to the expiry date if others are available. This has put pressure on the retailer to ensure that stocks are properly rotated, that stock levels are not excessive, and that stocks are purchased at frequent intervals.

## Poultry meat industry

Production figures for the 9 months ended March 1977 show that the number of meat chickens grown increased by approximately 8%. Dressed weight of broilers produced increased in the same period by an estimated 4%. The total number of birds grown for the year under review is expected to be in the vicinity of 20 million for a total dressed weight of about 27 000 tonnes.

There are now 92 broiler growers throughout the State with all but five of these situated in the South-east coastal area within 100 km of Brisbane.

One of the four major processors expanded production significantly during the year but much of this was achieved by growers transferring from another processor. These developments led to some pressure on growers to build new sheds to expand growing capacity, but the high cost of building new sheds has tended to deter growers from proceeding with expansion plans.

Because of the scarcity of shedding, processors have been stocking growers' sheds at higher stocking rates than normal. At present these range from 0.65 to 0.68 sq ft (0.060m<sup>2</sup> to 0.063m<sup>2</sup>) per bird. Broiler flock performance figures are now averaging 1.75 to 1.85 kg liveweight with a feed conversion of 2.2 to 2.3 kg feed per kg liveweight. Mortality figures average 3.7%.

There has been a continued inquiry into the commercial prospects for ducks, turkey, geese, pheasant, guinea fowl and quail. Two farms began duck production during the year. They are using Muscovy ducks and have started with small numbers. More than 1 000 pheasants and 1 200 guinea fowl have been raised for slaughter this season on a farm in the Mary Valley. This farm is also planning to produce 300 to 500 Japanese quail per week. Interest in quail is also being shown by two other people. Because of low egg production, short breeding seasons and the labour-intensive nature of this industry, production costs are high. The market for game birds is also limited, being mainly through restaurants and delicatessans.

## Disease

Proventriculitis has been a major disease problem during the year. The known total outbreaks of this condition is now over 30 with relatively fewer occurring during the second half of the year. A swollen proventriculus with congestion or small petechiae around the glandular openings, a friable and easily peeled off mucosa at the gizzard entrance and a small atrophied bursa of Fabricius were usually characteristic of the disease.

The reticulo endotheliosis (R.E.) virus, which has been variably present as a contaminant in certain batches of Marek's disease (H.V.T.) vaccine, has been shown to produce stunted, unthrifty chickens having a characteristic feather growth defect. It was first described by Japanese workers as 'nakanuke'. Although a similar condition has been associated with proventriculitis, the virus has not definitely been shown to be a cause of the proventriculitis.

As part of a continuing interest in salmonellas other than *S. pullorum*, several feed ingredients, mashes and pelleted feeds were examined. Salmonellas were isolated from both mashes and pelleted feed as well as ingredients. Further investigation is proceeding on the effectiveness of pelleting in killing salmonellas.

Sporadic outbreaks of omphalitis of young chicks still occur. In outbreaks caused by *E. coli*, losses may be as high as 30%. In one hatchery, troublesome losses of about 15% were associated with *Pseudomonas* sp. Investigation showed this contaminant was present in wood shavings used to replenish nesting material and it presumably penetrated the shell membrane during incubation.

A number of outbreaks of avian encephalomyelitis occurred during June-July in young commercial meat and layer chickens. In some flocks, deaths occurred as early as the third day of age, with the death rate being about 25% to 30%. In others, little evidence of disease was seen during the first 2 weeks and losses were comparatively low.

Three hatchery flocks were found involved. Two of these had not vaccinated their developing breeding pullets with a commercially-available vaccine.

Outbreaks of fowl pox were reported in laying hens and point-of-lay pullets on the Darling Downs during autumn. In all cases, there was a history of day-old chick vaccination at the hatchery source without subsequent re-vaccination.

Outbreaks of infectious bronchitis subsequent to vaccination led to a search for a new vaccine strain capable of protecting chickens against a number of new antigenic field strains which now have been recognized in the last several years. A commercial vaccine is now available which is based on a University of New England isolate (A<sub>3</sub>/26) which protects against all known strains.

## Nutrition

**RESTRICTED FEEDING OF LAYERS.** The layers used commercially in Queensland tend to be obese. Their propensity to deposit excessive amounts of depot fats represents a significant inefficiency in our egg industry. Restricting the feed intake of both the replacement pullet and the mature laying hen is an effective means of controlling fat deposition and, consequently of improving the efficiency of egg production.

The emphasis in research by the Husbandry Research branch has been in developing restricted feeding programs, capable of easy application on commercial farms, that are based on limiting the bird's time of access to feed.

Earlier work showed that denying the birds access to feed for 40 hours in 72 hours during the growing period reduced the feed required to produce 1 kg of eggs from 2.71 kg for full-fed birds to 2.54 kg. Recent results have shown that other programs are equally effective. For example, week-end feed denial and access programs have been developed which require no labour or management decisions on week-ends when farm staff is often reduced. The density of housing layers and/or the cage population has no effect on the response of birds to restriction.

The requirements of both full-fed and restricted birds for the essential amino acid, lysine, have been defined as 768 and 785 mg of lysine per bird per day. Restricted birds have been shown not only to have the ability to respond to higher lysine intakes than full-fed birds but also to use the lysine ingested more efficiently. For example, when both consumed 760 mg of lysine the full-fed birds produced 36.2 g of egg per day while restricted birds produced 37.6 g.

As the results of the research on limiting time of access have a potential value to the Queensland egg industry of approximately \$½ million a year, it has been used in a planned program of extension by the Poultry Section. The first phase of the program involved preparation of a comprehensive article on controlled feeding and the making of a film entitled 'Controlled Feeding of Pullets'. All egg producers have received a copy of the article.



The second phase was a workshop for industry servicing and managerial staff to inform them of the details of the controlled feeding program which was being recommended for commercial adoption. It was hoped that this would minimize problems arising due to farmers being given conflicting advice about controlled feeding from different sources.

A series of workshops for producers was then held in all major egg producing districts. These workshops were well attended but farmer representation tended to favour the larger, more progressive groups of farms. For example, in one region there was a 93% attendance by farmers with more than 5 000 birds compared with a 21% attendance by producers with 5 000 birds or less.

This phase also included follow up visits to farmers adopting the practice and investigations of some farms where problems had been reported. In most cases, problems were found to be due to farmers not following the recommendations. In some cases, the occurrence of proventriculitis in controlled fed flocks has prevented an assessment of the expected benefits from controlled feeding.

The final phase of the program will involve evaluation (based on change in number of producers adopting the practice), and an on-going program of producer education to introduce any necessary modifications to the recommendations and to maintain a high rate of adoption of the practice.

Research is also continuing at the Poultry Section of the Husbandry Research Farm at Rocklea and experiments in progress are: the persistence of lay of restricted birds in their second year of production and their response to force moulting; the methionine requirements of full-fed and restricted birds; and the application of time of access restriction programs to broiler breeders.

**OTHER NUTRITIONAL RESEARCH.** Apart from the work reported on restricted feeding, the Husbandry Research Branch is undertaking a comprehensive program of nutritional research at the Poultry Section of the Husbandry Research Farm. The results of this work are summarized in this section of the Report.

Three experiments have been done on restricted feeding of broilers either from 4 or 6 weeks of age comparing unrestricted feeding, mild restriction (feed withheld for 8 hours per day) and severe restriction (feed denial every other day). Mild restriction improved growth rate by 2.3% and feed efficiency by 0.03 units. Severe restriction generally worsened growth rate and lowered carcass dry matter content indicating less fat in the carcasses.

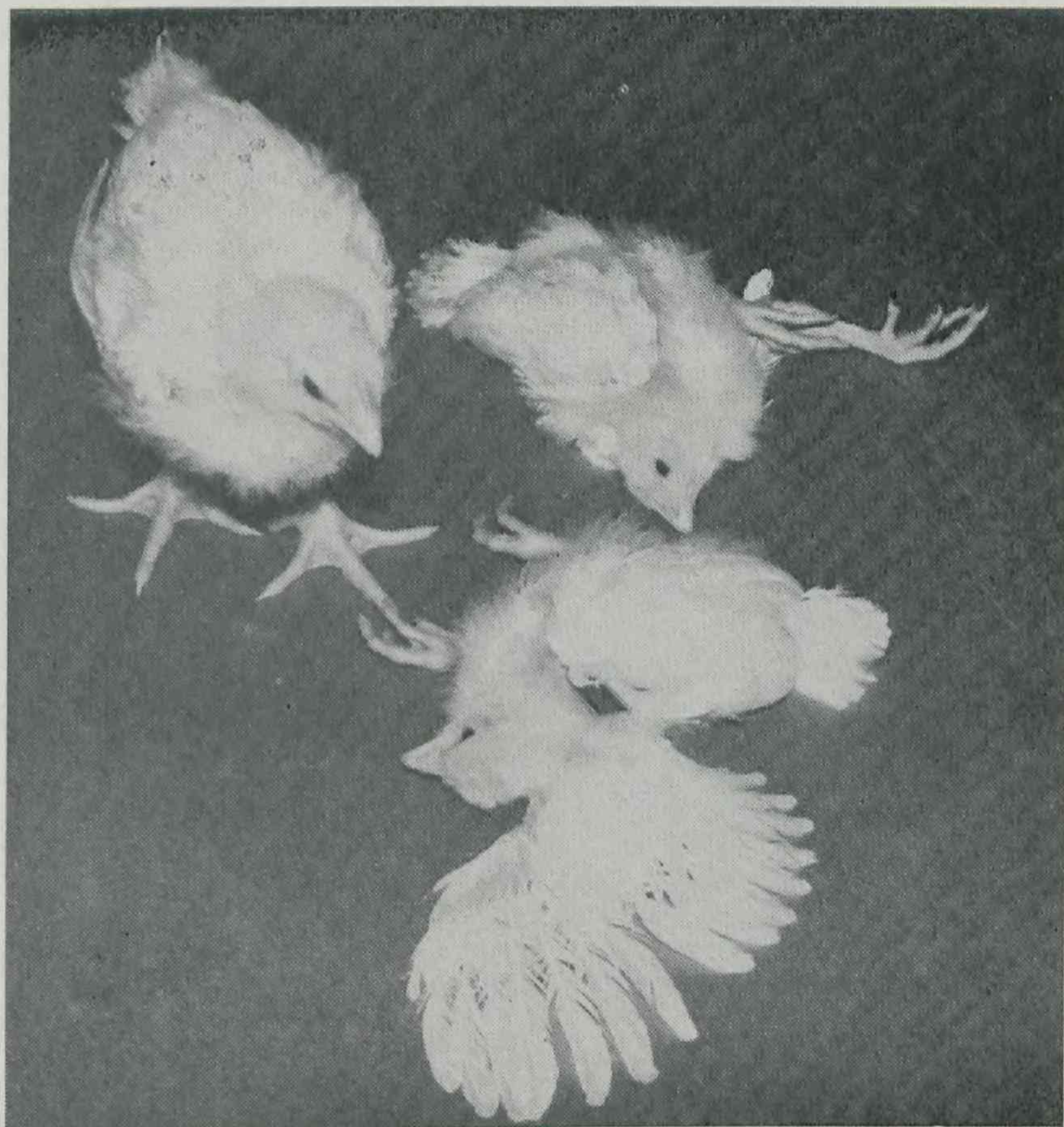
A well-developed grain amaranth produces such a large quantity of seed, though the seeds are individually minute, that the yield of the crop per unit area could exceed that of maize. The seed of *Amaranthus edulis* is interesting nutritionally since, in a crude protein content of 14.5%, it contains 1% lysine. Other grains are only poor sources of this essential amino acid. It therefore has great potential in the nutrition of monogastric animals. For example, if fed alone, it would meet the amino acid requirements of laying hens.

A very small quantity of seed was obtained in 1972 from the Plant Culture Section of the Australian National University. Since then, the plant has been propagated at the Hermitage Research Station and a preliminary experiment evaluating the material using young chickens was conducted this year. The *Amaranthus edulis* grain was fed either untreated or following heat treatment as approximately 70% of a broiler starter diet. Chickens were fed from 7 to 20 days of age.

Chickens fed the heat-treated material consumed significantly less feed (404 g) and gained less weight (262 g) than chickens fed a conventionally formulated control diet (441 g and 286 g respectively). However, they converted their feed just as efficiently (1.54 against 1.50). The difference in intake could probably be attributed to the diet containing the heat-treated amaranthus forming a less satisfactory pellet than the control diet.

The amaranthus fed without treatment drastically reduced feed consumption (194 g) and liveweight gain (61 g). Feed conversion was poor (3.18). After 10 days on this diet, chickens began to show signs of a central nervous system disorder similar to that induced by thiamin deficiency. On *post mortem*, pathological changes were observed in the liver and bone marrow. Further experiments will be conducted to identify the heat labile toxin in the raw seed.

In work supported in part by the Australian Chicken Meat Research Committee, the amino acids, leucine, isoleucine and valine, have been shown to interact in broiler diets. For example, a large excess of leucine increases the requirement of the chick for isoleucine and valine. Similarly, an increase in dietary isoleucine increased the requirement of leucine and valine. These relationships were demonstrated experimentally. However, the dietary concentrations of these amino acids may be varied within the ranges likely to be encountered in practical diet formulation without grossly affecting the young male broiler chicken's requirement for the other branched-chain amino acids, provided that the valine level in the diet is 0.78% or higher.



Feeding *Amaranthus edulis* seed, which has nutritional interest for monogastric animals because of its high lysine content, produced a central nervous disorder in chickens when they received raw seed as approximately 70% of their diet. Heat treatment prevented the condition.

A development of this project has been the evaluation of plasma amino acid levels as an index of the chickens amino acid status. Results suggest individual amino acid intake is accurately reflected by amino acid level in the plasma.

There is little biological data and much controversy on the 'availability' of amino acids. Apparent digestibilities are not synonymous with 'availability', but are simpler to determine and could be useful in grading protein sources. With this in view, a basal diet and diets containing basal plus either soybean meal or meat and bone meal were fed to cockerels. From analyses of diets and excreta, the apparent digestibilities of lysine were estimated to be  $86.0 \pm \text{SD } 4.8$  and  $73.4 \pm 5.1$  for soybean and meat and bone meal respectively. Values for isoleucine were  $87.1 \pm 5.2$  and  $72.4 \pm 7.0$  respectively. This work has also received support from the Australian Chicken Meat Research Committee.

In studies on the lysine requirements of broiler cockerels, a basal diet plus added lysine hydrochloride provided diets ranging from 1.07 to 1.27% total lysine. When fed to chickens either from 7 to 28 days or from 7 to 56 days of age there were no significant differences in performance indicating either that the lowest level of 1.07% lysine was adequate or that another amino acid limited performance.

Because the availability of lysine in individual ration ingredients can vary greatly (from 50 to 95%), these results indicate only that, with the particular diet used, which is basically one currently used commercially, Australian broiler strains need less than the 1.25% lysine recommended by the U.S.A. National Research Council.

A meat and bone meal containing 49% crude protein was included at 0 (control), 5, 10, 15 or 20% in various diets at the expense of some 55% protein meat meal and of soybean meal. Feed efficiency from 7 to 28 days of age was significantly worse both at the 15 and 20% inclusion rates. Other treatments indicated that this was mainly due to the bone meal protein (collagen) rather than the higher concentrations of calcium and phosphorus in those diets (2.19 and 2.51% calcium) compared with 1.22% calcium in the control.

An expeller-extracted soybean meal was compared with a solvent-extracted meal where each meal was included to supply either 5 or 10% protein in the diet. Each of the four diets was supplemented with lysine to provide either 0.90, 1.06, 1.22, or 1.38% total lysine and fed to cockerels from 7 to 28 days of age.

Chickens were significantly heavier on diets containing solvent compared with expeller meal (627 against 601 g); and had better feed conversions (1.80 against 1.85). Chickens had a better feed conversion at the 10% protein contribution of the soybean meal than the 5% but weight gains were not significantly different. This difference could be due to less meat meal in the diets with more soybean meal. Live-weights in diets containing 1.06% lysine were significantly greater than in diets containing 0.90% lysine (600 against 631 g). No other treatments were significant. Feed efficiency at 0.90% lysine of 1.87 was significantly worse than it was at 1.06%, 1.22% and 1.36% lysine.





Egg quality problems can be traced back to the supplier through an identification symbol stamped on each egg. Here a Poultry Adviser, who is also an Inspector under the Poultry Industry Act, checks that eggs are correctly stamped and graded.

## Egg quality

The 1975-76 survey of egg quality at retail outlets established the need for action to improve the quality of eggs reaching the consumer. An extension program was commenced by the Poultry Section to assist producers to meet the new internal quality standards set by the Egg Board in 1976. From 1 January 1977, eggs not meeting the 67 Haugh Unit standard attract a 1c per dozen penalty, and this is to be increased as the scheme progresses.

The first phase of the program involves holding workshops for producers in all the major egg producing districts. Egg Board technical staff have also been involved in these workshops, which have been well attended. Five workshops have been held at Toowoomba, one at Caboolture and others are planned for Brisbane and Rockhampton.

The next phase of the egg quality extension program will involve retail store employees. Approaches have been made to the management of large retail chains and to the Retail Traders' Association to seek their support for workshops for retail store employees. These workshops are to begin in September or October 1977. The aim of these workshops will be to create an awareness of the factors which affect egg quality and the precautions which can be taken at the retail level to minimize quality loss.

Another aspect of egg quality is shell strength, which is a problem in Queensland in summer, particularly if older birds are retained for egg production. A selection program for the genetic improvement in egg shell strength is continuing at the Animal Husbandry Farm, Rocklea. In the current generation, the specific gravity of eggs, which is an indicator of shell thickness, from the selected line was 1.090 compared with 1.085 for unselected controls, indicating that some improvement is possible by genetic means.

## Horses

### Babesiosis

The major item of interest to report is the recording for the first time in Australia of babesiosis in horses caused by *Babesia equi*.

In July 1976, the first case was diagnosed in a horse near Moss Vale, New South Wales. The horse was dull, had an elevated temperature and an elevated heart rate. The gelding had attended the National Polocrosse Carnival conducted on a property near Nerang (in south-east Queensland) some 3 weeks before. The diagnosis was supported by the successful transmission of the gelding's blood into two horses at C.S.I.R.O. Long Pocket Laboratories. A U.S.D.A. reference laboratory confirmed the diagnosis as *Babesia equi* in late September.

After the initial notification, attempts were made to trace and test all horses which had attended the polocrosse carnival in June. As the disease is known to be transmitted by various species of ticks in other parts of the world and by contaminated needles, all horses on the Nerang

property were examined for any sickness and serological tests were undertaken at the Tick Fever Research Centre, Wacol. On preliminary testing, this property showed some horses with suspicious titres but transmission tests and subsequent repeated negative serological tests have eliminated this property as being infected.

Seventy-nine Queensland horses that attended the polocrosse carnival were traced and tested. None of these horses has shown any evidence of the disease.

Seventy-one horses imported since 1974 and now resident in Queensland have been tested. The only evidence of any infection has been demonstrated in five imported horses on one property at Springbrook. To date, there has been no evidence of any spread of babesiosis to the indigenous horses on that property.

Both the Nerang and the Springbrook properties were placed in quarantine but further testing has allowed the Nerang property to be released from movement restriction.

On an infected property, horses are subjected to regular anti-tick treatments and kept under surveillance both clinically and serologically using the indirect fluorescent antibody (I.F.A.) test. Movement from the property is subject to satisfactory testing of individual horses.

Current evidence suggests that contaminated needles may be the only significant route of transmission within Australia. If this is true, then the prospect of eradication is greatly enhanced.

Since this outbreak, the quarantine requirements for importing horses to Australia have been amended to include a negative I.F.A. test within 30 days of embarkation.

### Other diseases

Equine infectious anaemia was again confirmed on a number of properties, including seven in south-west Queensland, one at St. George and one at Barcardine.

An infectious respiratory condition was prevalent in south-east Queensland during the winter of 1976. The condition was particularly common in intensively housed young horses. Training schedules in many racing and trotting stables were severely disrupted. The condition has some similarities to equine influenza (type I) but none of 40 serum samples from affected animals gave a positive result to the haemagglutination-inhibition test for antibodies to equine influenza virus type I.

A further 100 samples from horses in Queensland were tested at the Animal Research Institute, Yeerongpilly, with no significant titres being detected. This suggests that the disease due to type I virus is not present in Queensland and, as far as we are aware, it is not present in Australia.

A review of skin lesions diagnosed at the Animal Research Institute from 1970 to 1976 was carried out. Altogether, 482 lesions and tumours were examined. Sarcoids were the most frequent (32%). Other major groups diagnosed included fibrous tissue-granulation tissue (16%), squamous cell carcinoma (14%), fibromas (6%), fungal granulomas (5%) and hebronemiasis-parasitic granulomas (5%).

Selenium toxicity caused loss of hair, cracked hooves and shedding of hooves in eight horses at Hughenden. Tissue levels of 8.0 p.p.m. were found.

Osteodystrophia fibrosa ('Big head') was diagnosed at Rockhampton, Yalleroi, Cloncurry, Belmont, Miles, Dirranbandi, Mudgeeraba and Comet. Buffel grass pastures were incriminated in most situations but other pastures such as *Setaria* spp., and green panic were incriminated also.

Research is being undertaken on this disease at the Animal Research Institute, some of the work being in collaboration with Agriculture Branch. A 2-year study of the oxalate levels in four cultivars of buffel grass (*Cenchrus ciliaris*) has produced data on the total and soluble oxalate content of 110 pasture samples. Some seasonal and varietal differences are apparent but the data require statistical assessment.

A major project on osteodystrophia fibrosa, involving all three Branches at the Animal Research Institute, Yeerongpilly, and supported in part by the Queensland Equine Research Foundation, began during the year. The project is designed to test the hypothesis that the condition is due to the oxalates in pasture grasses interfering with intestinal calcium absorption.

The present project is designed to investigate the effects of long term oxalate feeding on the calcium metabolism, bone and other tissues of horses. In the initial phase six horses are being selected for use in metabolism crates for total faeces and urine collections. The diet used is a mixture of oaten and lucerne chaffs to provide the levels of calcium and phosphorus measured in the buffel grass pastures on which osteodystrophia fibrosa has occurred. Oxalic acid is being added in the form of potassium oxalate.



## Meat inspection services

Commonwealth Department of Primary Industry and State inspectors stationed at export meatworks co-operated in the inspection of all meat processed, whether for export or for domestic consumption.

Dispute, however, arose over the State's need to station disease control officers at export meatworks, in particular those works where State staff are not engaged in routine meat inspection duties.

Following protracted negotiations, it was agreed that disease control officers share amenities and that further action be deferred until October on the basis that export meatworks management provide separate amenities for Commonwealth and State staff. To date, most meatworks managements appear to be planning separate amenities for Commonwealth and State inspectors.

Abattoirs killing solely for domestic consumption were staffed by State inspectors, who also undertook inspections as far as was practicable at country slaughter-houses. In areas where no Slaughtering and Meat Inspection Branch staff were available, the latter services were undertaken by Veterinary Services officers.

Inspection of meat in premises registered as butchers' shops was regularly undertaken for the purpose of policing franchise provisions of the Meat Industry Act in relation to Public and District Abattoir and Regional meat areas.

## Slaughtering facilities

Construction work continued at the Ipswich Public Abattoir on the provision of a new rendering section and boiler. The new boiler, when operational, will facilitate cleansing operations at the works. Slow progress was made to an extension to the slaughter floor.

During the year, the kill at this abattoir increased substantially, mainly because the slaughtering charges are considerably less than those applicable at the Metropolitan Public Abattoir at Cannon Hill.

Construction of new stockyards and a new cattle race and knocking box was completed during the year at Tancred's Bromelton Works, Beaudesert. Swicker's Bacon Factory, Kingaroy, was upgraded to abattoir standard during the year and a full-time meat inspection service provided. The construction of new abattoirs at Innisfail and Mount Isa proceeded during the year.

The South Burnett Regional Meat Area was declared during the year and came into operation on the 1 May 1977.

During the year, continuing advice and assistance has been given by officers to licensees of country slaughter-houses to ensure compliance with legislative requirements. From the structural standpoint, the position now must be considered reasonably satisfactory. More supervision of slaughter-house procedures and inspection of carcasses and meat is required at these slaughter-houses but location and distance between premises make the provision of more staff to undertake these duties an uneconomic proposition at the present time.

Slaughter-house licensees who intend feeding swill containing animal matter to pigs are now being asked to bring their boiling down pots and piggeries to full compliance with the requirements of the Meat Industry Regulations 1973 as quickly as possible.

## Poultry

Regular inspection of poultry slaughter-houses was carried out during the year. Weight gain tests were undertaken during the year at the large poultry slaughtering establishments using spin-chilling equipment. Three results over the legal limit of 8% were recorded but in each case subsequent tests were satisfactory.

The Director, Slaughtering and Meat Inspection Branch, attended conferences in Sydney to consult with industry on poultry inspection proposals and to finalize documents on standards required.

## Butchers' shops and smallgoods' establishments

The high standards of construction and appliances in new premises have been maintained during the year. Excellent co-operation has been forthcoming and some very high standard premises have been constructed. Reasonable standards in older premises are being maintained.

Even small improvements suggested by officers of the Branch, such as the raising of the butchers' saw on bolts above floor level to assist the cleansing and drainage of the floor have been welcomed and adopted by many butchers.

More specialized and regular inspection is now being given to Class 2 butchers' shops (smallgoods' factories) because of their high volume of throughput. A high hygiene standard at these premises is essential.

## Meat quality

Promotion of tenderstretch continued during the year at a low level. Technical problems associated with the process at Metropolitan Public Abattoir Board were overcome during the year. While usage among property owners appeared to increase during the year, especially with sheep, it remained static in country areas and fell slightly again in the Metropolitan area.

It must be emphasized that this fall in usage in Brisbane is not due to any fault in the process. It is clearly a reflection on the fall off in public confidence in and demand for processed meat caused by substitution of untreated meat by unscrupulous butchers. Several requests have been received from butchers genuinely using the process for the Department to initiate a branding system to identify treated meat to prevent substitution.

During the latter part of the year, staff were able to observe and assist in C.S.I.R.O. research into electrical stimulation of hot carcasses to accelerate rigor and so prevent cold-induced toughening and possibly allow hot boning to become a commercial reality. This method is not seen as a replacement for tenderstretch but as complementary to it. Concern has been felt that substitution will retard the adoption rate of this process.

Late in the year, a request was received from the Australian Lot Feeders' Association that genuine feedlot beef be positively identified to protect it against the same type of substitution mentioned above. In view of these three areas of concern, consideration is being given to a system of marking beef with distinctive colours to protect processor and consumers.

Officers have given numerous talks, slides and film showings on meat topics to housewives and organizations including each intake of apprentice butchers at the Food School, Coorparoo. Again, response has been excellent. During the year, a fourth film was purchased on the subject of buying meat in bulk.

Concern is still being felt about the lack of trade and consumer education associated with the growing volume of trade in vacuum-packaged meat. No effective way of influencing this situation is yet apparent.

## Classification and carcass appraisal

Over the past decade, there has been a steadily increasing awareness by cattlemen of the need to take an interest in their cattle after they are sold for slaughter. This is evidenced by the great interest in carcass classification and their general increasing interest in carcass characteristics.

Beef Cattle Husbandry Branch introduced, for the first time, measurement of back fat on entries at the R.N.A. Exhibition in Brisbane. This generally elicited favourable comment and willing co-operation from competitors. At three country shows, a special competition has been arranged at which entrants are required to judge the carcass characteristics on live cattle. These are then slaughtered and carcass parameters measured.

It is strongly felt that this new competition has much more to offer in creating interest in carcasses and developing relevant knowledge and skills among cattle producers than conventional carcass competitions.

Slaughtering and Meat Inspection Branch officers appraised carcasses in competition for several shows including the Royal National Association—Department of Primary Industries bone out competition.

Early in the year, negotiations prompted by Slaughtering and Meat Inspection Branch to have the Australian Meat Board's carcass classification system installed at the Metropolitan Public Abattoir Board were successfully concluded.

Staff have been involved in preliminary work associated with this. Instruments for the pig and beef chains are currently being installed. The question of what organization will be responsible for staffing remains unresolved.

Preliminary work associated with classification has included (1) manually classifying beef carcasses and feeding back the information to producers; (2) manually classifying pig carcasses and feeding back the information to producers; (3) using trial work under items 1 and 2 above to make abattoir personnel and meat wholesalers at the Metropolitan Public Abattoir Board familiar with the principle of classification; and (4) small scale studies of the distribution of pig carcasses in relation to weights and fat, introscope accuracy and wholesale price of pig carcasses as related to carcass parameters.

## Grading

The modifications to blue ribbon grading system outlined in last year's Annual Report continue to be well received by the trade in Brisbane. The percentage of carcasses offered for grading is now fairly high (85%). Plans are well advanced for the early adoption of the modified grading in centres outside Brisbane. No difficulty is envisaged in adapting the blue ribbon grading system to classification when introduced.



## Poisonous plants and mycotoxins

### Poisonous plants

**LOSSES IN STOCK.** A spectacular loss attributed to Noogoora burr (*Xanthium pungens*) poisoning was investigated in the Central Highlands during the spring of 1976. A mob of 500 young steers had been handled in yards and then placed in a freshly burnt paddock at about the same time that heavy storm rain fell over much of the area. The paddock contained 150 to 200 hectares of creek flat which had been flooded in the previous wet season. Within a day of the storm rains, the entire flat was covered with a thick sward of Noogoora burr seedlings, and a week after the mob was placed in the paddock 190 of the steers were dead. Other cattle losses from Noogoora burr poisoning include Lowmead 18, Wallaville 15, Clermont 8, Injune 20, Gunalda 18, and Gundiah 12.

In sheep, fuschia bush (*Eremophila maculata*) is suspected of causing the loss of 100 animals at Charleville, while a diagnosis of humpy back at Quilpie was confirmed by microscopic examination of the spinal cord.

### Research

The major toxin in the sawfly larvae (*Lophyrotoma interrupta*) which causes heavy mortalities in cattle when large heaps of dead larvae accumulate at the base of silver-leaf ironbark trees, has been isolated by the Biochemistry Branch and its chemical structure has been partly determined in collaborative studies with the Australian National University in Canberra. The magnitude of this problem for some individual producers can be gauged from the fact that last year in the Injune area alone, 310 animals on six properties were reported dead after eating sawfly larvae.

Several *Pimelea* spp. associated with St. George Disease in cattle are being studied chemically. It is evident from the work of the Biochemistry Branch and that of other workers in Australia and New Zealand that these plants contain complex mixtures of toxic components.

## Environmental studies

### Pesticide residues

Two hundred and forty samples of kidney fat from abattoir-slaughtered cattle at Ingham, Townsville, Cairns, Innisfail, Bundaberg, and Maryborough have been examined for dieldrin residues. These cattle were selected from properties dedicated principally to sugar-cane farming.

Altogether, 15% of properties yielded mean dieldrin residues in fat above the maximum residue limit (MRL) of 0.2 mg per kg and a further 15% of properties showed dieldrin residues above 50% of MRL.

The incidence of individual cattle with above MRL values for dieldrin (12% of all samples tested) was in strong contrast to the State incidence (0.9%) for the same period as indicated by the Commonwealth Survey.

Because of increasing concern in relation to export markets, particularly for beef, an extensive program for monitoring of organo-phosphorus and organo-chlorine compounds in beef is planned to begin in 1977-78—with financial support from the Australian Meat Research Committee and some assistance in meatworks from Commonwealth Department of Primary Industry inspectors.

Intensive sampling, involving the collection of a total of 140 samples per week, will be undertaken in one abattoir in each of Townsville, Rockhampton and Toowoomba to provide sampling from environments ranging from tick-infested pastoral country to areas of intensive agriculture. The monitoring program will be allied to the tracing back of samples with unacceptable residues with the aim of introducing practices to minimize residues and to the mounting of a general extension campaign aimed at reducing the problem.

The work, which is a co-operative program involving Veterinary Services, Biochemistry and Slaughtering and Meat Inspection Branches, would not have been possible without the regulations providing for property identification of cattle.

### Manure disposal

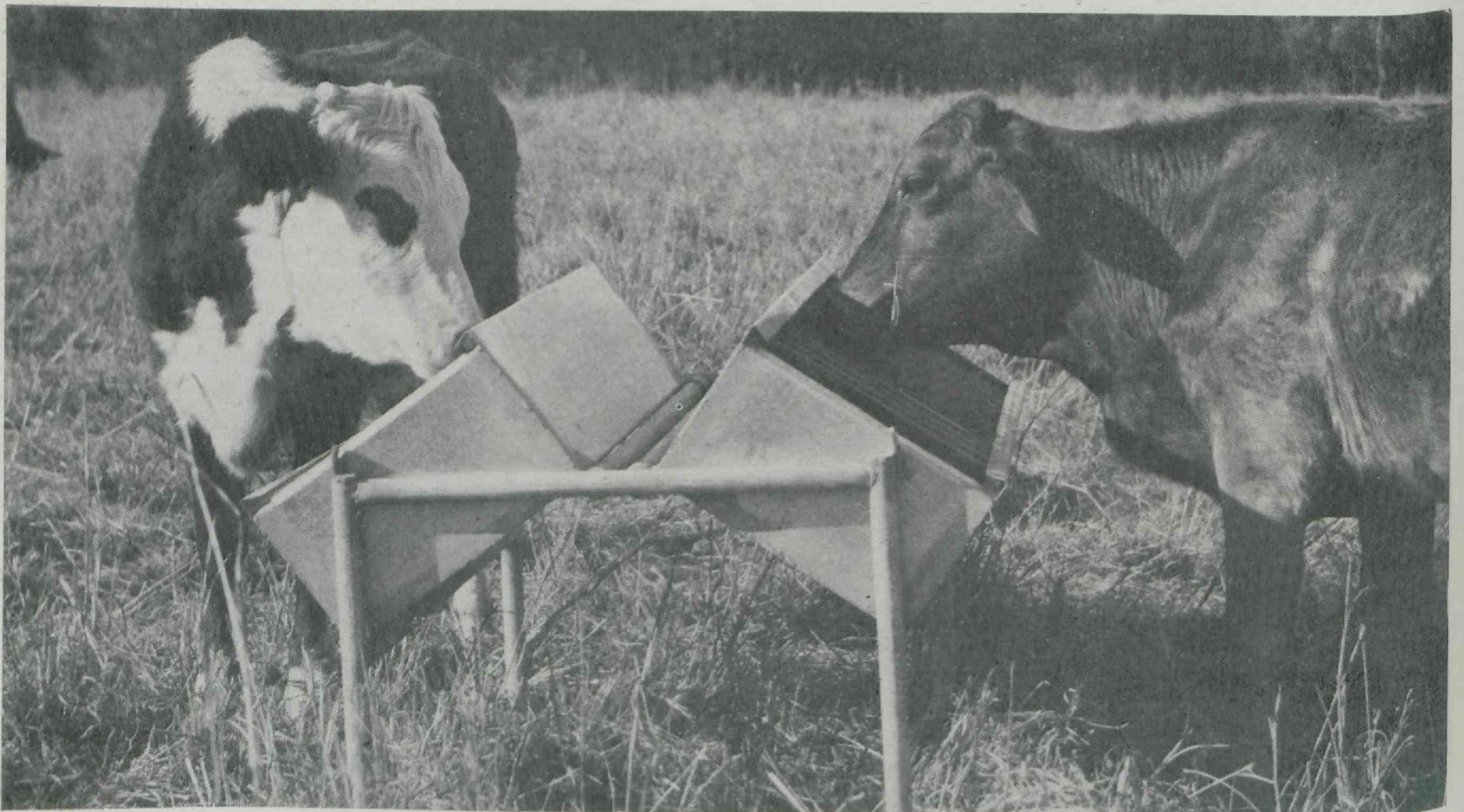
The project partly supported by the Environmental Control Council and involving a number of Branches of the Department to determine the beneficial and pollutant effect of the disposal of beef cattle manure on pasture continued through the year. Manure is spread at monthly intervals on two paddocks and at intervals of 6 months on another two paddocks. The trial has been in progress approximately 20 months.

To date, there has been no significant difference in pasture yield between the treated and control paddocks and no significant change in pasture species. This is possibly because the manure is spread on the surface with no attempt at soil impregnation. Bacterial pollution of the ground and run-off waters with coliforms and salmonella remains at a significant level. Sampling at specific sites indicates that some of the salmonella present in the run-off and ground water may result from pasture contamination from fauna or soil persistence of the organism for at least 2 years from when the pastures were last grazed.

Pollution of the run-off and ground water with organic and inorganic elements remained low but with a gradual increase resulting from either a build up on the surface or decreasing infiltration rate.

An experiment to test the effect of the composting of bovine manure on the survival of salmonellas naturally present in the manure indicated that they survived in spite of the high temperatures being generated within the heap.

Despite the recession in the beef industry, graziers are still interested in supplements. These block-holders are being tested at 'Brian Pastures' Pasture Research Station, Gayndah.





## Laboratory services

### Specimens examined

A major part of the Division's activities is devoted to the examination of specimens by laboratories to support the extension and research officers servicing the livestock industries.

The total batches of specimens examined by Pathology Branch, excluding those received in connection with the Brucellosis and Tuberculosis Eradication Campaign, were 8 069 at the Yeerongpilly Laboratory and 1 624 at the Animal Health Station, Oonoonba. For many years, specimens from cattle have predominated, but this year there was a slight decrease in this category, due to the financial problems of that industry. This decrease was compensated for by an increase in specimens from other species.

A major area of involvement is the examination of samples for livestock intended for export so that the required health certification can be met. This year, 27 300 tests were done. These involve testing for five different serotypes of *Leptospira* and various combinations of 10 other serological tests and include 6 455 tests for contagious bovine pleuropneumonia, which is still required by some importing countries despite Australia's freedom from this disease following the successful eradication campaign.

At the Yeerongpilly Brucellosis and Tuberculosis Laboratory, 371 000 Rose Bengal and 268 000 complement fixation tests were undertaken and 540 cream samples tested for brucellosis. At the Animal Health Station, Oonoonba, the figures were 172 000 Rose Bengal and 58 700 complement fixation tests. Most of these tests were carried out under considerable difficulties in the temporary accommodation before the new laboratory was occupied in May.

Apart from normal services provided to the extension, regulatory and research functions of the Division, the Biochemical laboratory at Yeerongpilly has assisted Entomology Branch with screening of pesticide residues in grains before their use in studies on effective pesticides against stored product pests. Residue analyses in dairy feeds and forage and in a range of waste products from the food industries fed to dairy cattle have been provided for Dairy Field Services Branch. Outside organizations receiving assistance include the University of Queensland, the New South Wales Board of Tick Control for residue analyses, the Queensland Fish Board for mullet taint investigation, the Peanut Marketing Board for the mycotoxin certification of export peanuts, and the Inter-Departmental Committee on Chemical Contaminants in Food for the cadmium levels in seven varieties of commercial fish.

A total of 850 field samples was analysed for a wide range of toxic substances by the Biochemistry Branch. A wide range of clinical tests was undertaken on biological samples, including blood, liver, urine and calculi, in support of field investigations of animal disorders (2 740 samples) and in Departmental research programs (6 205 samples).

Analyses for defining and monitoring of food quality in connection with grazing or pen experiments on research stations or on private properties numbered 3 680. Increasing costs have necessitated a review of analytical services available in ruminant nutrition. Services to individual producers have been confined to analyses associated with suspected clinical disorders. This restriction was adopted in favour of a regional approach to problem solving through the acquisitions of data applicable to a wider range of producers. The implementation of this program is deferred while awaiting a national decision on the adoption of uniform expressions of energy value and on methods for their estimation.

Demands on the dip analytical service have declined slightly; 2 722 samples being analysed for the year. The decline reflects the depressed state of the beef industry and the withdrawal of the principal chemical used in dips with mixed acaricides.

### Method development

One of the areas of concern in the central performance testing of pigs is that there has apparently been an increase in the incidence of pale soft exudative pork (P.S.E.) and porcine stress syndrome (P.S.S.) in Europe particularly in the Landrace and Pietrain breeds where selection for high lean content of carcasses has been undertaken intensively. As these conditions either lead to transport deaths due to stress or to poor curing of carcasses for bacon, it is important to monitor their incidence in pigs undergoing testing because the potential influence of highly rated performance tested boars in Queensland herds is high.

It has been shown overseas that there is a close correlation between the results of anaesthesia with helothane gas for 5 minutes and P.S.E. and P.S.S. Pigs that react to the test develop a syndrome called malignant hyperthermia in which temperature rises, rigidity of muscles occurs and death results if the anaesthetic is not removed.

This test has now been introduced for use in the Boar Performance Test Station at Rocklea and in breeding research. To date, three reactions have been observed in boars undergoing testing, but none has been detected in boars used in the Hermitage and Biloela Research Station breeding programs.

Observations on muscle colour and pH testing of muscle were begun on boars being slaughtered from the Test Station at Rocklea.

The occurrence of *Babesia equi*, a blood parasite of horses new to Australia, resulted in a demand for a diagnostic test to test sera from imported and in contact horses. Expertise of Pathology Branch staff in the study of babesiosis of cattle enabled an indirect fluorescent antibody test to be developed and applied quickly. Tests were also undertaken for other States and the reagents produced in Queensland were provided for use by laboratories in other States.

Services to the pig industry were extended to include methods for detecting parvovirus and its antibody. These viruses cause mummification and mortality in litters.



Part of the herd at 'Swan's Lagoon' Cattle Field Research Station, Millaroo. Cattle from this herd are used in investigations into all aspects of beef production in the tropics.



# Division of Plant Industry

POLICY and programs in the Division of Plant Industry are designed to achieve improvements in crop and pasture productivity. The Division's broad objectives are yield increase and quality improvement consistent with cost containment and conservation or improvement in soil fertility.

An ancillary role is the continuing search for new crops and new species which may add diversity to an already diverse agriculture.

The Division's functions are principally research and extension. It is, however, involved in the administration of regulations concerned with crop protection.

Officers of the Division provide a service to other State Departments and to organizations and the private sector, servicing agriculture and to users of agricultural products. They provide advice to home gardeners and the rapidly growing cut-flower industry and to nurserymen.

The Director of Horticulture Branch is also Chief Plant Quarantine Officer for Queensland and, as agent for the Commonwealth Minister for Health, administers plant quarantine in this State.

The Division's objectives are pursued in the two major production Branches—Agriculture Branch and Horticulture Branch, supported by specialist groups in Plant Pathology Branch, Entomology Branch, Agricultural Chemistry Branch and Botany Branch.

The Division of Plant Industry is responsible for the administration of three research units, supported by industry or Commonwealth-industry funds.

THE QUEENSLAND WHEAT RESEARCH INSTITUTE, Toowoomba, is financed by contributions from the Australian Wheat Research Council and the Queensland Wheat Research Committee. The State Government provided \$45 000 towards operating costs in 1976-77, and pays most of the salaries.

The wheat breeding program has provided the State's growers with yet another new variety, Cook, a quick maturing

variety and companion variety to the now widely accepted mid season variety Oxley.

'BRIAN PASTURES', PASTURE RESEARCH STATION, Gayndah, is an Australian Meat Board research centre. Program objectives are concerned with improved beef productivity and studies are in areas of nutrition and husbandry. Staff salaries and running costs are met by the Queensland Government.

SOUTHEDGE TOBACCO RESEARCH STATION, Mareeba is financed by the Tobacco Industry Trust Account, with some salary commitments being met by the Queensland Government. Progress has been made with the development of disease resistant varieties. A new variety Deb 73, will be proposed for release for south-east Queensland in 1978.

Disease resistance has been incorporated into maize and grain sorghum varieties.

A new bean variety, Redlands Pioneer, has been selected for increased tolerance of cold conditions and suitability for mechanical harvesting.

Mechanization for the planting and harvesting of fruit and vegetable crops is being fostered with some considerable success.

The outstanding extension effort of the year has been the virtual elimination of herbicide spray drift damage to susceptible crops in the cotton growing districts on the Darling Downs. It was a program in which farmers, farmers' organizations, the aerial operators and Department of Primary Industries' staff worked in harmony and in understanding and to their mutual benefit.

## Agriculture Branch

IN broad terms, Agriculture Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in the State through a combined research and extension program.

The extraordinary diversity of Queensland's agricultural environment necessitates major plant breeding effort in wheat, barley, sorghum, maize, sunflower, soybeans, tobacco and cotton to seek superior local adaptation and disease resistance. Significant selection programs are also applied to varietal improvement in forage oats, linseed, safflower, peanuts, rice, navy and mung beans, potatoes, sweet potatoes and onions. Exploratory work is assessing the potential for such new crops as gram (*Cicer arietinum*), sesame, lupins and cassava.

Soil fertility and weed problems are also diverse and Branch research encompasses tillage practice, plant nutrition, fertilizer technology, crop and pasture rotation systems and weed control. Irrigation developments require specialized technical servicing.

The pasture research program seeks principles to guide balanced use of our natural grazing lands with emphasis on the mulga, Mitchell grass, blue grass and bunch spear grass communities. Improvement of animal production from natural grasslands is pursued through legume selection and introduction to extensive grazing lands in the humid eastern sector 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 important but more basic studies undertaken by C.S.I.R.O. and Universities.

To provide a continuum in the service to industries, communities and farmers, the Branch maintains a widely deployed extension staff skilled in promoting the application of crop and pasture technology. This is a particularly demanding activity which has to blend profit motives with a conservative treatment of natural resources. Extension services maintain effective liaison with all agricultural industries, and in this way identify problems to ensure a proper orientation for research activities.

### Pasture research

#### Seed production studies

Seed production studies are based at Gympie and Walkamin Research Station.

Narok setaria, a valued, vigorous winter grass with poor seeding characteristics has been found to require at least 150 kg of nitrogen (N) per ha per crop for reasonable seed

yields. Header harvesting of seed of this crop only recovers 40 to 60% of the total potential seed crop present at any one time.

Seed production of *Paspalum plicatulum* and 'Bambatsi', *Panicum coloratum* has been studied at Gympie. Rodds Bay and Bryan cultivars of plicatulum produce higher seed yields than Hartley due mainly to differences in inflorescence size rather than density.

With Bambatsi panic 100 to 150 kg N per ha per crop was identified as the optimum level of fertilizer with N increasing tiller fertility and inflorescence density, stimulating secondary tillering and hastening crop maturity.

In far northern Queensland, greater effort is being put into grass seed production. Studies on the efficiency of header harvesting have shown that efficiency increases with seed size. The differences in efficiency of recovery of ripe seed can be explained in terms of the different physical forces to which spikelets differing sevenfold in mass are subjected during threshing.

The extreme immaturity of tropical grass seed crops at harvest makes them particularly vulnerable to post harvest mishandling. Overheating and accumulation of waste gases occur if harvested bulk remains unventilated. Oxygen is rapidly depleted and carbon dioxide levels become excessive within an hour of harvest. Temperatures have risen to lethal levels (60°C) in less than 10 hours. With ventilation, seed benefits from slow drying. Rapid drying is not immediately fatal but greatly impairs subsequent germinability.

Control of flowering in Siratro has been further studied. Heavy irrigation in the dry season gives rise to vegetative rather than floral development and the initiation of floral buds ceases temporarily. There is some evidence that bud abortion occurs. The development of flowers is also retarded and seed ripening delayed.

*Stylosanthes viscosa* will produce more than 1 000 kg per ha seed but headers often extract only 100 kg per ha. The use of desiccant chemicals such as reglone and grammoxone have improved header efficiency giving higher seed yields.

Safari Kenya white clover is a promising new *Trifolium* species with tropical adaptation in higher rainfall areas. Commercial seed of this plant has proved difficult to harvest. Plots defoliated in February and April failed to produce autumn seed crops and vigorous regrowth produced a deep vegetative canopy with few flowers. By grazing until June and July a rain-grown crop of 470 kg per ha and an irrigated one of 1 000 kg per ha have been produced in early spring.





A 3-year-old stand of *Nandi setaria*, *Siratro* and *lucerne*.

*Desmodium heterophyllum*, an excellent companion legume for pangola on the wet coast, is also under investigation. It also appears to flower best under marginal moisture conditions but to date seed set has been poor.

### Dry tropics pastures

Considerable progress has been made in the search for legumes capable of improving the nutrition of cattle under the extensive conditions of the region. 'Verano' (*S. hamata*) and 'Seca' (*S. scabra*) have now been released and the former is already complementing Townsville stylo.

Of the newer material, lines from a 1970 Departmental collection and the 1972 C.S.I.R.O. collection are under study from Walkamin Research Station. The *Stylosanthes* continue to dominate these trials but lines of *Centrosema pascuorum*, *C. brazilianum* and *Canavalia* sp. are also giving high yields in rows and small swards. Some *Vigna*, *Macrotyloma Atylosia*, *Alysicarpus* and *Zornia* lines are surviving at a range of sites under severe field conditions which include fire and bandicoot attacks on tuberous rooted material.

The search for new grasses is increasing and nurseries have now been established at Southedge, Boomerang, Merluna and Kalinga. Persistence of this material has been poorer than that of the legumes.

Simple methods of pasture establishment are also under study and, at Kalinga, the effects of timber treatment with picloram/2,4,5-T and of fertilizers, have been studied with *Stylosanthes* and *Urochloa bolbodes* mixtures. Timber treatment and high fertilizer gave the highest end of season legume yields (2 086 kg per ha). Legume yields with low fertilizer input and no timber treatment were 560 kg per ha. All legumes were readily established with the lower fertilizer input (100 kg per ha superphosphate).

Sulphur has been identified as an important factor in growth and persistence of a number of *Stylosanthes* on the red basaltic soils of the Boomerang-Meadowbank area, 20 to 40 kg per ha per annum appearing the necessary level. Small residual effects are obtained from 20 kg per ha S as gypsum and elemental sulphur has been an inefficient source of S in the year of application compared to gypsum.

At Meadowbank, cattle grazing a range of *Stylosanthes* spp. in strips or a paddock of *S. guianensis* (CPI-40255) have performed poorly over the dry season, despite high presentation yields of legume. In 1975, cattle gained weight faster on native pasture between June and December. In

1976, all cattle lost weight from May to September at 0.31 kg per day on native pasture, 0.23 kg per day on *S. guianensis* and 0.53 kg per day on the mixed stylos. This has been a most disappointing result and reasons are presently being sought.

Work on the 'sandy forest' Mayvale Land System between Normanton and Croydon has also shown the *Stylosanthes scabra* lines and 'Verano' to be superior legumes. They have established readily with limited fertilizer but rarely with none at all. The *S. scabras* are providing forage well into the dry season but Verano loses all leaf from ungrazed stands early in the dry.

### Pasture studies in central Queensland

Preliminary studies with the *Stylosanthes* species have continued in this region and with the recent run of wetter summers good growth has been obtained on a number of situations including brigalow soils, especially the duplex brigalow-Dawson gum soils. It remains to be seen whether this promising performance is a function of the recent wetter years or whether in fact the new genotypes such as *S. hamata*, *S. scabra* and *S. viscosa* are better adapted to these soils.

*S. guianensis* 40255 has shown considerable promise in the higher rainfall country north and south of Mackay and 'Verano' and *S. scabra* have also performed well. The *scabra* lines on the whole appear to be able to withstand frost and mild fires.

On the wetter part of the Mackay coast, a search has begun for legumes able to persist under the wet conditions that develop on the solodic soils. Plants showing initial promise include *Aeschynomene americana* and lines of *Centrosema pubescens*.

### Pasture studies at 'Brian Pastures' and Isis

At the Isis Experimental Site in the drier northern wallum, a herd of 31 breeders is being run at 1 beast per 1.1 ha on fully sown fertilized pasture based on Siratro, *Lotononis bainesii*, Narok setaria and Bryan plicatum. Following an 84% calving in 1975-76 summer, 96% of the breeders had conceived again by May 1976.

The weaner calves which weighed 190 kg per head gained 123, 143 and 158 kg per head on similar pastures grazed at 0.6, 0.8 and 1.0 head per ha respectively from May 1976 to April 1977.





Buffel grass pasture in brigalow country.

At 'Brian Pastures', a series of breeding and growing-finishing systems has been devised, based on past research, and are being installed on various areas of the station. The first of these systems to become operational is an intensive beef production one in which 6 to 9-month old weaner steers (Hereford x  $\frac{3}{4}$  Sahiwal) are grazed in sequence on 25 ha sown pasture (green panic plus 125 kg per ha urea), 25 ha forage crop and 60 ha of native pastures (containing 6 ha leucaena). Total liveweight gain per animal in 1975-76 was 217 kg with variable degrees of finish. This has been improved early in the 1976-77 cycle by reducing the initial stocking rate on sown pastures from 2.5 beasts per ha to 2 beasts per ha and applying the nitrogen fertilizer in October instead of December.

That an input of adequate quantities of high quality protein into animals grazing poorer quality grasses can lead to excellent liveweight gains has also been seen at 'Brian Pastures' this year, where a grazing trial has been operating for some years on a predominantly Natal grass (*Rhynchospora repens*)-Oxley fine stem stylo pasture. From April 1971 to June 1976, the weaner Hereford steers have gained an average 188 kg per head per year. In 1975-76 this figure reached 200 kg per head for the year.

Fine stemmed stylo has been restricted in its adaptation to the lighter textured granite soils in the Burnett region but there is promise that some of the newer species of *Stylosanthes* may have value on the heavier textured basaltic soils which also occur on 'Brian Pastures'. Fourteen lines established well, maintained green leaf through a cold winter and yielded up to 6 200 kg per ha (CPI 40255 *S. guianensis*) and 5 724 kg per ha (CPI 40205 *S. scaba*). All lines were making good crown regrowth by late spring.

### Lucerne studies

At Biloela and Brigalow Research Station, it is becoming clear that several factors influence the persistence of lucerne. By October 1976 at Biloela, in a trial planted in January 1974, 46% of Hunter River plants, 79% of Siro Peruvian and 73% of Walkabout had died and these losses were similar irrespective of water regime and competition from green panic. Plant deaths have been due to high soil temperatures and to *Colletotrichum* crown rot.

At Brigalow Research Station, a further series of plantings was made in June 1975 on a cracking brigalow clay, a loamy duplex and a softwood scrub duplex soil. Serious stand losses were associated with heavy December rain. Flooding damage was essentially responsible, but the picture is confounded by the presence of *Rhizoctonia solanii* in the survivors in proportions which relate to the losses incurred.

Medic lines planted at both stations in 1973 continue to persist with negligible growth in the dry 1976 winter. Commercial *M. truncatula* lines are outstanding with good performance also from some unreleased South Australian lines.

### Pasture studies in the wet tropics

The major work on the wet tropical coast revolves around the fitting of present technology into farming systems and ensuring that fertilizer strategies are adequate.

Monitoring of fertilizer applications on a number of commercial properties reveals that at least 300 kg superphosphate every second year is required to maintain available soil P levels and pasture vigour over 4 years. Potassium change has been surprisingly small but, where superphosphate has not regularly been reapplied, pasture decline has been

dramatic and previously good pastures are now very low in legumes, high in weeds and of very low carrying capacity. Inaccuracy of commercial fertilizer application has been considerable.

Johnstone hetero (*Desmodium heterophyllum*) has proved superior to possible alternatives in the species *D. adscendens* and in the Ingham-Kennedy areas. Common centro, Belalto centro, Cook stylo and Johnstone hetero have out-performed possible alternative species.

### Productivity and stability of semi-arid grazing lands

Monitoring of the exclosures and transects in western Queensland continued with bench mark sites on cracking clays being recorded. These sites showed an increase in the proportion of perennial grasses due to favourable seasons. *Aristida latifolia*, an undesirable grass, has shown the greatest increase—to 30% of total at one site near Blackall. The associated forb species have declined.

Measurements of summer productivity on several mulga grassland sites over 4 years have enabled the development of range assessment criteria. These assessments can provide an estimate of the production potential in relation to summer rainfall.

The net primary production of Mitchell (*Astrelba* spp.) grasslands has been measured. Maximum productivity rates recorded were 30 and 1 kg per ha per day in summer and winter respectively. After 6 weeks' growth, pasture dry matter yields recorded were 1 200 kg per ha and 50 kg per ha in summer and winter respectively.

This distinct seasonal pattern of pasture production highlights the importance of the summer growing period in providing forage for grazing animals in *Astrelba* grasslands. Therefore, management decisions on the stock numbers that can be safely carried over a 12-month period are best made at the end of summer based on the standing forage available at that time.

### Management studies on semi-arid pastures

Pasture and animal responses of wethers grazing a buffel grass pasture near Blackall have now been measured for 9 years.

Above average rainfall over the last 3 years has raised the productivity (wool and body weights) of sheep in the heaviest stocked treatments of 0.2 ha per sheep, to the same level as the two lightest stocked treatments. In the drier initial years of the project, it was necessary to hand feed sheep for survival in the former treatment. The recuperative ability of buffel grass has also been demonstrated. Without change in stocking rate (0.2 ha per sheep) basal cover has increased from the low of 2.10% in 1972 and 8.07% in 1976. Slight increases have also occurred in the lightly stocked treatments.

At Toorak Sheep Field Research Station, 30 steers have grazed a 32 ha paddock of Mitchell grass for 6 consecutive years over the dormant winter spring period. The Mitchell grass tussocks are continuing to break up into numerous small parts, with an apparent reduction in basal area compared with an adjacent leniently-grazed paddock. Flinders grass has increased dramatically in the treatment paddock while feathertop (*Aristida latifolia*) has shown an equally dramatic decline.

Heavy grazing in the dormant period followed by spelling during the wet has not resulted in complete destruction of the Mitchell grass plants. Above average wet seasons over the last 3 years have strongly influenced Mitchell grass recovery





Timber regrowth is a major pasture problem to the depressed beef industry.

At 'Burenda', Augathella, a medium term grazing study, begun in April 1975, aims at establishing parameters essential for the long-term biological and financial stability of grazed semi-arid grassland communities.

Above average summer rainfall at the trial site (500 mm) was reflected in the annual stocking rate; the stocking rate at the heaviest utilization level was maintained for the entire year.

A feature in all treatments has been the increase in frequency of *Dichanthium sericeum* associated with the wet year. Litter production increased with the utilization level being dependent on both standing crop and grazing pressure. Litter production at the heaviest level was 35% greater than at medium levels. A litter bag decomposition study indicated that the time taken for 50% of this grassland herbage to decay was around 12 months. Assuming values of 0.17% P and 1.30% N to hold for the maintenance requirements of a sheep, values in excess of these were recorded for green tissue of all species.

Nutrient concentrations of forbs were much greater than for grasses. Standing dead material of all species was well below the above standards. Gross calorific values showed little variation between species (grass, forbs, legumes) and values recorded were around 4 kcal per g.

The influence of rainfall on stability of Mitchell grass pastures is generally considered to be of much greater importance than the influence of stocking, provided stocking is not excessive. In dry years, the proportion of Mitchell grass in these pastures has been known to decline through overstocking. In the first year of a study near Blackall, basal area and foliage cover decreased as percentage utilization increased. This influenced the proportion of forbs in the pasture. Though fewer forb species were present at the heavily grazed sites, their yield was considerably higher than in the lightly grazed paddocks. Forb yields ranged from 100 kg per ha under light grazing to 950 kg per ha where grazing was heaviest.

At Toorak Field Station, Julia Creek, there appears to be no advantage from irrigating Mitchell grass over winter. To obtain a response, defoliation before irrigation is necessary. A maximum yield of 1 300 kg per ha followed slashing in April, fertilizing with 50 kg per ha N and two irrigations. A noticeable feature was the complete lack of response from annual species.

### Plant Introduction and species evaluation on mulga soils

The work includes initial nursery evaluation and seed build up and sward evaluation on representative soil types throughout south-western Queensland. Recent emphasis has been on the ability of the most promising introduced species to spread under field conditions. Volunteer seedlings are developing from *Eragrostis chloromelas* C.P.I. 30374, *Schmidtia bulbosa* Q10092, *Cenchrus ciliaris* Q10077, *E. curvula* C.P.I. 33944 and *S. bulbosa* C.P.I. 43715.

These species, as well as *Antheophora pubescens* C.P.I. 43713, *C. ciliaris* Q10087, *C. ciliaris* cv. Biloela, *E. curvula* C.P.I. 30379, have been established in 0.5 ha paddocks for evaluation under sheep grazing.

### White spear grass in Mitchell grasslands

A project to examine some of the factors influencing the population changes of white spear grass (*Aristida leptopoda*) in the Mitchell (*Astrebla* spp.) grasslands of western Queensland has commenced.

In a controlled environment study, growth rate of both species increased with temperature up to 30°C and then declined. The results suggest that *Astrebla* has a competitive advantage over *Aristida* at high temperatures only, and that the time of year at which rainfall occurs should be an important factor controlling composition of these two species in degraded Mitchell grasslands.

### Studies on annual medics

Medics are the only major alternative legume to lucerne for large areas of southern inland Queensland. They have considerable potential as source of grazing protein and organic nitrogen. Research is directed at understanding how medics react to the subtropical climate, assessing their potential value, and finding ways to improve their performance. It is now possible to predict their phasic development patterns from field temperature records and this is being evaluated over a wide geographic range. Roma and Gayndah produced slightly earlier maturity in medics than Warwick. At Biloela, being warmer, medic maturity is considerably earlier.

### Temperate species

A range of temperate pasture species has been under study in attempts to find the best adapted to local conditions and to fit these into the farming systems. Safari clover (*Trifolium semipilosum*) has given erratic results. An attempt is now being made to survey all plantings of this cultivar in Queensland to identify factors needed for success. Of the normal white clover cultivars, Haifa and Louisiana have been the most consistent lines, Haifa in particular giving good winter-spring growth.

A range of temperate grasses is being examined with some emphasis on ryegrasses for high density nitrogen fertilized plantings. Manawa, Tama, Paroa and Kangaroo Valley all performed well at Dayboro in 1976 with 7 000 kg per ha the top yield. Saia oats gave the highest yield at the first harvest but failed subsequently.

Under irrigation at Gatton, *Phalaris tuberosa* cv. Sirocco has yielded 24 800 kg per ha over 36 months compared with 23 800 kg per ha from Narok setaria, 23 500 from Whittet kikuyu and 23 300 kg per ha from Alta fescue. A range of promising new phalaris lines is under study and greater seedling vigour and summer yields than Australian phalaris are evident in a number of lines.

Of the temperate grasses under study on the high rainfall sector of the Darling Downs, Demeter fescue and Sirocco phalaris have been the most productive during autumn and winter respectively and cocksfoot and prairie grass generally low yielding. Application of 100 kg per ha N in autumn has doubled winter yields but planting of Jemalong medic has had little effect.



## Plant nutrition

Emphasis has been placed on maintenance nutrition of established pastures and a series of co-operative trials with C.S.I.R.O. on the residual effect of molybdenum (Mo) were completed during the years. Differences in Mo requirements by differing legumes were evident with *Lotononis* least responsive and Tinaroo glycine most responsive. The use of 100 g per ha of Mo as either trioxide or sodium molybdate every 3 to 5 years is required for Siratro, a less responsive plant, on deficient soils.

On soils of low phosphorus status, field responses to phosphate fertilization in both the establishment and subsequent years have been erratic. There is now substantial evidence that phosphate fertilization for maintenance of Siratro and *Stylosanthes*-based pastures can be reduced considerably without detriment to pasture growth or composition.

By closing areas of tropical pastures based on *Narok setaria* in autumn and fertilizing with nitrogen useful quantities of reasonably high protein feed can be carried through well into the winter. Application of 50 kg per ha N increased yields at Mt. Mee by 117% and 100 kg per ha N by a further 49%. The mean production for 3 years from the earliest closing time (March) and highest rate of nitrogen (100 kg per ha N) was 7 340 kg per ha available for grazing in June and July. Later closing gave good yields into August. Autumn rainfall has had little effect on these yields but winter rainfall can be important.

Of five grasses under study since 1972 near Toowoomba, *Bothriochloa insculpta* yielded 11 000 kg per ha in 1975-76 against 5 400 for Pioneer Rhodes grass, 6 400 for Pollock makarikari, 5 100 for angleton grass and 8 100 for Silk forage sorghum. *Bothriochloa* was most responsive to high nitrogen but was low yielding at nil nitrogen.

## Grass establishment on black earths

Testing of grasses for ease and reliability of establishment on the heavy black clays has been continued. Five plantings of equal numbers of pure live seed gave mean plants per m<sup>2</sup> of 13.5 for *Bothriochloa insculpta*, 62.9 for *Setaria porphyrantha*, 1.3 for Pioneer Rhodes, 7.8 for Bambatsi makarikari and 3.4 for Biloela buffel. *S. porphyrantha* gave the highest establishment density in all five sowings and is showing considerable promise.

## Irrigated pastures on the Burdekin

Pangola grass has proved the highest yielding grass under irrigation at Millaroo on the heavy intractable clays. Dry matter yields and livestock performance however are poorer than those recorded on a better soil type at Parada in earlier years. Greatest gains of liveweight per hectare have been 865 kg over 295 days at the highest N rate (675 kg per ha) at five steers per ha.

Studies in soil disturbance have shown improved pangola growth from simple harrowing of the pasture following fertilization but a slight reduction in growth when lightly disced. Double disking caused a severe growth reduction.

## Agronomy research

### Wheat

The crossbred, UQ 7401 from the Queensland Wheat Research Institute was named as the variety Cook in May 1977 and, at the same time, the State Wheat Board released 85 tonnes of seed to growers. Cook is a quick-maturing variety with high yield, disease resistance and outstanding grain quality.

The early release of the variety to growers was made possible by the co-operation now operating for wheat improvement in Queensland. This involves, on the one hand, the disciplines of plant breeding, plant pathology and cereal chemistry in the development and selection of genotypes and a co-ordinated program of field and laboratory testing to establish their value to all sections of the industry. The State Wheat Board co-operates by ensuring that an adequate seed supply is on hand by the time the variety is named and released.

Oxley, the mid season variety, also developed at the Queensland Wheat Research Institute, proved popular with growers in 1976. Despite widespread ear tipping, it gave excellent yields. However, a race of stem rust virulent on Oxley was found in late-planted crops and urgent attention is being given to developing replacement mid season varieties.

The variety Cook (2.63 t per ha) performed best in the quick maturing section of the Queensland Wheat Variety Trials which included five advanced crossbreds and six commercial varieties. Performance of commercial varieties in the 16 trial comparison was as follows: Kite 2.58 t per ha, Songlen 2.43 t, Gatcher 2.28 t, Mendos 2.23 t, Timgalen 2.21 t, and Spica 2.19 t.

In the mid season section of the Queensland Wheat Variety Trials, six successful trials were conducted, all in southern Queensland. Of the four entries, Oxley (2.66 t per ha) produced the highest yield, two crossbreds yielded 2.57 t and 2.27 t respectively, while Timson yielded 2.21 t.

Commercial use of fertilizer on wheat in the Central Highlands and on the Western Darling Downs and Maranoa has been placed on a sounder footing as a result of soil fertility research conducted during the period 1974 to 1976. Recommendations can now be based on first hand experience with fertilizers in these regions.

Queensland Wheat Research Institute, local Department and Consolidated Fertilizer Sales Pty. Ltd. staff have been involved in this large co-operative program. Thirty-three trials were conducted in the Central Highlands and 27 on the Western Darling Downs and Maranoa.

Soils potentially responsive to phosphate fertilizer in these regions can be identified by soil analysis with a high level of success (80%). Rates of phosphate fertilizer between 5 and 20 kg per ha of P are appropriate. Similar economic increases in grain yield can be gained by applying phosphate in both wet and dry seasons, and the best rate of fertilizer may even be higher in dry seasons.

Economic responses to nitrogen fertilizer are obtainable in the Central Highlands. A soil test can assist (success rate approximately 60%) in identifying soils which may respond to fertilizer, by eliminating non-responsive sites. Nitrogen rates not exceeding 30 kg per ha are recommended for the Central Highlands region where its application is warranted by soil test or by cropping history. Nitrogen fertilizer is not recommended for wheat in the Western Downs or Maranoa regions. Generally, soils in this region have been found to contain large quantities of nitrate nitrogen at planting. However, even where the nitrate level is low at planting, soils in this region have failed to respond to nitrogen fertilizer.

### Barley

The superior yielding ability of the feed barleys, Lara (3.01 t per ha) and Corvette (2.97 t), over the standard malting variety, Clipper (2.68 t), was maintained in the 1976 regional testing program which involved eight varieties in six trials. Over 3 years of testing, Lara and Corvette have each outyielded Clipper by 17%.

For the first time, selections derived from the Queensland barley breeding program were included in the strain trial series in 1976. The best selection, a Bussell x Zephyr cross, outyielded Clipper by 37% and Corvette by 16%. This, along with other promising selections, will undergo malting evaluation at the new micro-malting unit established at the Queensland Wheat Research Institute.

*Wide-row sorghum, band-sprayed with Atrazine before inter-row cultivation.*





## Sorghum

The breeding programs aim at releasing useful parental material to commercial breeders. These programs are centred on Hermitage and Biloela Research Stations.

The hybrid Q5161 is susceptible to sugarcane mosaic virus and a program has been conducted to produce a virus resistant version of the male parent. This virus resistant male parent should be at the release stage later this year. In addition to virus resistance, the line will have good resistance to rust, leaf blight and grey leaf spot. Hybrids produced by this male line will have a more open head than the current Q5161 which will be an aid in insect control.

A program to introduce midge resistance is in the initial stages. It has been established that some lines do have true resistance and the heritability of midge resistance is being studied.

Emphasis in the breeding programs is being switched from the traditional pedigree, backcross, single seed descent method to population breeding. The method has been used advantageously in the Department's maize breeding program and an impressive genetic advance has recently been demonstrated using this technique in sorghum in the U.S.A.

A study of the effects of inter-row cultivation and weed competition on yields of grain sorghum was carried out at Biloela Research Station. It was shown that cultivation in itself did not affect sorghum grain yield but weed growth did.

In April 1977, shattering type sorghum plants were detected in hybrid sorghum trial plots at Biloela and Capella.

Shattercane causes a serious weed problem in parts of the U.S.A. as a result of the seed-shattering characteristic and high inherent dormancy in the seed.

It was established that the seed of the experimental hybrid had been produced in the Burdekin area. A survey of this area by a botanist and two sorghum breeders disclosed that a number of wild *Sorghum* spp. exist in the area including *Sorghum verticilliflorum*, *S. almum*, *S. bicolor* hybrids, *S. laxiflorum*, *S. almum x halepense*, *S. nitidum* var. *aristatum*, and *S. plumosum*. Shattering occurred in most of these species, particularly *S. verticilliflorum*, which has the same base chromosome number as the commercial *S. bicolor*. Crossing would, therefore, occur readily between commercial sorghums and at least some of the wild types.

A survey of crops grown from commercial seed produced in the Burdekin area was, therefore, undertaken. It is obvious that the shattering characteristic has been distributed over a fairly wide area in commercial seed and control approaches for 1977-78 summer are being planned.

## Maize

Hybrid varietal testing has been continued at a number of sites in south and north Queensland. The DeKalb hybrid XL81, which has been very popular with growers for a number of years, continues to show up well in trials. However, a number of experimental lines from the commercial seed companies are showing equal or superior yielding ability to XL81.

Mid maturing hybrids from the Department's breeding program have undergone preliminary testing at southern sites. Ear height, period to flowering and yield compare favourably with the commercial hybrids. Indications are that two or three more cycles of improvement in the mid maturing populations will generate hybrids competitive with current commercial hybrids.

In the northern tableland area, where the Department's maize breeding program is centred, the tropical type hybrids from the breeding program are outstanding. The hybrid QK487, which was released last year, is not only resistant to head smut (*Sphacelotheca reiliana*) but is producing higher yields than the current commercial varieties QK217 and QK231.

The sweet corn single cross, KSC467, was released to southern Queensland sweet corn growers for commercial evaluation during the 1976-77 season.

A study of plant populations was carried out in north Queensland with six cultivars last season. Populations of 40 000 and 50 000 plants per hectare gave significantly higher yields than 30 000 and 60 000 plants per hectare. Stalk lodging tended to increase as plant population increased.

In a variety and time of planting trial in the Lockyer Valley, good yields were obtained in August, September and October plantings but not in the December planting. August and September plantings were relatively free of disease. Wallaby ear and stalk rots were present in the October planting and were very severe in the December planting.

## Soybean

The soybean breeding program is centred at Hermitage Research Station.

Inbred lines are produced using the single seed descent method. Rapid turnover of generations is achieved by using a daylight control box in summer and the glasshouse in

winter. While yield is the main criterion used for making selections, other agronomic characters such as resistance to disease, lodging and seed shattering are important.

A population breeding program has been commenced based on 17 parents. The objective is to produce populations of inbred lines with much larger genetic variation.

Regional variety testing was very successful in the 1975-76 season with 27 trials being harvested. For climatic reasons, the trials on the Darling Downs and in the West Moreton were planted late. This affected the yields from the new varieties, Collee and Flegler, which are not suited to late planting. Nevertheless, these varieties performed creditably under the circumstances.

Lines from the University of Queensland breeding program are showing considerable promise. The Brazilian variety Cannapolis was the best variety in far north Queensland and performed extremely well in central Queensland.

Soybean nutrition studies on soils in the South Burnett indicate that 25 p.p.m. phosphorus is the threshold value. Yield responses can be expected from phosphorus fertilizers applied to soils with lower soil phosphorus contents.

## Sunflower

The breeding program, centred on Hermitage Research Station, aims at producing rust resistant open-pollinated varieties and parental lines for hybrids. Resistance or tolerance to *Alternaria helianthi* is also being sought.

The first hybrid sunflowers to be marketed in Australia under the name Hysun possessed resistance to rust and this was their only advantage over the open-pollinated varieties. More recent releases of commercial hybrids are showing yield advantages of about 30% over Sunfolia 68-2, the standard open-pollinated variety. These new hybrids possess a well developed field resistance to rust.

*Alternaria helianthi* was a serious disease of sunflower crops last season. No source of resistance to *A. helianthi* is known but a composite population is being screened for tolerance to the disease.

Work is in hand to test the hypothesis that quick maturing cultivars sown at high plant populations in late winter will produce higher yields due to increased water use efficiency. An experiment on the Darling Downs was planted on 3 August at 100 000 plants per hectare and produced a seed yield in excess of 2 000 kg per ha. As good spring rainfall probably was responsible for this yield level, further work is required to confirm the hypothesis.

Processing of data from the sunflower time-of-planting studies continues and relationships are being established between plant development and climatic variance, between soil water usage patterns and their predictability, and between yield-stress indices and both climate and rust incidence. The system being formulated will be used to indicate yield, oil content and oil quality trends from meteorological data.

## Peanuts

The current export market for peanuts is extremely good and the Peanut Marketing Board is encouraging the expansion of peanut growing into other agricultural areas. A peanut breeder has recently been appointed and is developing a breeding program to produce improved varieties for a range of environments.

Fertilizer investigations in peanuts have shown that peanut plants have the ability to derive their phosphorus requirements from dispersed sources in the soil. It is therefore better to apply phosphorus fertilizer to other crops in the rotation which will respond to direct applications.

On soils with low potassium contents, there have been significant responses to applications of potassium fertilizers. This work is now being extended to determine optimum application rates. The nutrient balance between potassium and calcium is significant to peanut quality. Gypsum is superior to lime as a source of calcium.

## Potatoes

The Department participates in an interstate potato evaluation program which is now in its seventh year. The variety Sutton's Foremost looks most promising as a possible variety for Queensland.

The pilot scheme for producing disease-free seed potatoes is now nearing completion. Results indicate that seed potatoes can be produced in Queensland of a standard at least equal to that of certified seed from Victoria and New South Wales.

A project to examine the effect of cool storage on dormancy in seed potatoes has shown that dormant seed potatoes sprout faster after a short period in cool storage. The increase in speed of sprouting, however, is not great enough to compensate for the time spent in the cool store.



In work with plant densities and depth of planting, it has been found possible to grow potatoes without hilling or any other form of inter-row cultivation. The system requires the use of herbicides for weed control and very close plant spacing within the rows. It was also noted that clod formation was greatly reduced by omitting cultivations and this is of considerable assistance at harvest.

### Tobacco

The primary aim of the plant breeding program is to develop varieties with tolerance to blue mould and acceptable performance characteristics in each tobacco district of the State. In addition, breeding and evaluation of varieties with resistance to bacterial wilt, black shank and nematodes are continuing. The blue mould tolerant breeding line 63/73/7 is being considered for commercial release in south-eastern Queensland. This line, however, has some quality defects. Leaf quality appears to be reduced when blue mould tolerance is incorporated in the current breeding lines.

Field trials have shown that mechanical harvesting of tobacco is technically feasible and the resulting labour savings indicate that this method of harvesting is an economic proposition. In conjunction with mechanical harvesting, the value of maleic hydrazide to provide adequate sucker control has been demonstrated.

Other phases of the tobacco agronomy program are directed towards reducing costs of production through modified cultural and fertilizer practices. Varieties are being evaluated for their suitability for early, mid or late season plantings. This program aims at extending the harvesting period so that increased use can be made of tobacco facilities and machinery resulting in reduced capital investment per unit of production. Fertilizer practices are being examined and results to date have shown that both the level and cost of fertilizer application can be reduced without adversely affecting tobacco yield or quality. Cost savings of between \$100 and \$200 per hectare can be achieved by using reduced quantities of fertilizers and by applying straight fertilizers rather than pre-mixed compound fertilizers.

### Navy bean

The problem of supplying bacterial blight free seed to growers has been successfully resolved in co-operation with the Navy Bean Marketing Board. Certified seed is produced in the Burdekin bean seed quarantine area, and this seed is distributed to approved seed growers for growing in isolation from other bean crops. Seed from disease-free crops is distributed to growers throughout the State at reasonable prices.

Two varieties, Actosan and Actolac, were released by the Department last year. Although only small quantities of seed were available last season, the first commercial crops look very promising. Seed has been increased and will be available in quantity for the 1977-78 season.

### Cotton

The development of host plant resistance to *Heliothis* spp. has been pursued in the cotton breeding program.

High and low gossypol lines and the standard variety Deltapine Smoothleaf were included in 1976 trials. In the sprayed trial at Biloela, Deltapine Smoothleaf produced the highest yield and the high gossypol lines the lowest.

In the unsprayed trial at the same centre, the high gossypol lines produced the highest yield and the low gossypol lines the lowest, with Deltapine Smoothleaf giving a medium yield. In the unsprayed trial at Gatton, there was no significant difference between the yields from the high gossypol lines and Deltapine Smoothleaf but the low gossypol lines produced significantly less yield.

Variety trials are conducted in co-operation with the New South Wales Department of Agriculture at five sites in Queensland and four sites in New South Wales. The Deltapine Smoothleaf types have given good mean yields in both States.

### Rice

Over the past decade, research on rice growing has defined the basic cultural practices required for the small but well-established rice growing industry in the lower Burdekin area. A variety evaluation program is being implemented to screen new varieties from southern rice belt of the United States and the International Rice Research Institute in the Philippines.

Bluebonnet 50 has exhibited some severe lodging problems in recent years when wet weather delayed harvest. The variety Starbonnet, of slightly earlier maturity, has shown some resistance to lodging and has been released by the Department as a replacement variety.

Carbutylate has shown up as the most effective chemical for weed control on rice levee banks with bromacil and diuron almost as effective but slightly more mobile in the irrigation water. Each of these formulations can control weeds on rice banks for up to 12 months.



Progress with the safflower crop has been slowed by the new *Alternaria* disease.

### Miscellaneous crops

**SAFFLOWER.** A leaf spot disease, caused by *Alternaria carthami*, was widespread in 1975 and caused severe reductions in yield in badly affected crops. This disease was responsible for a large contraction in the area sown to this crop in 1976.

Safflower varieties and breeders' lines are being introduced from overseas in an attempt to obtain a source of resistance to *Alternaria*. To date, none of the lines screened has resistance but some tolerance has been detected. The progenies from an interspecific cross between *Carthamus oxycantha* and *Carthamus tinctorius* made at the Nimbikai Research Institute in India are reputed to have total resistance to the disease. Seed of this material is being introduced and will be screened after release from quarantine.

**LINSEED.** An experimental program has been conducted over 4 years to determine the requirements of irrigated linseed in the Emerald area.

Late maturing varieties produce their highest yields when planted in early April, mid maturing varieties yield best from late April plantings while early maturing varieties achieve their maximum performance from mid May plantings.

Increasing the plant population above 3.5 million plants per hectare was found to have little effect on yield.

The highest yielding experimental lines tested were Dunes, New River and Zona Buenos Aires. The highest yield, 2 656 kg per ha, came from the variety Dunes. The varieties generally outyielded Glenelg by 200 to 300 kg per ha.

A small breeding program has been carried out in linseed at Hermitage Research Station for a number of years. In recent trials, selections from the crosses Bonnydoon x RR204 and Morocco x Bahmalaki have produced higher yields of seed with higher oil content than the current commercial varieties Bonnydoon and Glenelg.

**ONION.** Variety testing and time-of-planting investigations over a number of years have permitted firm recommendations being made to growers. The local strains of the Early Lockyer Brown and Early Lockyer White varieties give best production if planted in late February or early March. The commercial strains of these varieties, however, give their best yields if planted in late March or in April. For later plantings, in the period May to July, varieties with resistance to downy mildew (*Peronospora destructor*) such as Gladalan Brown or Gladalan White and W100 give the best yields.

**LUPIN.** This winter legume has considerable attraction as a rotation crop with wheat and barley, and as a crop to meet an increasing demand for grain protein. The variety, Ultra, is apparently well adapted to both central and southern Queensland with average yields approximating 2 500 kg per ha in both areas under good moisture conditions.

**TEA.** Most of the information required for successful establishment and maintenance of tea is now available.



A bush management trial has shown that close planting followed by pruning and bending of branches gives a quick cover of tea and more branches. Yield is positively correlated with bush spread and number of branches.

A trial to compare tea first plucked at 1½ years from planting with tea first plucked at 4½ years from planting shows the earlier plucking to be the better system. Earlier yields are obtained and, in later years, yields have not suffered due to the early exploitation.

**CASSAVA.** There is substantial commercial interest in the potential of cassava for stock food, starch and fine chemical production and, in the longer term, for methanol production. Fielders Pty. Ltd. are developing a plantation in the Bundaberg district for starch manufacture.

Cassava investigations in the Lockyer Valley indicate that the growing season is too short to allow proper tuber development. The mean yield obtained from all varieties was only 3 t per ha (fresh tuber weight) with a top yield of 8 t per ha.

Trials in north Queensland, however, have shown that the crop can produce very good yields on some soils. At South Johnstone Research Station, in a trial with CUQ 6 comparing different times of planting, the December planting gave the most vigorous plants and the largest root crop, the highest yield being 100 t per ha (fresh weight). More extensive work is being considered to complement that being undertaken by the University of Queensland. This work will investigate the adaptation and production rhythms of cassava in eastern Queensland.

**GRAIN LEGUMES.** A number of grain legumes are being investigated including cowpea, mung bean, adzuki bean, guar, chickpea, vetch, peas, faba bean, lentils and lathyrus.

It is expected that future farming systems will require the nitrogen fertility benefits of grain legume rotations to offset increasing costs of synthetic nitrogen fertilizers.

### Irrigation

In the lower Burdekin area at the 'Fort Site', work has continued on the potential of several irrigated crops on soil types which would be irrigated if major irrigation expansion were undertaken. In the 1975-76 wet season, bulk crops of rice (yield of 3.35 t per ha) and soybeans (1.17 t per ha) were grown on Koberinga soil while soybeans (1.47 t per ha) and maize (2.75 t per ha) were grown on Dalrymple soil. Yields were generally low due to excessively wet, cloudy conditions, high insect and disease incidence and poor weed control. In the 1976 dry season on the Koberinga soil, Bluebonnet 50 rice yielded 4.71 t per ha, XL81 maize, 3.27 t per ha and sunflower, 1.36 t per ha. On Dalrymple soil the maize averaged 4.37 t, sunflower 1.81 t, and safflower 0.96 t.

Cassava failed to produce adequate tubers on the heavier soils (Oakey and Koberinga), but growth and yield were favourable on the Dalrymple and Levee soils.

Peanuts produced 1976 wet season yields of about 22 000 kg per ha for Red Spanish and 1 500 kg for Virginia Bunch on the Dalrymple soil. Quality assessments indicated a high proportion of edible nuts.

At Emerald, a trial was conducted on irrigated grain sorghum to compare various plant arrangements under furrow irrigation. A 70 to 80 cm gap between individual plant rows is the minimum that can be handled with commercial equipment. At this row spacing an intrarow spacing of 5 cm eliminates tillers and yields of 8 500 kg per ha could be expected from a September planting with optimum fertilizer and water supply. For every increase in the furrow gap of 10 cm, the yield was reduced about 10%. Multiple rows did not offer any great yield advantage and yield is reduced if an equidistant spatial ratio is not maintained.

Studies have also been carried out on the Emerald Irrigation Area with linseed, safflower, soybeans and lupin to assess their potential as rotation crops with cotton, sorghum and wheat.

### Weed control

The Johnson grass (*Sorghum halepense*) control program has been continued. Mowing roadside stands at intervals of 8 weeks from December to May increased the paspalum cover from 5% before commencement of mowing to 35% after 1 year, and to 82% after 2 years. The experimental areas will be monitored for the next 2 years to determine the extent of Johnson grass reinfestation. The use of glyphosate for eradicating Johnson grass in cultivated areas is being investigated.

Chemical control of Parthenium weed (*Parthenium hysterophorus*) in grain sorghum crops on the Central Highlands has been investigated at two sites comparing the post emergence herbicides picloram plus 2,4-D, 2,4-D amine, atrazine and dicamba. Of these atrazine gave excellent knockdown and residual control. Picloram plus 2,4-D and dicamba both gave satisfactory control, with picloram plus 2,4-D giving better residual control. 'Velpar' gave excellent control at rates as low as 0.25 kg a.i. per ha, but at this rate appeared to be affecting sorghum growth adversely.

At this stage, Parthenium weed has not emerged as a major weed problem in cultivation in the Central Highlands.

In navy beans, trifluralin is used commercially and gives satisfactory results. Two other herbicides appear promising, vernolate (a preplant herbicide) and bentazone (a post emergence herbicide).

In intensively cultivated areas, the residual effects of chemical herbicides assume importance. In the South Burnett trifluralin is used for weed control in peanuts and atrazine is used for weed control in maize and sorghum. The crops likely to be damaged by trifluralin are winter cereals following peanuts, soybeans or navy beans, while atrazine is likely to affect legume crops following maize and sorghum for a period up to 18 months, depending on rates of application used. A study is being undertaken to determine the cultural, soil and climatic factors important in accelerating the breakdown of these herbicides.

Over the past 5 years, the weed control programme carried out on the three main crops on the Atherton Tablelands, maize, potatoes and peanuts has provided chemical or mechanical control methods for most situations. The change in weed flora usually observed in all agricultural areas is occurring here, where the tall weeds now controlled, such as apple of Peru (*Nicandra physalodes*) and stinking-Roger (*Tagetes minuta*) have been replaced by weeds such as Johnson Grass and nut grass. The efficacy of chemical herbicides used in similar crops in southern Queensland is lower under Atherton Tableland conditions, probably due to the hotter and wetter conditions.

## Agricultural extension

Farmers, primary producer organizations and local authorities require technical information and managerial advice on crop and pasture production, soil and farm management. Agri-business firms and their representatives are also making increasing demands for assistance of this type. The extension service exists to meet these needs.

The extension officer's role is to link industry with developing technology and to temper this with consideration and concern for the stability of our soil and water resources. With this role, extension officers undertake specific projects emphasizing new problems or techniques, they engage in routine dissemination of information, and they are frequently involved themselves in technical training.

### Branch extension in the State

The extension program on the control of insect pests of stored grain was continued. This program is very long term because of the persistent nature of the problem. Nevertheless, progress is being made. Every primary producer who grows, feeds or stores grain is well aware of the need to control these pests.

Farm machinery and on-farm buildings are the major barrier to effective control through farm hygiene. Many farm machines, headers in particular, are not designed for easy cleaning. Similarly many farm buildings have inaccessible corners, and tongue and groove floors which are almost impossible to clean.

Farmers are being encouraged to design new farm buildings so that they can be readily cleaned and steps have been taken to influence machinery manufacturers to design machinery that can be easily cleaned. This avenue is not promising as much farm machinery is designed in overseas countries where the insect problem is not so important.

The depressed state of the beef industry has again been a major factor influencing extension operations. Many beef producers are diversifying their enterprise, particularly into grain sorghum production.

Despite the limited plant, equipment and capital associated with this diversification, useful crops have been grown and the limits of cultivated agriculture expanded. This expansion of cropping is providing information on the adaptation of cultivars to new environments.

One very useful side-benefit of this expansion in cropping is control of timber regrowth. Cultivation offers permanent control of most woody weed species and in the long term is the most effective method of handling timber regrowth in pastures.

While pasture development in the grazing industries is almost at a standstill, sown pastures continue to make a significant contribution to beef, dairy and wool production. In recognition of the contribution sown pastures have made and will make in the future, the main inservice training activities during the year were two sown pasture workshops.

The first was a *Stylosanthes* symposium held in Townsville. Officers from both the Department and C.S.I.R.O. Davies Laboratory participated in the symposium which reviewed recent developments in research on *Stylosanthes* species evaluation and grazing management. A workshop on developments in lucerne production and management was held at Biloela. The workshop brought together extension and research workers from the Department and also researchers from C.S.I.R.O. at Cunningham Laboratory and Deniliquin.



The role of extension officers is expanding as farming becomes more complex, more technically based and more management oriented. This trend will continue as extension officers move into areas of need not serviced by other governmental instrumentalities.

### North Queensland

The navy bean industry has expanded into the Burdekin irrigation areas. Present navy bean production does not meet Australian demand. Burdekin production widens the geographical base of the industry and, as the crop will be grown in the autumn and winter months under irrigation, should increase the stability of production.

An extension project on tobacco seedbed management in the Mareeba-Dimbulah irrigation area reduced the incidence of blue mould during the seedbed phase of the crop. Other tobacco crop husbandry practices are being applied more rigorously although the efficiency of fungicide and insecticide treatment is low. Extension in this subject area has been less successful because of the shortcomings of conventional spray equipment. Tobacco farmers are loath to buy new equipment during the present tobacco marketing difficulties.

The rice industry in the Mareeba area has expanded from an initial 25 ha in 1975-76 to 250 ha in 1976-77. Yields in 1976-77 are also expected to be about 6 t per ha, an increase of nearly 1 t per ha over 1975-76.

The peanut industry in north Queensland is expanding rapidly. Peanuts are being grown at Mt. Garnet, Mareeba and Lakeland Downs and, as well, the industry is expanding in the traditional area of the Atherton and Evelyn Tablelands.

Because of the number of new growers in the industry a booklet on peanut growing on the Atherton Tableland was produced in conjunction with the Peanut Marketing Board.

The maize and potato industries on the Atherton Tableland are also expanding and the demand for extension service is such that a second officer was appointed to Atherton.

The wet tropic coast from Mossman to Ingham is now being serviced by an extension officer based at Innisfail.

### Capricornia

An extension project to control the rate of spread of *Parthenium* weed has been the major extension activity in this region during the year. The project has required close co-operation with the Department of Lands.

A booklet published jointly with the Sir Alan Fletcher Research Station contains the latest information on *Parthenium* weed and its control. The booklet was released in early March and required a second printing in May.

*Parthenium* weed remains a major pest of disturbed ground and degraded pastures in the Capricornia region. It has not emerged as a major weed in cultivation.

A field day was held at Clermont in early March to discuss all aspects of *Parthenium* weed and its control. Since then, the demand for technical advice has declined markedly.

Grain growing has emerged as a major enterprise in the region and, in 1976-77, the value of grain production in the Capricornia region will probably equal or exceed the value of beef production. Extension officers in the region have concentrated their activities in the grain industries.

One extension project aimed at educating growers to identify the parasites and predators of insect pests so that unnecessary chemical control of insects can be avoided.

However, the highlight of the agricultural scene in the Capricornia region is the successful establishment of a cotton industry in the Emerald Irrigation Area. Some 2 500 ha were grown in 1976-77 compared with 730 ha in 1975-76.

This rapid expansion will continue and an estimated 4 500 ha could be sown at Emerald in 1977-78.

### Burnett and South Burnett

Extension officers are conducting trials to ascertain the adaptation of a wide range of crops on the better drained soils of the wallum. Soybeans, navy beans and sunflowers are summer crops showing promise and lupins look particularly promising among the winter crops.

Lupins are being grown commercially in the 1977 winter in the Maryborough district. Graziers on the wallum soils are looking to diversification as the combination of high fertilizer prices and low beef prices has made beef production uneconomic.

In the Monto district, weeds are becoming a significant production restraint. An extension project aimed at minimizing weed taint in dairy products from the district has been commenced in association with officers of Dairy Division.

Peanut rust is now endemic throughout the peanut areas of the Burnett and South Burnett. Extension activities have stressed the need for regular spray schedules to be maintained if the rust is to be controlled.

Extension officers are also heavily involved with Soil Conservation Branch officers in extending the area of cultivation protected by soil conservation measures. These include crop stubble retention and mulching, reduced tillage and modification to existing farm machinery.

Many of the farming areas of the South Burnett have been cropped continuously for many years. Extension officers are conducting a project to encourage crop rotations. The range of crops grown in the South Burnett is such that crop rotations offer considerable benefits to insect, disease and weed control while also reducing the rate of soil structure loss.

### Near North Coast and Moreton

Extension officers in the dairying areas promote the use of sown pastures. As costs rise, more dairy farmers are recognizing the economics of sown pasture based feeding systems.

Kikuyu grass is becoming a favoured dairy pasture species. When fertilized adequately with nitrogenous fertilizers, milk production from these pastures is high. These summer growing pastures are also being oversown with ryegrass in the autumn and, with fertilizer and irrigation, can provide year-round feed.

The new orange-fleshed sweet potato varieties command a premium on the Brisbane and Melbourne markets. They have not gained acceptance on the Sydney market. Grower interest is high and a field day at Deception Bay in May attracted an attendance of more than 200.

Lantana control is under investigation in the Gatton district in a project being conducted with the Lands Department. Farmer interest in chemical control is high but evidence to date suggests that regrowth will have to be treated. Competition from sown pastures will not control lantana regrowth.

### Darling Downs and Near South-west

A successful extension project to minimize crop damage from herbicide spray drift was conducted in the central Darling Downs. The project was so successful that no crop damage was reported from the central Darling Downs. In 1975-76 some 450 ha of crop damage were reported.

Farmer co-operation was outstanding and landholders have recognized the right of individuals to grow the crops of their choice. The farmers have changed their weed control practices to minimize spray drift to adjoining susceptible crops.

Agricultural pilots, commercial companies and grower organizations such as the Queensland Graingrowers' Association and the South Queensland Cotton Growers' Association all contributed significantly to the success of the project.

A successful project on Johnson grass control was conducted in the Jondaryan Shire with the release of the chemical glyphosate. This chemical, together with appropriate mechanical control methods, offers hope that Johnson grass infestations can be reduced.

The extension project aimed at fostering the development of farming systems in the Crows Nest-Haden areas was continued. This project, which involves the integration of sown pastures and forage crops into new feeding systems, has achieved useful gains in farm production and income. The evolution of these systems is also having an impact on farms in adjacent areas.

The development of high value crops in the irrigation areas continues. Mung beans and navy beans are now an integral part of the cropping systems in the irrigation areas in the Inglewood Shire and the current demand for lucerne hay has rekindled interest in that enterprise.

An Australian plague locust outbreak in the Mt. Abundance district, near Roma, caused considerable damage. Some newly-sown wheat and oats crops were eaten in May despite an intensive spraying campaign by the local Plague Locust Destruction Committee. The area infested is only a small portion of the Roma region, but hatchings in the spring could cause trouble over a wider area.

Crop husbandry practices for reliable summer cropping in the near south-west region are being refined. Appropriate varietal selection, careful timing of planting dates, correct plant populations, adequate weed and insect control all influence the reliability of summer crops such as grain sorghum and sunflowers.

Buffel grass production is declining on many of the lighter soils of the near south-west region, particularly under high grazing pressures. The problem appears to be associated with lower soil fertility and the role of annual medics in building up soil nitrogen as well as the contribution these legumes make to the quality of the feed available is being collated.



## Horticulture Branch

HORTICULTURE Branch is concerned with the production, post harvest handling and processing of fruits and vegetables. Its activities cover also ornamentals, including commercial production of cut flowers and nursery stock, landscaping and the home garden.

Cultural research is centred at five horticultural research stations at Applethorpe (Granite Belt), Ormiston (Redlands), Nambour (Maroochy), Cairns (Kamerunga) and Bowen (Delta), supplemented by field trials in the main producing districts. Post harvest and processing research are carried out at the Sandy Trout Food Preservation Research Laboratory.

The Branch provides extension services in all fruit and vegetable growing districts. These services are integrated on a regional basis under the Extension Services Section. In recent years, Horticulture Branch has collaborated with the Marketing Division in paying increasing attention to post harvest extension, starting with the grower and continuing through the market chain to the consumer. This aims to minimize the losses in quality that can occur at every stage of handling.

Liaison with industry is maintained through six horticultural advisory committees, covering six major crops or groups of crops, and composed of grower and Departmental members.

The Branch also has a substantial regulatory function. It plays a major part in administering the Diseases in Plants Act, and as an agent of the Commonwealth it also administers within the State, the Commonwealth Quarantine Act (Plants).

A further function of the Branch is to supervise the gardens at Government House, the Museum Gardens, Queen's Park and the State Migration Office.

### Research

The major aim of the research program of this Branch is to improve the quality of fruit and vegetables going to the consumer while containing production costs through developing cost and labour saving techniques.

Some emphasis has also been given to the development of potential new crops. This includes the extension of some established crops to new growing areas as well as the assessment of crops that are new to the State.

### Development of new varieties

A new bean variety to be named Redlands New Pioneer has been selected for its increased tolerance of cold conditions. The variety has been tested in major bean growing areas and has been found to outyield standard varieties in most tests. It also has a more concentrated cropping pattern which saves labour in hand harvesting. It also means that the variety is more suited to machine harvesting.

A new tomato cultivar Flora-Dade has been introduced from Florida, and the results of preliminary tests indicate that it has considerable potential. It is a good quality cultivar with resistance to many diseases including *Fusarium* races 1 and 2 and *Verticillium* wilts. Seed has been increased and it will be tested in all major tomato growing areas.

The continuing tomato improvement program at Bowen involves both local breeding and plant introductions. More than 40 lines from various sources, including California and Florida, have been evaluated in comparison with Walter which is the most popular variety. Several show promise and they, together with some new accessions, will be tested next season. Over 30 primitive tomato lines have been collected and are to be screened for possible resistance to the newly recorded disease *Fusarium solani* which presents a considerable threat to the industry.

In a program of plant improvement in papaws, emphasis is being given to both bisexual and dioecious types. Breeding for improved dioecious types is continuing using mass selection with a view to producing high-yielding, good-flavoured fruit, free from ripe fruit rots and incorporating dieback resistance. Considerable amounts of seed from superior types have been released to industry and is being used by growers.

The program with bisexual types is now well advanced and six superior strains are being assessed. These were selected on the basis of production, fruit shape and quality, flavour and a high degree of self-pollination. It is expected that these lines will be more suited to the central districts rather than the cooler southern growing areas of the State.

Several improved peach and nectarine varieties have been introduced from overseas. These have been selected for their low chilling requirement and are expected to have potential in a number of districts other than the Granite Belt. Plants have been propagated and tests established in the Atherton Tableland and Burnett districts.

### Improvements in mechanization

Mechanical harvesting of beans for the fresh market was introduced to the industry this year, and five machines are now in use in the major bean growing areas. The machines are very effective. Damage to pods is minimal and in no way detracts from the fresh market potential. Standard varieties are being used and yields from the once-over harvests are rather low. Tests are in progress to find a suitable variety with a more concentrated cropping pattern. The most promising varieties at this stage are Slenderette and Redlands New Pioneer.

An interested group watches a demonstration of the 'Plug-mix Transplanter'.





The development of the passionfruit harvester prototype at Maroochy Horticultural Research Station has progressed almost to the final stages and the unit is now at the stage where a grower or engineering shop could use the design as basis for a commercial unit.

A modified 'Tee Trellis' system for use in conjunction with the passionfruit harvester has been designed and is under test. This trellis not only facilitates mechanical harvesting, but also allows more plants to be grown per unit area with proportionate yield increases. These investigations are being financially supported by Redlands Industries Pty. Ltd.

A machine to demonstrate the benefits of 'plug-mix planting' has been purchased from a firm in U.S.A. The machine can place in the soil small quantities of a seedbed type mixture into which seed has been previously mixed. This provides a mini seedbed for ideal crop establishment and also has the advantages of controlling weeds and damping off diseases. It is also a useful technique for getting plants established in areas where soil crusting is a problem. The unit is also a good seedling transplanter and is capable of planting on bare soil or through plastic mulch.

The machine has been demonstrated at several field days and has been used in a number of demonstration trials. A local firm has been appointed agent for the unit and so it is now available to Queensland growers.

The 'plug-mix' technique has been tested at Bowen Horticultural Research Station as an aid to direct seeding of tomatoes. It has been found to greatly aid plant establishment and leads to higher yields. An important factor was that root damage under normal transplanting allowed the establishment of root diseases whereas direct seeded plants remained free.

A method for mechanized packing of single bananas was developed and demonstrated some years ago. Following this, Mr K. Lindsay, a banana grower at Caboolture, has designed and built a mechanical dehandler and packing machine for bananas in hands. The dehanding machine is a very significant advance in the banana industry and could lead to mechanization of banana dehanding and packing.

A research project in the Bundaberg district is aimed at producing fresh fruit tomato crops suitable for mechanical harvesting. Although no suitable machine is yet available, it is considered that, by improving some cultural systems, its development and later integration in the industry will be facilitated. Uniformity is the key to success in growing crops for mechanical harvesting and emphasis is being given to improving methods of crop establishment, selecting varieties, determining optimum plant densities and investigating growth regulators to control flowering times and plant size. Some of the findings are being used by growers to minimize hand harvesting costs.

### Potential new industries

The potential of guava as a commercial crop is being investigated and preliminary results are very promising. This crop is well adapted to local conditions and grows naturally on a wide range of soils. Most of the material being tested was introduced from Hawaii as seedlings and is being selected for suitability under local conditions.

Techniques involving the use of urea sprays have been used to concentrate the flowering and fruiting period and this has enabled fruit fly to be economically controlled by spraying. Some of the 2-year-old plants produced up to 500 fruit weighing a total of 40 kg. Perhaps the greatest potential for the fruit is for processing and techniques are being developed for the production of frozen or preserved quarters, nectar, juice, jam and jelly.

Interest in Kiwi fruit is still growing. It is becoming apparent that the near inland areas are more suited to this crop than the warmer coastal environments. Trials are being established with several varieties in a number of areas and arrangements are being made to introduce newer varieties from New Zealand.

The pecan is showing promise as a nut of high quality that can be grown in some areas in Queensland. A number of varieties is currently under test and a survey is being made to determine potentially suitable areas. Arrangements are being made to introduce further promising varieties from overseas.

Avocado and mango varieties are being evaluated at Walkamin as potential alternate crops for the Atherton Tableland. The fruiting season of several mango varieties is later than the main Bowen production and this offers the possibility of extending the rather short season for this fruit. Fuerte and Rincom avacados matured at least 1 month ahead of those in southern districts and other varieties are expected to show similar patterns.

While Queensland is a leading State in the production of most processed vegetables, the production of tomatoes for processing is very small, with the major national industry being centred in southern States. It is a large industry and some local production would be of benefit to both producers and processors. However, most attempts to produce the crop have not been successful.

Studies are being made of possible causes of quality problems in seed produced by the Queensland bean seed industry. The white-seeded processing varieties appear to be most susceptible to problems and selections are being made to produce varieties with smaller, rounder seed and with generally less seed production problems.

A survey has shown that cutting and threshing operations are often being carried out when seed moisture is too low, thus making the seed more susceptible to damage. Tests have shown that the cleaning procedures also often damage seed leading to a further loss in germination percentage. Engineers are now involved in this work to redesign harvesting and threshing equipment to handle the crop with minimum damage.

The decline of mandarin varieties on rough lemon rootstocks is now clearly evident in trials that were established in 1960. The major varieties, Hickson, Ellendale and Glen Retreat, are included in the trial. The rootstocks Parramatta sweet orange, Emperor mandarin and Cleopatra mandarin are showing up as equally suitable for each variety.

### Banana irrigation

A series of investigations has been carried out on the water requirements of bananas in north Queensland. Where plants suffer water stress, there is a reduction in bunch weight, involving fewer hands and fewer fingers, and an increase in time to maturity. A field trial using trickle irrigation has shown that, where supplementary irrigation is supplied to meet the needs of the plant, yield increases of up to 500 cartons per hectare are obtained.

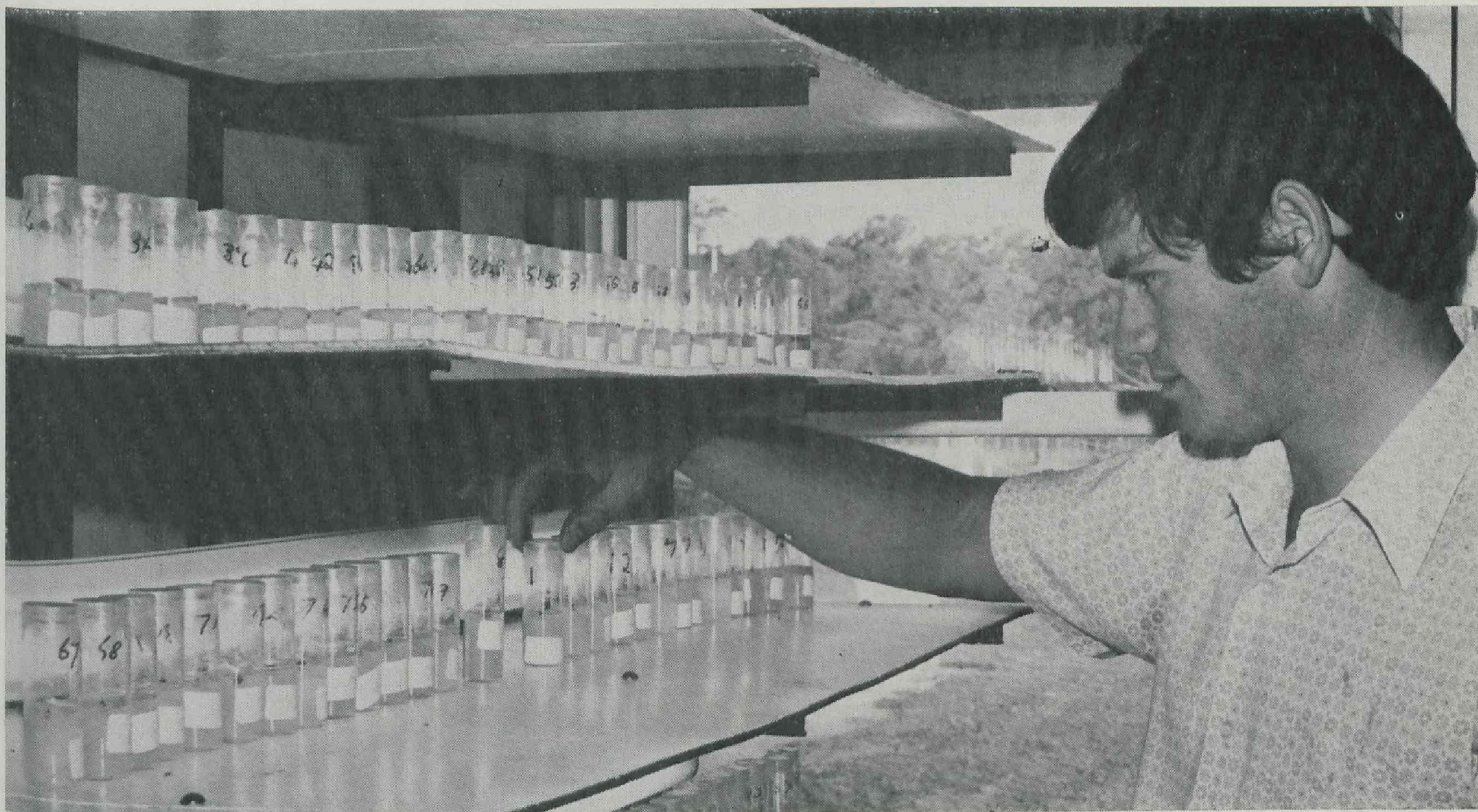
Close spacing in bananas has resulted in higher yields. However, to achieve this, greater care in plantation management is required. Selection of top quality planting material, together with proper soil preparation, is important if uniform growth is to be achieved since retarded plants are smothered. Plantings at high density also require efficient irrigation. Leaf spot control was not impeded by high density plantings.

The removal of unwanted banana suckers is a labour-intensive job for banana growers. Recent tests have shown that, if suckers are treated before they reach 1 m in height, they can be killed by an application of 2,4-D amine without depressing the yield of the parent plant or affecting fruit quality.

*Bananas respond to irrigation with greater bunch weight and more hands.*







Fruit crops are being propagated by tissue culture.

### Vegetables for processing

The production of baby carrots for both the fresh and the processing markets is a major industry in south-east Queensland, and a series of trials has been carried out to find the seeding rates required to give high yields of carrots of the required size. It has been found that best yields are obtained when seed is used at 8 kg per ha. At this rate, the roots are found to hold at an acceptable size even if harvesting is delayed.

Zinc deficiency continues to be a major problem in the production of beans for processing in the Lockyer Valley. However, trial work has led to a better understanding of the problem and the development of some satisfactory control measures. It has been found that moderate deficiencies can be corrected by four foliar spray applications. Soil applications are usually required for more severe deficiencies. However, it has been found that, where soil temperatures at 15 cm depth are below 20°C, zinc deficiencies are severe. It is now recommended that planting be delayed until soil temperatures rise above this level.

### Reducing citrus tree size

All citrus rootstocks in current use produce large trees which are expensive to harvest. Two trials have been designed to assess the effect under Queensland conditions of a recently developed dwarfing technique. It involves inoculating trees on Troyer citrange stock with strains of exocortis viroid which dwarf the tree without adverse effect on fruit size and quality.

The problem of large tree size is also important in the mango industry as it leads to low productivity and high labour costs. The rootstocks varieties Sabre and Willard are reported to have dwarfing characteristics and these have been introduced into Queensland for testing.

### Tissue culture

Tissue culture is currently stimulating much commercial interest in Australia as a method of plant propagation. Studies are being made to develop techniques of meristem culture for some major Queensland crops. Strawberry clones from which mild yellow edge virus has been eliminated by tissue culture have given significantly higher yields in recent field testing. These improved plants are being introduced to the industry through the Strawberry Runner Approval Scheme.

A major aspect of the meristem work is concerned with the removal of woodiness virus from passionfruit. The culture of tissue of this crop is proving to be very difficult and a systematic approach to determining the balance of nutrients, and growth substances required for growth is in progress. Other crops in which tissue culture might have application are avocado, mango, pineapple and rhubarb. Preliminary studies are being made to develop techniques for these.

### Ornamentals

Investigations are being made into the potential of supplementary lighting for producing gladioli in winter. Overseas results have shown that, under the conditions of short winter days, the length of spike and the number of florets are reduced. This is also aggravated by planting corms at high densities. The use of low intensity continuous incandescent light offers considerable potential for economically improving the yields and quality of winter blooms.

The range of flower crops grown in Queensland has been rather limited but, if the industry develops as it has done in many other countries, there will be a demand for a wider range of species.

With this in mind, a program has been started to determine the suitability of a number of popular overseas species. These include *Strelitzia*, *Anigozanthus* and *Gypsophilla*. The native Christmas bell (*Blandfordia*) would also appear to have potential and has been included in the tests.

### Storage and transport

Studies over several seasons have shown that the Ellendale mandarins have a better out-turn from long-term storage when a temperature of 3°C is used rather than 7°C and more lately 5°C, which temperatures are used for exporting fruit. These results have now been accepted by industry and, in the coming season, a carriage temperature of 4°C will be used up to the end of June and then 3°C for the remainder of the season.

The need to have fruit cooled to the carriage temperature before loading into containers has been well demonstrated. Techniques of forced air cooling are being developed for citrus so that fruit can be brought more quickly from field temperature to the carriage temperature.

Trials conducted over the past few years have shown that a 10 p.p.m. gibberellic acid spray at the time of colour break was beneficial in delaying senescence of Ellendale fruit during storage and export. This treatment was put to commercial test in the 1976 export season. Ellendale fruit given this treatment was assessed on export market by growers and export officers. All agreed that the fruit out-turned in superior condition to untreated fruit.

An investigation aimed at determining the optimum temperature and maximum storage life for processing unripe Kensington Pride mangoes has been completed. Results show the optimum storage temperature to be 12°C and that 2 weeks' storage can be achieved without flesh recovery falling below commercially acceptable levels.



## Distribution of fruit and vegetables

There is a need for a more effective maturity standard for mangoes to ensure that only fruit of acceptable quality are offered to consumers. A investigation of several potential standard tests has been made and it has been found that '% total solids' is the most suitable. In a market survey carried out to test this standard, it was found that peak and late season fruit were of excellent quality, but much of the early fruit was too immature.

The returnable plastic crate that was developed over many years has now been on the market for more than a year. In that time, tests have confirmed its technical performance, but its general incorporation into the fruit and vegetable distribution system has not eventuated. This is no doubt associated with the lack of a national crate hire system. Twenty thousand crates are in use in closed circuit situations in the State and are performing very well.

## Extension

Once again there has been a very heavy demand for the services of horticultural extension officers in all districts this year. This has been accentuated, particularly in coastal areas, by the fact that appreciable numbers of properties have been changing hands, and the new owners are usually not familiar with horticultural crops.

A major project in the Granite Belt involving a study of the viability of the apple industry was initiated in October last year. The overall objective is to investigate and extend methods by which the net return being obtained by Stanthorpe apple growers can be improved.

The project began with a series of press articles and radio talks indicating methods by which orchard efficiency and market strategy could be improved on the basis of present knowledge. Several meetings have been held to discuss specific aspects of the subject and grower attendance has been good.

On the basis of research findings, efforts are being made to improve the handling and storage techniques for Delicious apples held in controlled atmosphere storage. The efficiency of the distribution system from the farm to the Brisbane Markets has also been the subject of investigation.

The promotion of high density apply planting is being actively pursued in the Granite Belt since it is considered that this is one of the main methods by which production costs can be reduced.

During the past year, the first crop was harvested and, with the assistance of Economic Services Branch, costs and returns have been calculated for apple close planting. Using an average price of \$3.50 a case and an average yield of 2 500 cases per hectare, the gross margin for apple close planting was \$1 438 per ha compared with \$19 per ha for wide spacing with a yield of 700 cases per hectare. The variable costs for close planting were \$2.92 per case while for wide spacing these costs were \$3.47 per case.

Efficient use of irrigation is another aspect of the overall program and three growers who installed under-tree irrigation systems throughout their orchards have been able, because of the dry conditions last summer, to pay off the costs of the systems in one season. During the year, publicity in the

form of published articles and demonstrations has been used to impress upon growers the considerable advantages which follow the use of irrigation.

As an adjunct to improving soil management, herbicide observation plots were established on the Granite Belt Horticultural Research Station and on three commercial orchards in the district. The results are being published and it is hoped that this information will be of considerable assistance in persuading growers to discontinue soil cultivation practices which can result in considerable damage to the root systems of the trees.

The Deciduous Fruit Handbook Part 2, which covers all aspects of deciduous crop protection, was published again this year and met with a very enthusiastic reception by all growers.

This publication provides the latest recommendations for the control of pests and diseases based on research findings, and also covers weed control in deciduous orchards and vineyards. A comprehensive pest and disease control spraying program is provided for each of the major crops. Since its initial publication some years ago this handbook has become the most important extension publication in the Granite Belt.

In the South Moreton District, the major importance of annual crops and the considerable expansion in floriculture which has occurred has imposed a sizeable commitment on extension officers in regard to both individual grower and industry problems.

Two issues of the South Moreton Digest were published during the year, and in each case some 1 500 copies were distributed to growers. This publication has become an important medium for the transmission of up-to-date extension material within the district.

A number of field days, seminars, workshops and group discussions has been held in the South Moreton District during the year, covering practically all the major aspects of horticultural crop production.

A prototype machine which has been developed in association with the Engineering Section for the accurate fertilizing of vegetable crops has been widely demonstrated. It permits much greater flexibility and accuracy of placement in the application of straight fertilizers, and also eliminates the cost of making commercial mixtures.

The 'plug mix' seeder and planter, imported from America during the year has been the subject of an extension drive, initially in the South Moreton but later in other districts. There has been considerable grower interest in many parts of the State and for this reason a demonstration program covering all districts in rotation has been developed.

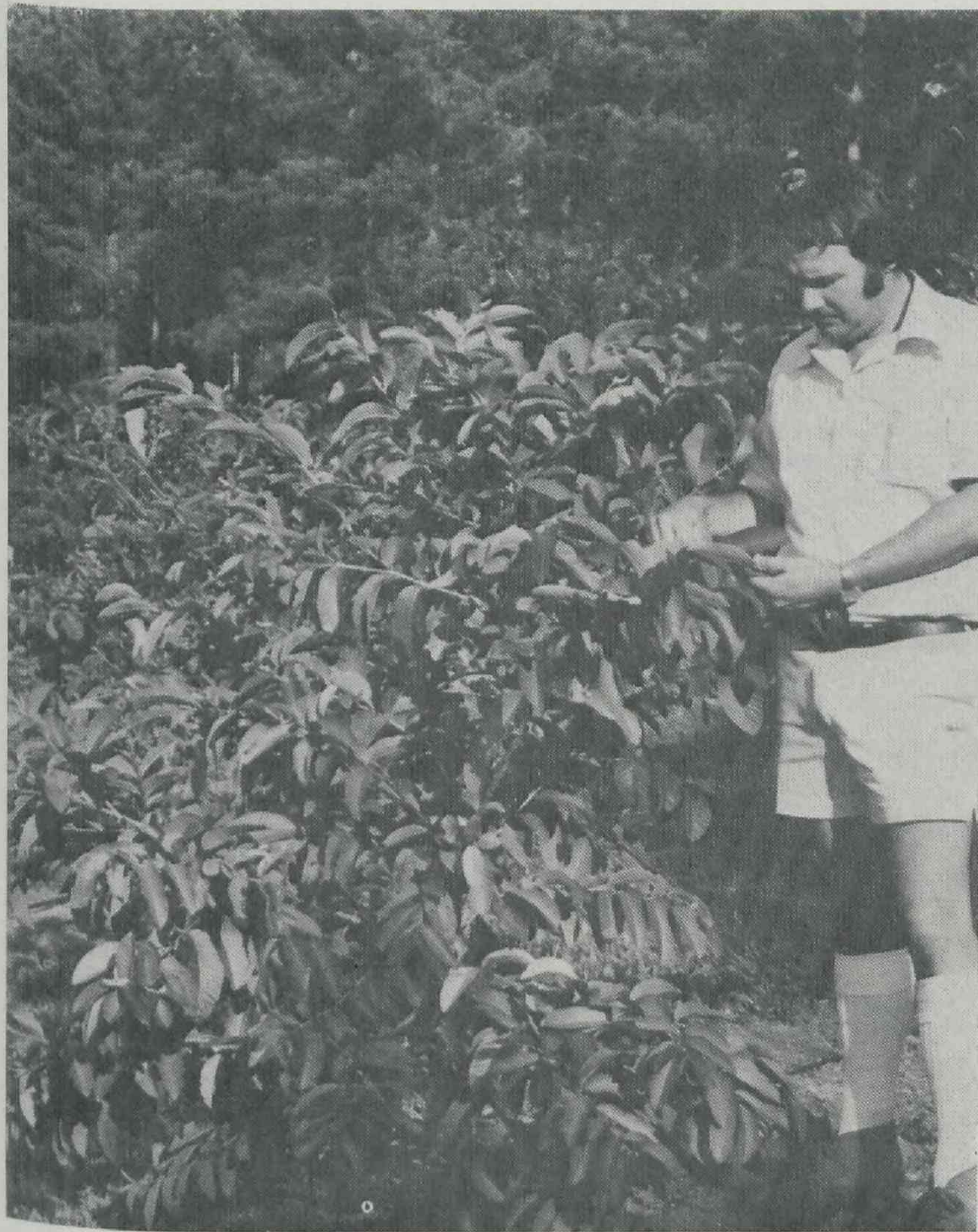
In the North Moreton District there has been increasing interest in the production of cut flowers and a sizeable export trade in gladioli has been developed in New Zealand and other States.

In this area also, appreciable numbers of properties are changing hands thereby requiring greater attention from extension officers because of the lack of horticultural knowledge by the new owner. There appears to be a slight swing from pineapple production, although it is still the major crop, to the establishment of tree crops and, to a lesser extent, small crops.

*Developments in machinery for horticultural producers were demonstrated at field days.*







*The potential of the guava as a commercial crop is being investigated.*

One of the major extension projects in the North Moreton District is the investigation of alternative horticultural crops. Guava and Chinese Gooseberry (Kiwi fruit) have received some attention. However with the latter it has become evident during the past year that if this crop is to be successful the vines will require winter chilling in order to ensure that a reasonable fruit set occurs. It is not yet possible to indicate the yields which may be expected here or the market potential. At the present time, only limited quantities of this fruit are imported from New Zealand and these appear to sell fairly readily.

There is an increasing interest in grape culture in the district, possibly as a result of the influx of new growers from the south and an overall greater interest in wine production. New grape varieties have been introduced in an attempt to provide a degree of disease tolerance. In the first year of growth, three of these introductions have shown good tolerance to both downy and powdery mildews.

Following on previous work carried out at the Redlands Horticultural Research Station in connection with the vibration packaging of bananas in singles, a grower in the Caboolture area has developed a machine to dehand bananas. A special field day was arranged on this property and this was attended by some 200 growers from as far afield as Coffs Harbour and Babinda.

In association with the dehanding machine, the grower has also developed improved packing and handling techniques based very largely on Departmental findings. All growers were very impressed with the speed of the dehanding machine and its ease of operation. There appears to be little likelihood of damage to the fruit, and the development is seen as a significant advance in the industry.

With the increasing importance of the Kingaroy District for horticultural crop production, an extension officer was stationed there to provide assistance to present and future growers. This is a fairly large district and appears to have considerable potential for producing a wide range of horticultural crops. The main limiting factor appears to be the lack of suitable water for irrigation.

*Banana grower Mr K. Lindsay, of Caboolture, demonstrates a banana dehanding machine which he designed and built.*





A project to investigate horticultural production efficiency in the Gympie area has indicated the necessity for growers to consider mechanization of vegetable crops and to adopt aids to improving quality such as pre-cooling if they are to improve or even maintain their present returns. While present trends indicate that overall vegetable production is increasing, it is evident that there is a need to educate the many new growers, and to promote diversification of crops as a means of stabilizing production and prices.

In the Burnett District, two issues of the Citrus Bulletin were again published this year and distributed to all Queensland citrus growers. A total of 23 articles was included. The indications are that the Citrus Bulletin has become a very popular and highly esteemed publication, and very favourable comment continues to be received from many growers.

Another publication prepared by extension staff at the Gayndah office is the Citrus Orchard Spray Programme booklet which is printed each year. This contains the latest information on pest, disease and weed control.

Following the results obtained from successful trials using gibberellic acid as a pre-harvest treatment on Ellendale mandarins to extend and improve their storage life, an extension program has been developed to promote the use of this material by all growers of export Ellendales. At this stage, every grower interested in exporting Ellendales has indicated his intention of using this treatment, but it will not be possible to evaluate the results until the end of the export season.

As in other districts, there is appreciable interest in diversification of cropping in the Burnett. Trees of eight peach cultivars which have low chilling requirements have been planted in selected locations for observation. In addition, plots of promising new grape varieties have been established, and it is planned to assess the prospects for mango and litchi production.

One of the main features of the extension program in the Bundaberg area has been a drive to impress upon growers the advantages of pre-cooling and cold storage of produce. So far, the results appear promising and increasing numbers of growers are becoming convinced of the necessity to install these facilities.

The major horticultural crop in the Bowen area is still tomatoes, and this year the production exceeded 2 million 10 kg containers. This was 30% greater than last year's production in spite of the fact that November storm rains resulted in an estimated loss of some 300 000 containers.

This increased production has imposed a greater burden on the local extension staff. It appears at present that the most important problem facing the Bowen tomato industry is the increasing incidence of fusarium foot rot, and there are very few farms in the Delta area where this disease is not present in significant proportions. The most practicable immediate solution is to bring new areas into production and this is the underlying reason for the expansion of tomato production in the Mount Dangar and Duck Creek areas.

In view of the problems which have occurred in recent years over the quality of French bean seed produced in the Burdekin, surveys have been carried out in an effort to determine at which stages in the production chain improvements are required. It has been found that one of the basic causes of the low quality in some seed lines has been that cutting and harvesting has been carried out at moisture levels which are too low, resulting in mechanical damage to the seed.

It has also been found that the conditions under which the seed is subsequently stored are often far from optimum and these, coupled with the damage already sustained in the harvesting operations, have undoubtedly accentuated the overall problem. During the past year, an investigation was carried out into complaints regarding the performance of Queensland bean seed in Tasmania and here, again, it was found that faulty harvesting and storage techniques were mainly to blame.

An intensive extension drive has been launched in the Burdekin in an endeavour to make all growers and seed merchants aware of the problems, and assistance is being given to enable them to develop improved harvesting and storage techniques.

Diversification of horticultural crops is also an important extension project in the wet tropics. On the Atherton Tableland, emphasis is being placed on the development of avocado production and grower interest at present is high. Observation plots have been established with avocados, litchis, mangoes and custard apples. In addition, a wine grape observation plot has been established at Kalunga.

In the Innisfail area, a considerable extension effort has been directed towards assisting growers to rehabilitate banana plantations which were seriously damaged by the cyclone earlier this year and the following severe flooding. In some instances individual plantations were almost completely destroyed necessitating replanting, resulting in a shortage of planting material.

There is some interest in this area in the development of avocado production, and some growers have embarked on cut-flower production with mixed success. However, the indica-

tions are that the major horticultural crop will continue to be the banana, although it may be some 6 to 8 months before full production is resumed.

## Servicing activities

### Marketing Extension Service

This service has continued during the past year and appears to be very favourably received by most growers. The general procedure is for information to be channelled back to the field officers in the districts from which produce originated in cases where it is considered that improvements in packaging or presentation could be effected. The extension officers then endeavour to assist the growers concerned to improve their techniques.

It is very difficult to assess the results being achieved with this marketing extension service but, from discussions with some of the market agents, it appears that improvements in consignments from many growers have been observed.

### Citrus Budwood and Seed Distribution Scheme

This scheme, which has been in operation since 1931, involves a considerable time commitment on the part of extension staff, particularly those centred at Gayndah.

A total of 103 775 citrus buds was supplied to 14 nurserymen this year. Seed supplied for growing citrus rootstocks amounted to approximately 70 kg.

In an endeavour to enable nurserymen in future to become self-sufficient in citrus seed for rootstock production, trees of selected strains of rough lemon, Cleopatra mandarin and Troyer citrange were supplied to nine nurserymen during the year. It is estimated that these trees should provide sufficient fruit to satisfy the seed requirements within about 6 years. Trees of selected bud lines of sweet orange rootstock will be supplied during the coming spring.

### Strawberry Runner Scheme

The main objective of this scheme, which has now been in operation since 1963, is to provide commercial strawberry growers each year with high quality, true-to-type planting material as free from the major virus and other diseases and pests as possible.

As a result of the generally high prices which growers received for strawberries in 1976, there was increased interest in plantings for 1977 and this resulted in orders being received for Special runners totalling about 1.4 million. Unfortunately, as a result of circumstances beyond our control, it was not possible to fulfil all of these orders but more than 1 million runners were supplied.

### Bean Seed Scheme

Bean seed produced under this scheme is grown almost exclusively in the Burdekin and Bowen areas. For the fourth successive year, production in the Burdekin has declined and in 1976 the area under crop was only 574 ha. This is a little more than half the area planted in the previous year. There are a number of possible reasons for this reduction, including reduced processing requirements, quality problems and increased imports.

## Regulatory

### Plant quarantine

Administration of the Commonwealth Quarantine Act, in so far as it applies to plants and plant products, continues to be a substantial commitment of this Branch.

It involves two somewhat distinct operations, one being the surveillance of passengers and cargo entering the State from overseas by sea and by air, and the other the supervision of plant introduction. The main purpose of this surveillance is to minimize the risk of some serious pest or disease of plants or plant products, or any serious weed species from entering this country. It necessitates inspectional services at all points of entry, the main ones being Brisbane, Townsville, Cairns, Gladstone and Port Alma.

While every effort is made to prevent the entry of pests, diseases and weeds, from time to time one of these may pass through the quarantine barrier and become established here. To deal with such a contingency, a Consultative Committee on Exotic Pests, Diseases and Weeds was set up in 1976-77 to operate from Commonwealth level under the Plant Quarantine Act. This Committee which includes the Chief Plant Quarantine Officer for the State, together with the senior specialist officer appropriate to the outbreak, saw its first operation in Queensland in April when the Giant African Snail was found to be established at Gordonvale.

Active measures were at once initiated to contain and eradicate this pest, and wide publicity was mounted to enlist public assistance in the detection of any spread from the above centre. The operation is continuing, and prospects of complete eradication appear good.



Two further exotic pests have been reported in Queensland for the first time this year. They are the spotted lucerne aphid (*Therioaphis trifolii*) and the blue green lucerne aphid (*Acrythosiphon kondoi*). The former was found to be present in four States. The latter is fairly widespread in south-eastern Queensland and is believed to be present also in New South Wales. Because of their wide distribution, it is unlikely that these pests can be eradicated, and other ways of coping with them are being studied. Their method of entry into Australia is not known.

The continuing risk of entry of exotic fruit flies through the Torres Strait islands is recognized and Plant Quarantine staff were again active throughout the year in the periodic monitoring of a selection of these islands together with the areas of Weipa and Bamaga.

The level of traffic subject to Quarantine supervision was similar to that for 1975-76 except that there was more timber. The increase in timber imports noted in 1975-76 continued and some 93 000 cubic metres were imported in 1976-77 compared with 73 000 in 1975-76.

The following brief selection indicates the volume of traffic under supervision during the year—

Total number of passengers by sea and air ..	151 000
Miscellaneous packages .. .. .	325 200
Packages treated following inspection .. ..	136 500
Containers from overseas .. .. .	27 400
Timber in cubic metres .. .. .	93 000
Timber—quantity treated under Quarantine direction	43 000
Number of incoming consignments of plants ..	290
Consignments of plants released from quarantine	203
Official forms issued during the year	15 800

## 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 decentralised basis from Branch headquarters at Indooroopilly, five field stations in southern Queensland, and three each in central and north Queensland.

### Major issues

#### Locusts

During recent years, the major locust threat to agricultural production in Queensland has come from two species, the migratory locust (*Locusta migratoria*) and the spur-throated locust (*Austracris guttulosa*). A recession in activity of the migratory locust has occurred and this pest was of no importance during the past year.

During the winter, resident populations of the spur-throated locust (*Austracris guttulosa*) consisted only of scattered individuals with little apparent likelihood of a major outbreak occurring. However, the situation changed with a heavy influx of spur-throated locusts from western and north-western regions into the Central Highlands during November.

The inflow populations of flying adults are believed to have originated on the Barkly Tableland in the Northern Territory and to have migrated to the Central Highlands over a period of approximately 3 days, under the influence of north-westerly winds. All areas of the Central Highlands and the Arcadia Valley were invaded.

#### Plants for interstate movement

During the past year, there has been an increase in the numbers of nurseries registered in Queensland, and associated with this there has been a considerable increase in the volume of plants being consigned interstate. In particular, this traffic has been directed towards indoor ornamentals, and is expected to expand.

#### Banana Industry Protection Board

There has been virtually no change in the size of the banana industry over the past year. The total number of growers is 1 122 and the area under crop is a little over 2 800 ha. The Northern Banana Quarantine Area still remains free from bunchy top, and the incidence of this disease in the Buffer Banana Quarantine Area has been reduced to a very low level. Unfortunately, however, bunchy top continues to be a problem in many districts within the Southern Banana Quarantine Area, although no new outbreaks have occurred during the year.

During the year, in spite of economies which have been effected, it was necessary to increase the levy payable by growers on Queensland-produced bananas by some 15%. The indications are that a further increase next year may become necessary to offset the continually rising costs.

New legislation was gazetted early in 1977 aimed at assisting inspectors to obtain eradication of neglected plantations in which bunchy top has not been recorded. This legislation specified levels of leaf spot infection and when plants exceed these an inspector is empowered to order their eradication.

In spite of these problems, however, it appears that the numbers of bunchy top-infected plants have remained at a fairly constant level and there is little variation from year to year. It seems that, under our present inspectional system, the disease is being held under control at a relatively low level but there is little prospect of reducing this level to any extent.

Although the initial adult population was only a fraction of those recorded in some previous years, the excellent breeding conditions resulted in a proportionately greater population increase, and control measures were required to protect summer grain crops.

A similar outbreak situation occurred in the Theodore district. Those locusts that escaped insecticide treatment dispersed as they matured and the outbreak entered a recession phase by mid April. Spur-throated locusts were not a problem in other areas.

Concurrent with the spur-throated locust outbreak, widespread populations of the Australian plague locust (*Chortoicetes terminifera*) appeared in central-western and south-western regions during December with the development of fledgling swarms in the far south-west.

Extensive breeding and concentration of Australian plague locusts in the wake of Cyclone Ted was a feature in these regions and numerous hopper bands and fledgling swarms were active over much of central and southern Queensland during late summer and autumn.

Crops in the Maranoa district of south Queensland, particularly in the Mount Abundance area, were the target for significant infestations of the pest. Development of the outbreak continued with some overflow of Australian plague locust populations into western Darling Downs areas.

Heavy damage was inflicted on young cereal crops and extensive control measures were required to reduce locust infestations. Local plague grasshopper destruction committees took prompt action and received valuable support from the Queensland Government in the form of technical aid and financial assistance.

#### Fruit fly studies

Officers of Entomology Branch have made regular trips to north Queensland to maintain surveillance for introduced exotic fruit fly species as a vital part of the north Queensland quarantine program.

The fruit fly survey covers an area from the far north-west of Queensland (Gulf Country), eastwards to Cairns and north to Cape York. Localities along the east coast as far south as Brisbane (including islands off the coast) also are being monitored. The major, immediate, aim of the survey





A close-up view of the blue-green aphid on a lucerne leaf. This pest was first found in Queensland on 10 May 1977 near Gatton. It has since spread rapidly through the Burnett, Gympie, Darling Downs and Lockyer districts.

is to ensure early detection of the presence of the melon fly (*Dacus cucurbitae*) and the Oriental fruit fly (*D. dorsalis*) should they reach Queensland. Both insects are among the most damaging fruit fly species in the world.

The melon fly (*D. cucurbitae*) is established in Papua-New Guinea while the Oriental fruit fly (*D. dorsalis*) is widespread in south-east Asia and has also become established in the Northern Territory. Despite an intensive search neither species has yet been recorded from Queensland and it may be assumed that, so far, they have not spread to this State.

As part of a balanced, fruit fly investigation program, an ecology study has been started in the Cooloola area of south-east Queensland, based in an area of rain-forest surrounded by open, eucalypt forest. The study was undertaken with the aim of determining the capacity of 'wild host' areas to produce significant fruit fly populations and the extent to which such populations could migrate to and invade orchards.

Large populations of pest species of fruit fly have been found in the study area, including the Queensland fruit fly (*Dacus tryoni*) and *Dacus neohumeralis*, both of which are major pests of horticultural production in Queensland.

This work was financed in part by Plant Quarantine funds and in part by the Rural Credits Development Fund.

Other studies have investigated the seasonal activity of Queensland fruit fly (*Dacus tryoni*) in passionfruit orchards. This work is seen as being complementary to research on gaseous disinfestation of passionfruit, as larval infestations of fruit fly have been detected in fresh passionfruit at Victorian markets, and this has prejudiced trade in the fruit with Victoria.

Extensive monitoring of fruit fly populations and cropping patterns has disclosed that the most severe stinging of passionfruit occurs in late summer, autumn and early winter. Populations decrease during winter and the spring-early summer crop, which is set when fly populations are at a low ebb, largely escapes severe stinging.

The studies have shown that there is a significant, natural shedding of immature fruit in addition to that induced by fruit fly attack. There was no apparent relationship between premature fruit fall and the severity of stinging in that individual fruit might be shed or retained on the vine whether they had one sting or several. However, extensive stinging of individual fruit severely affected seed and pulp development and reduced fruit size.

Field trials investigating control of fruit fly infestations have confirmed that protein hydrolysate-malathion bait sprays will not control Queensland fruit fly (*Dacus tryoni*) when populations are very large. Under these circumstances, conventional, chemical insecticides such as fenthion are needed to obtain reliable control.

### Two new aphid pests

This year saw the establishment in Australia of two new aphid pests of lucerne and related pasture species namely, the spotted alfalfa aphid (*Therioaphis trifolii* f. *maculata*) and the blue-green aphid (*Acyrtosiphon kondoi*).

The spotted alfalfa aphid originated in the Middle East but has since spread to Europe, Africa, Asia, and North America where it is a serious pest of lucerne, particularly in dry areas.

The blue-green aphid, which attacks lucerne and other small-seeded, leguminous, pasture plants, is widely distributed in Asia and has also spread to California and New Zealand. It is well adapted to cool conditions and is most destructive during winter and in areas that experience a cold climate.

The spotted alfalfa aphid was first located in Australia in the Lockyer Valley in south-east Queensland by Departmental officers in March 1977. A similar survey carried out in May 1977 found the blue-green aphid in the Inglewood district, also for the first time in Australia.

Subsequent investigations have shown that the distributions of the two species are so widespread that there is no possibility of containing them by quarantine procedures. The spotted alfalfa aphid has been collected from the Lockyer and Brisbane Valleys as well as from the Darling Downs and it has also been recorded from areas in New South Wales. The present known distribution of the blue-green aphid in Queensland extends from Monto in the north through Gayndah, Gympie, the South Burnett district, to the Brisbane Valley, Lockyer Valley, Darling Downs and, of course, the Inglewood district.

Information from overseas indicates that damage by the aphids results in lowered productivity and invasion of weakened lucerne stands by weeds. A heavy infestation of spotted alfalfa aphid can kill young lucerne seedlings.

Field trials have established that insecticides, monocrotophos, dimethoate and demeton-S-methyl will give satisfactory control of both pests. Long term control based entirely on insecticides is unlikely to be satisfactory, however, and the Department has initiated a program of research on the biological control of the pests by means of introduced wasp parasites and the use of resistant cultivars of lucerne.





A colony of blue-green aphid in the growing point of a lucerne plant. This pest and its partner, the spotted alfalfa aphid, are a serious threat to Queensland's \$30m lucerne growing industry.

### Grain storage pests

The continued development of insecticide resistance among storage pests, together with a demand for export grain having a nil tolerance for live insect infestations, emphasizes the vital importance of research on storage pests. The rice weevil (*Sitophilus oryzae*), the rust red flour beetle (*Tribolium castaneum*) and the lesser grain borer (*Rhyzopertha dominica*) are now resistant to both malathion and dichlorvos.

Although the origin of many grain storage problems can be traced to farms with infested headers, augers or stores, the insecticide resistance exhibited by the three pests listed above is more common in grain silos than in on-farm situations and varies from one area to another. As a result of the Branch's intensive research efforts in evaluating alternative protectants, the chemicals, bioresmethrin, pirimiphos methyl and fenitrothion recently have received international approval for use against grain storage pests.

Other, more detailed, studies with grain protectants have now provided basic data on the minimum effective dose, analytical methods and length of life of the residues in grain under a range of dose and environmental conditions. Current studies are concentrated on fenitrothion, pirimiphos methyl, methacrifos (CGA 20168) and chlorpyrifos methyl.

These materials have excellent activity but are in different stages of development so that some of the compounds may not be used for a number of years. With the exception of methacrifos, these compounds do not control *Rhyzopertha* so admixtures with synthetic pyrethroids, natural pyrethrins or carbaryl will be required. Carbaryl is the cheapest alternative.

## Research

### Fresh fruits disinfestation projects

The projects are designed to facilitate trade in tropical fruits with other States and overseas countries which have quarantine restrictions on the import of fruit to prevent entry of the Queensland fruit fly.

Effective disinfestation procedures already have been developed for mangoes, cucumbers, pumpkins and zucchini, while recent research efforts have focused on determination of effective commodity treatments against fruit fly in papaws, and passionfruit. Gas fumigation with ethylene dibromide (EDB) at 36 g<sup>-3</sup> for 2 hours at 20°C has been found

effective against eggs and larvae of the Queensland fruit fly in papaws packed in fibreboard cartons, but the method still has to be approved with respect to residue levels of organic bromide in the fruit.

Fumigation with 22 g<sup>-3</sup> EDB over 2 hours at 20°C is effective against eggs and larvae of the Queensland fruit fly in passionfruit, but levels of bromide residues in the fruit are unacceptably high and substitution of methyl bromide for EDB as the fumigant is being investigated.

The disinfestation procedures in current use were developed for fruit packed in fibreboard cartons. The increasing use of polystyrene and polypropylene containers for fruit packing has meant that fumigant doses have had to be re-evaluated. It was expected that containers manufactured from these plastic materials would absorb less gas than fibreboard cartons and that, consequently, a greater proportion of gas volume in the fumigation chamber would be available for commodity treatment, thereby enabling a reduction in fumigant dosages. This has been confirmed by experimental fumigation of mangoes.

A major advantage of a reduction in fumigant dose, apart from a saving in cost, is the corresponding reduction in levels of bromide residues in the fruit.

This work was financed in part by Fresh Fruits Disinfestation Fund.

### Integrated control of citrus pests

Field studies on the control of red scale (*Aonidiella aurantii*) and circular black scale (*Chrysomphalus ficus*) on citrus, by means of wasp parasites and discriminating use of insecticides, continued at the experimental sites at Gayndah, Grantham, Howard and Palmwoods.

At the start of the investigation, circular black scale (*Chrysomphalus ficus*) was a major problem on at least 20 orchards in the Palmwoods area alone. Now, it has been controlled effectively in all four trial areas by its wasp parasite, *Aphytis holoxanthus* which has reduced scale populations to levels which are economically insignificant, but which allow adequate numbers of the parasite to exist.

Populations of red scale (*Aonidiella aurantii*) increased from the very low levels experienced last season, but the parasites *Aphytis lignanensis* and *Comperiella bifasciata* were able to contain the increase and satisfactorily bring the scale populations under control without need for insecticide applications.

While infestations of the two major species of armoured scale were being controlled by the introduced natural enemies, pink wax scale (*Ceroplastes rubens*) became a problem of increased significance. However, this situation had been foreseen and breeding stocks of the wasp parasite, *Anicetus beneficus*, were imported from Japan where it is an important factor in the control of pink wax scale.

Two generations of the parasite have been reared from the imported, nucleus colony and releases have been made at Gatton, Gayndah, Howard, Palmwoods and Walkamin. The parasites are established and parasitism levels of 20 to 30% have been recorded from pink wax scales in citrus trees adjacent to the release sites at Palmwoods.

Insecticide and acaricide applications form an integral part of pest management systems, but their use must be compatible with biocontrol agents. Consequently, there is a need for the possible harmful effects of newer pesticides on beneficial insects to be determined as well as their efficacy in controlling pests.

In a test carried out to evaluate a range of acaricides and fungicides for harmful effects on the circular black scale parasite, *Aphytis holoxanthus*, sulphur severely reduced parasite numbers even 7 days after treatment. The acaricides, cyhexatin and cyclosulfyne caused up to 40% mortality of *Aphytis* at treatment but the effect diminished considerably 7 days after treatment. Endosulfan caused 100% mortality when first applied but the residues had little effect on the parasite after 1 day.

While some of these results are relatively encouraging, it is apparent that the search for pesticides that are less disruptive to parasites and predators needs to be continued.

### Heliothis control in cotton

To reduce the dependence of cotton growers on extensive insecticide applications an integrated control program using alternative control methods is needed. Research aimed at developing these methods is centred on *Heliothis* which is the key pest in the insect complex associated with cotton in Queensland. Releases of the egg parasite, *Trichogramma* sp., already have achieved a measure of success in regulating *Heliothis* populations in experimental plots.

Another facet of non-insecticidal control which is complementary to the release of egg parasites involves the use of cotton varieties resistant to *Heliothis* attack. Some breeding lines of cotton are characterized by high levels of gossypol, a chemical occurring naturally in cotton plant tissues and which, in high concentrations, may be toxic to insects feeding on the plant.



A laboratory, bioassay experiment to evaluate the effect of varying levels of gossypol on the development of *Heliothis* larvae showed that increasing concentrations of gossypol of up to 2% in synthetic rearing media decreased the liveweight of *Heliothis* larvae feeding on them and hastened the onset of pupation, resulting in small pupae. The moths emerging from such pupae could be expected to produce fewer offspring and this possibility is being investigated.

The laboratory experiment complements field trials in which a high gossypol breeding line produced yields only 15% less than those of the standard commercial variety under a normal, insecticide spraying regime but outyielded the commercial variety by more than 150% when no insecticides were applied.

### Tobacco pest control

Progress in research on the control of tobacco pests can be traced through a number of planned, evolutionary phases. The initial emphasis on evaluation of chemical insecticides was followed by research aimed at refining control measures through the efficient application of pesticides and by definition of the optimum time of application by means of a pest prediction service.

Further progress has now been made with the determination of economic injury levels for tobacco looper (*Plusia argentifera*) and budworms (*Heliothis* spp.), the two major pests of the tobacco crop. For a benefit-cost ratio of 1:1, the density of looper larvae that warrants insecticide treatment has been determined at three larvae per eight plants. For a benefit-cost ratio of 2:1 the appropriate level is three larvae per four plants. The relevant population densities of budworms have been determined at one larva per 54 plants and one larva per 27 plants respectively.

The figures principally represent a starting point and economic injury levels for these and other pests will need to be investigated over a wider range of agronomic conditions.

This work was financed in part by the Tobacco Industry Trust Account Fund.

### Sorghum phytotoxicity investigations

The application of some insecticides to susceptible varieties of grain sorghum such as Alpha and Pioneer 846 for control of locusts or sorghum head caterpillar (*Cryptoblabes adoceta*) can result in severe phytotoxic reactions. Usual symptoms are the appearance, several days after application, of reddish-purple areas on the leaf blade and then death of the affected leaf tissues.

Although the damage often appears quite spectacular, until now the extent to which such injury affects yield of the crop had not been determined. The lack of this information has made it difficult for growers to decide whether to apply insecticide sprays when faced with a pest infestation in a phytotoxicity-susceptible crop.

To establish a relationship between foliar phytotoxicity and yield, a range of seven insecticides was applied to a crop of Alpha sorghum at varying stages of growth, including the boot stage, early flowering, 11 days after flowering, 22 days after flowering and 33 days after flowering.

Trichlorfon, monocrotophos, dicrotophos and fenitrothion all caused severe phytotoxicity to the sorghum plants which resulted in appreciable yield losses. Yield losses were most severe when the insecticides were applied at the stage of growth between shot blade and 11 days after flowering. Use of the insecticides, methamidophos, endosulfan and methomyl, did not result in any plant injury or loss of crop and these materials may be applied to grain sorghum without fear of impairing crop yield.

### Rust red flour beetle in stored grain

Farm populations of the red flour beetle (*Tribolium castaneum*) have been studied at three wheat farms in the Dalby area, using flour-baited traps. Results have shown that control procedures such as removal of grain residues and spraying of sheds and machinery with insecticides are effective in reducing the number of grain insects dispersing around farms. The major populations of grain insects on farms are associated with stock feeds.

Studies of populations in central storages involved sampling of grain at intake to State Wheat Board depots and in storage sheds. Infestations of 15 to 20 insects per tonne were present in first and second deliveries of grain from farms, in first grain harvested after a break in harvesting due to rain and in grain from on-farm storages. The data suggest that insects from farms are entering the Wheat Board depots in sufficient density to initiate problem infestations soon after storage intake.

Sampling of populations inside a Wheat Board store has begun and the data indicate a fiftyfold rate of population increase for *Tribolium castaneum* in 5 weeks of storage.

### Insect ecology of farm grain residues and wastes

The project has been undertaken to determine the importance of inadequate farm hygiene in contributing to the grain pest problems of central storage.

The main effort has been devoted to surveys of farms on the Darling Downs with extensive collection and analysis of grain spills and wastes from farm sheds and headers.

A survey of 23 harvesters in the Dalby district before the 1976 wheat harvest indicated that dirty headers may have up to 2 000 insects at harvest, whereas, in those that have been cleaned, the number may be reduced to fewer than 100. It is clear that even partial cleaning would be beneficial in reducing contamination of harvested grain by insects.

The work was financed in part by funds from the Australian Wheat Industry Research Council.

### Spray timing in macadamias

Ecological and biological studies carried out in recent years have culminated in the development of an inexpensive and reliable sampling method that assists macadamia nut growers to decide when to spray to control macadamia flower caterpillar (*Homoeosoma vagella*).

The macadamia flower caterpillar, a serious pest in south-eastern Queensland, destroys the macadamia flowers and a heavy infestation can have a devastating effect on nut production. Some early flowering varieties may escape serious damage but, for late flowering varieties, chemical control of the pest is needed to ensure a satisfactory crop. Problems in deciding when to apply insecticides are encountered where a wide variation in flowering times occurs within the one orchard.

With the new technique, unnecessary spraying and crop loss resulting from inaccurate timing of spray applications can be avoided.

### Mealybug control on custard apples

Citrus mealybug (*Planococcus citri*) is a serious pest of custard apples and insecticide controls are sometimes required to ensure the production of clean fruit acceptable at the markets.

Methidathion at 0.05% has been found to give satisfactory kills of citrus mealybugs but, as with all pesticides, timing of application is vitally important to ensure optimum effect.

Trials showed that early spraying for mealybug control is of little use. Early spraying suppressed the controlling action of parasites and predators to the extent that breeding of the mealybug was able to proceed unchecked. Under these conditions, the degree of infestation on early-sprayed trees was not less than that occurring on trees that had received no insecticide sprays at all.

The trials clearly highlighted the importance of allowing the natural enemies of mealybugs to function without disturbance. If insecticidal control measures are needed to ensure clean fruit, they are best applied as two, late-season sprays, a fortnight apart and as close to harvest as withholding periods allow.

### Taxonomic projects

In recent years, the Department has emphasized the need for an integrated approach to pest control. In accordance with this approach, the importance of naturally occurring parasites and predators is now recognized and a number of taxonomic studies into these groups has been initiated.

These include a study of the larval stages of predacious coccinellid beetles. These beetles prey on a wide range of pests and are thought to exert a considerable control on pest numbers. As most species in this group are very similar in appearance, it is essential that a detailed study be made before any reliable identifications can be provided.

Extensive genetic studies have shown that the larval stage is the most satisfactory indicator of species identity as the adult often occurs in different forms which, in the past, have been described as separate species. The potential of this study has already been realized with the recent introduction of the spotted alfalfa aphid.

Field surveys of naturally occurring parasites and predators of this aphid are a pre-requisite to the introduction of other biological control agents. As coccinellids form one of the major groups of predators of aphids, reliable identifications must be provided for specimens collected in these surveys. As a result of the taxonomic-genetic study already in progress, this expertise can now be provided.

Because of the impact of recent grasshopper and locust outbreaks in Queensland, other studies are concerned with grasshopper and locust parasites. Parasites at present under study are scelionid wasps which parasitize the egg stage, and sarcophagid flies which attack the muscles of mature grasshoppers and locusts. These taxonomic studies are a necessary pre-requisite to future biological and ecological work to determine the beneficial effect and possible exploitation of these parasites.



Delphacid bugs are frequently implicated in the transmission of plant viruses. As our knowledge of this important group of bugs has, in the past, been most unsatisfactory, a taxonomic study has been initiated so that the insect vector can be identified reliably.

## Services

### Insect identification service

One of the responsibilities of Entomology Branch is the operation of an insect identification service to provide determinations for Departmental officers, primary producers, householders, quarantine authorities and workers of other institutions.

During the past year, 2 800 insect determinations were provided through the examination of almost 8 000 insect specimens. More than 800 of these specimens were identified for Quarantine authorities.

### Cotton pest monitoring

The cotton pest activity monitoring service is a continuing service maintained by Entomology Branch, in co-operation with local extension officers of Agriculture Branch, with the aim of providing cotton growers in central Queensland and the St. George district with details of seasonal activity by the major cotton pests so that they can plan appropriate control strategies.

Primary interest centres on the incidence and activity of the two species of bollworm (*Heliothis armigera* and *Heliothis punctigera*). *Heliothis armigera* has developed significant resistance to DDT in some areas and also has acquired a degree of tolerance for some other insecticides. *Heliothis punctigera*, in contrast, has shown no signs of developing insecticide resistance. Consequently, the relative abundance of the two species will influence a grower's choice of insecticide.

An intense period of *Heliothis* activity was experienced during December and continued until the end of March. Activity patterns were similar to those recorded in previous years, *H. Punctigera* predominating during the early part of the season until the end of December and *H. armigera* numbers increasing thereafter. Growers have found the service invaluable in assisting them to plan control programs.

## Plant Pathology Branch

PLANT Pathology Branch has as its objectives the development and incorporation into field practice of more effective and economical methods of reducing losses due to diseases caused by fungi, bacteria, nematodes and viruses in crops other than sugar-cane.

The Branch maintains a record of all plant diseases found in Queensland, other than those in sugar-cane, with reference to specimens stored in an herbarium and a collection of plant pathogens particularly fungi and nematodes.

Plant Pathologists develop more effective strains of rhizobia for legumes, particularly tropical pasture legumes, and to improve their performance in the field.

## Research

### Field crops

NAVY BEANS. The introduction of approved seed of some common cultivars of navy bean has led to a reduction in common blight (*Xanthomonas phaseoli*) damage. As greater areas are planted with approved seed, further disease reduction is expected.

Unreliable nodulation of navy bean following the use of commercial inoculants is a problem on the heavier soils of the Darling Downs, Lockyer and Kingaroy districts, but not on the lighter sandy soils at Inglewood. Recent investigations have indicated that the increase of nitrate nitrogen in the soil following dry weather and fallowing inhibits nodulation. Strains of nodule bacteria tolerant of high nitrate levels are being selected.

At Inglewood where nodulation of navy beans is prolific, yields in excess of 2 000 kg per ha have been obtained from a nodulated crop receiving no nitrogenous fertilizer.

KENAF. A rickettsia-like organism has been found in the xylem of kenaf plants with 'little leaf' disease from the Lockyer Valley. The epidemiology of the disease suggests an active insect vector but no specific vector has been found. This is only the second disease found to be caused by rickettsia-like organisms in Australia and the information obtained may be of value in the study of other diseases of unknown etiology, such as lucerne yellows.

### Tobacco pest prediction

The tobacco pest prediction service has been in operation in north Queensland for the past 8 years. It has been refined by the determination of economic injury threshold levels for some of the major pests and has a vital role in a rational, multi-faceted system of pest management for tobacco crops in the region.

### Beekeeping

Services available to the beekeeping industry include the provision of advice on all aspects of honey production together with the implementation of regulatory duties associated with the 'Apiaries Act of 1947'. Inspections carried out by officers of the Apiculture Section under the Apiaries Act provide the means of restricting the spread of diseases and pests harmful to the beekeeping industry.

The importance of this regulatory function has increased considerably with the expansion of beekeeping into areas not previously exploited. An example is provided by a relatively new beekeeping area in the Paroo district of south-western Queensland, which is used by local beekeepers and also by beekeepers from New South Wales who travel across the border with their hives.

In this situation, the Department constantly has to guard against the possible introduction of diseases with hives originating in southern States.

Research on honeybee genetics has established that artificial insemination of queen bees provides the most satisfactory method of maintaining the quality of queen breeding stock. Owing to the northward movement of the undesirable, 'Africanised' strain of honeybee from South America, the queen breeding industry in North America could be jeopardized in little more than a decade.

Australia, because of its climate, has the potential to fill the gap and become a major supplier of queen bees to Europe and America. The Apiculture Section of Entomology Branch is playing a leading role in the development of this potential through its research on artificial insemination of queen bees and its involvement, last December, in an Advanced Bee Breeding School.

The school, which was held at the Queensland Agricultural College, Lawes, featured an international authority on honeybee genetics, Professor J. Woyke, of the University of Warsaw, Poland, as guest lecturer. It attracted wide interest and attendance from commercial breeders, honey producers and apiculture personnel from other State Departments of Agriculture.

LUPIN. A root and crown rot of lupin cultivars Hamburg and Ultra caused by *Fusarium solani* was recorded from Emerald in August 1976 affecting about 10% of the plants in a varietal trial.

Pathogenicity tests on six lines have established that *Fusarium solani* is pathogenic to varying degrees on *Lupinus albus* cvs Hamburg and Ultra, *L. angustifolius* cvs Uniharvest and Unicrop, *L. luteus* cv Weiko III and *L. cosentinii*.

MAIZE. A report of leaf blight (*D. turcica*) on a formerly resistant hybrid, XL81, from the Kingaroy district confirms that a new race of the pathogen virulent on material containing the Ht<sub>1</sub> resistance gene has become established in Queensland. This race was reported from the Darling Downs in 1976.

Ratings for maize dwarf mosaic (MDM) and wallaby ear severity in commercial and experimental maize hybrids continued. A feature is the improved MDM resistance in some commercial early maturing entries. Inbreds and hybrids from the Kairi breeding program have also been tested to help in the continued selection of MDM resistant types.

New sweet corn hybrids produced at Kairi are being assessed for MDM resistance and suitability for use in south Queensland. One of these has reached the stage of limited commercial trials.

Two rhabdovirus diseases of maize have been investigated. One is transmitted by Delphacid leafhoppers and is confined to particular genotypes in breeding plots. The other is widespread but of low incidence in south-east Queensland and is transmitted by the leafhopper *Nesoclutha pallida*. This virus has been named cereal chlorotic mottle virus.

Black bundle, a vascular disease caused by *Cephalosporium acremonium*, was prevalent at Gatton and Hermitage Research Stations. Early and late maturing varieties were rated for black bundle incidence and severity. Incidence ranged from 5 to 91% in late cultivars and from 8 to



72% in early maturing cultivars with high, intermediate and low levels of varietal resistance being expressed by groups of related cultivars produced by seed companies.

Regional maize varietal trials were rated for *Fusarium* stalk rot incidence and black bundle disease incidence and severity at Gatton.

**PEANUT.** A trial to determine a suitable fungicide schedule for use with a new rust and leaf spot-tolerant Pink Spanish line was begun at Walkamin in January 1977. Figures so far available indicate that weekly sprays of chlorothalonil at 1.8 litres per ha commencing at 6 to 8 weeks from germination give best control of leaf spot. The incidence of rust throughout the trial was low.

Eleven introduced FESR peanut lines appear to have little to recommend them for any future breeding work. All were susceptible to rust and leaf spot and poor, uneven growth and low yield were characteristics of most lines.

**POTATO.** The disease of potatoes known locally as autumn wilt has been prevalent in autumn plantings in the Lockyer Valley for the past 2 years. Many of the characteristics of this disease syndrome suggest it may be caused by one or more pathogenic organisms. Many plants in this year's autumn crops showed obvious symptoms of purple top wilt although no successful transmission of the presumed mycoplasma casual agent by graft or leafhopper has been accomplished, nor has any likely disease organism been detected by electron microscopy.

Possible leafhopper vectors other than *Orosius argentatus* are being tested, including a previously undescribed *Orosius* species which feeds on bellvine, a common weed often infected with a mycoplasma-induced phyllody disease. Most plants with leaf rolling symptoms in the later autumn crops show symptoms of potato leafroll virus although different clones of aphids (*Myzus persicae*) vary in their ability to transmit the virus to test plants. Both mild and severe strains of the virus were present.

In summary, there is no evidence to date that any 'new' disease organism is involved in autumn wilt of potato which may be the result of a combination of strains of the purple top wilt mycoplasma and the potato leafroll virus. Environmental and nutritional factors may play a part in determining the symptoms produced by these diseases.

**RICE.** In a trial in the Burdekin area on the 1976 summer-planted rice crop, benomyl plus oil, mancozeb plus oil and chlorothalonil applied at early heading and 14 days later gave good control of narrow brown leaf spot (*Cercospora oxyzae*).

**SAFFLOWER.** *Alternaria* leaf blight (*Alternaria carthami*) is the most serious disease of safflowers in Queensland. In a trial at Biloela, mancozeb sprays controlled the disease and increased yield by 70%. There is still a need for resistant safflower cultivars to replace Gila in central Queensland.

Further work was conducted to find a seed treatment to eliminate seed borne *A. carthami*. Soaking diseased seed in a 1 500 p.p.m. maneb suspension at 50°C for 30 minutes reduced

disease transmission from 23 to 2% and increased emergence from 56 to 80%. Although the treatment gave a higher level of control than fungicidal dusts, it did not eliminate seed transmission.

**SORGHUM.** Field trials to determine the effects of sugarcane mosaic virus (SCMV) infection on sorghum cultivars have shown that—

1. There is a drastic reduction in grain yield in cultivars susceptible to the red stripe and red leaf reactions.
2. There is a variable reduction in yield for mosaic reactions which does not entirely correlate with symptom severity.
3. Texas 610SR, an important cultivar in southern Queensland, is tolerant of the virus.

To assist the sorghum breeders in selecting breeding lines for public release from their Krish-SCMV resistance program, 100 lines were assessed for slow rust development and grey leaf spot (*Cercospora sorghi*) resistance.

Some sorghum breeding lines with Krish resistance to SCMV such as KS19, a parent of Q5161, are ready for release by Agriculture Branch. Yield benefits other than from virus resistance have been a useful by-product of the selection program carried out in co-operation with Agriculture Branch.

**SOYBEAN.** In contrast to the previous season, rust (*Phakopsora pachyrhizi*) was difficult to find and appeared only in the Lockyer Valley towards the end of April. These observations support previous laboratory findings that high temperatures are not conducive to rapid rust development.

**SUNFLOWER.** Severe *Verticillium* wilt (*Verticillium dahliae*) of sunflowers was recorded for the first time on the Darling Downs in several hybrid crops planted in January in the Clifton-Nobby area. Stunting, leaf necrosis, premature death and abundant production of microsclerotia in stems were observed. Hot, dry weather during December, January and February followed by rain and cooler weather after flowering is thought to have been ideal for severe symptom and microsclerotium development.

**TOBACCO.** In screening trials, most lines from the Agriculture Branch tobacco breeding program showed good resistance to bacterial wilt (*Pseudomonas solanacearum*). Some were moderately resistant to black shank (*Phytophthora nicotianae* var. *nicotianae*).

Experiments to test a method of screening for blue mould (*Peronospora hyoscyami*) tolerance in the seedling stage have shown promise. The technique should be further developed since, if reliable, it would provide a rapid and inexpensive method of testing large numbers of lines.

A new systemic chemical CGA 38140 proved to be extremely effective against blue mould in seedbed trials whether applied as a drench at germination or as a spray every 7 to 14 days. In the field, regular weekly applications gave almost complete protection against blue mould despite high disease pressure. Fungicides such as this would be ideally suited for use as strategically applied sprays in combination with blue mould tolerant cultivars. Work with this and other promising materials is continuing.

A plant pathologist examines a stand of lucerne affected by *Phytophthora* root rot.







Results of a trial to test fungicidal dips for controlling brown rot in peaches.

A comparison of the two blue mould organisms (*P. hyoscyami* f. sp. *tabacina* and *P. hyoscyami* f. sp. *hybrida*) showed they differed in the size and shape of their spores. This allows ready identification of field samples.

**WHEAT.** Stem rust (*Puccinia graminis tritici*) was detected in late crops of the wheat cultivar, Oxley, for the first time during December 1976, an event which once again illustrates the need for a more durable form of resistance. The rust strain involved, 343-1,2,3,5,6, is new to Queensland and is virulent on Oxley, Gamut, Tarsa, Gala and Spica. Timgalen, Gatcher, Kite, Songlen, Timson and the impending releases UQ7401 and SUN23A remained free of virulent strains of stem rust. Single resistance genes protect a number of these cultivars from the new rust and further changes in the rust could greatly reduce the number of resistant cultivars available.

### Pastures

**LUCERNE.** Co-operative work with the C.S.I.R.O. Division of Tropical Crops and Pastures aimed at incorporating disease resistance into lucerne cultivars has continued.

Development of a line of Hunter River with resistance to the root rot organism *Phytophthora megasperma* has continued to the third generation. The F<sub>2</sub> line showed significantly higher resistance to *P. megasperma* than commercial Hunter River in controlled environment tests. In a field trial at Gatton, in the F<sub>2</sub> line outyielded commercial Hunter River by over 100%, and was 40% more persistent during the first 12 months.

Development of lines of Hunter River and Siro Peruvian lucerne with resistance to *Colletotrichum trifolii*, the anthracnose organism, has progressed to the second generation stage. F<sub>1</sub> material of both lines has shown superior resistance to the commercial cultivars under glasshouse conditions. Field testing of F<sub>1</sub> and F<sub>2</sub> material of both lines is now in progress.

**STYLOSANTHES.** Two different diseases of *Stylosanthes* spp. caused by *Colletotrichum gloeosporioides* have been found in Queensland. Type A disease, found in all *Stylosanthes* pastures, is severe on lines of *S. fruticosa*, *S. viscosa*, *S. humilis*, *S. subsericea*, *S. hamata* and *S. scabra*. Type B, found only at Samford and Tully, is severe on lines of *S. guyanensis* only. Pathogenic race specialization with the Type A isolates has been established.

### Fruits

**BANANA.** Nematode root rot caused by the burrowing nematode *Radopholus similis* is still a major problem in north Queensland. In an attempt to find cover crops suitable for banana growing areas, 67 plant species and cultivars were screened for resistance to burrowing nematode. Thirty-seven were considered to be hosts and 14 of these are new records.

The most resistant grasses were species of *Paspalum*. Some *Stylosanthes* species were resistant.

**CITRUS.** The Queensland citrus cultivars chosen for inclusion in the fruit variety foundation scheme (fvf) were indexed for xyloporosis and indexing for citrus tristeza virus was also started. Heat treated Villa Franca lemon and mild strain tristeza infected March grapefruit were acquired for distribution to Queensland growers.

**DECIDUOUS FRUIT.** Testing of the new fungicide EL222 for control of apple scab (*Venturia inaequalis*) has again shown that this fungicide is an eradicant as efficient as thiophanate-methyl. Testing of alternative methods for eradication of apple scab has shown that ascospore release may be substantially reduced by ground treatment of overwintered diseased leaves in September with 5% or 10% ammonium sulphate or by controlled burning of apple leaf litter.

Mother trees of nine important Queensland apple cultivars free of virus disease are established at the Granite Belt Horticultural Research Station and distribution of secondary budwood trees to nurseries is envisaged. There should be no further apple virus problems in new plantings derived from this material. New cultivars should become available free of virus either from the fvf or as introductions from similar overseas sources. Co-operation with fvf and our own products should soon extend virus disease-free material to peaches, nectarines, plums and apricots.

Losses from brown rot (*Sclerotinia fructicola*) in stone fruit were much less than in previous years. In field tests glyphene and triforine gave promising results.

**MANGO.** In a field trial at Bowen, benomyl and mancozeb spray schedules gave good control of anthracnose (*Colletotrichum gloeosporioides* var. *minor*).

Approximately a quarter of the Bowen crop was treated for anthracnose in the post harvest hot water-benomyl dip. Results were satisfactory.

**PINEAPPLE.** Mealybug colonies were established in the glasshouse and transmission of the mealybug wilt agent to glasshouse-grown pineapples has been successful. Studies to determine the number of mealybugs necessary to transmit the disease agent are in progress.

Preplant soil applications of element sulphur gave good control of root and heart rot caused by *Phytophthora cinnamomi*. Sulphur has been found to reduce leaf calcium levels but in all tests this reduction has not been sufficient to result in 'hold-overs' and fruit malformation. However, sulphuring does reduce natural flowering and in plants where flowering has been induced harvesting is delayed by 2 weeks.



Preliminary investigations have shown that *Penicillium funiculosum* is not a summer pathogen of rough leaved pineapple. *Fusarium moniliforme* was consistently isolated from all fruitlet core infections. The etiology of fruitlet core rot caused by this pathogen is not well known, although infection is believed to occur shortly after forcing. Benomyl applied at 0, 4, 8 and 12 weeks after forcing reduced the incidence of fruitlet core rot.

**STRAWBERRY.** Granular formulations of aldicarb, fenamiphos and thioazin, applied 3 weeks after planting, increased the yield up to the end of August from strawberries cv. Redlands Crimson infested with the bud nematode *Aphelenchoides besseyi* and reduced the incidence of crimp in the runners.

Renamiphos spray applied 3 weeks after planting, increased the yield of Redlands Crimson runners which showed severe crimp symptoms at the time of planting but did not control bud nematode in the ratoon crop.

## Vegetables

**FRENCH BEANS.** Rust (*Uromyces appendiculatus*) caused problems on beans in the late winter. Under conditions of moderate disease pressure and good growing conditions at Gatton Research Station, a significant increase in yield of the cultivar Gallatin 50 was obtained by spraying with mancozeb 2 and 4 weeks after emergence.

The fungicides oxycarboxin and triforine were compared with mancozeb for control of rust on the bean cultivar Redlands Greenleaf C. Oxycarboxin and triforine caused leaf distortion and stunting.

Field trials in the Burdekin aimed at control of Sclerotinia rot (*S. sclerotioria*) did not give positive results due to low disease incidence. Observations have shown that many infections originate through early basal infections rather than through colonization of spent blossoms. Some revision of experimental spray schedules has therefore been necessary.

**BEETROOT.** Resistance of *Cercospora beticola* to benomyl was confirmed in six plantings in the Lockyer Valley.

**CAPSICUMS.** Bacterial canker (*Corynebacterium michiganense*) was recorded on capsicum in Queensland for the first time. Symptoms occurred on both leaf surfaces as pale green corky pustular lesions which coalesced and became necrotic. Severe leaf fall occurred but fruit symptoms were not seen. The isolate from capsicum produced canker symptoms in the tomato cultivar Floradel.

In a varietal trial at Ormiston, no resistance was detected.

**CELERY.** Septoria leaf spot (*S. apiicola*) continued to be the major disease of celery and screening has established that chlorothalonil and copper oxychloride will control the disease better than other fungicides tested.

**CRUCIFERS.** A new type of black rot appeared on crucifers in the Stanthorpe district, some plantings of Brussels sprouts being severely affected. The disease was found subsequently in other districts. Comparative studies indicated that the causal agent (*Xanthomonas* sp.), although similar to *X. campestris* var. *aberrans*, is more pathogenic. Its relationship to this bacterium and *X. campestris* is being investigated. Cultivars and breeding lines were checked for resistance to black rot and the new disorder. Several lines had some resistance to black rot whereas only one showed resistance to leaf spot.

The effect of preplant soil treatments with EDB, Telone or fenamiphos on growth of the cabbage cultivar Henderson's Beauty in old apple orchard land was investigated in a field trial at Cottonvale. Each nematicide reduced the numbers of the root-lesion nematode *Pratylenchus penetrans* in the roots at harvest and increased the number of heads taken at the first pick. Telone was more effective than EDB and fenamiphos.

**CUCURBITS.** Isolates of the wilt organism *Fusarium oxysporum* f. sp. *niveum* virulent on Calhoun Grey have now been recorded from coastal watermelon growing areas north of Bowen. *Fusarium oxysporum* has also been isolated from wilted pumpkin (Windsor Black and Crown Prince) and bitter melon (*Momordica charantia*). Pathogenicity tests have shown that the watermelon and pumpkin isolates can be cross-inoculated to pumpkin and watermelon respectively but the bitter melon isolate infects neither.

In a field trial at Bowen, pyrazophos and dimethirimol gave excellent control of powdery mildew (*Sphaerotheca fuliginea*) and three experimental compounds were also effective. A schedule of alternating weekly application of pyrazophos and chlorothalonil was satisfactory. It is clear that alternative materials will be available if pyrazophos should lose its effectiveness through resistance. In a trial at Gatton, treating pumpkin seed of the cultivar Queensland Blue with 5% hydrochloric acid plus 1% non-ionic spreader-sticker for 1 hour controlled seed transmission of bacterial spot

(*Xanthomonas cucurbitae*). It was also shown that germination could be reduced if the seed is inadequately washed after treatment. The effectiveness of treating bulk quantities of seed was confirmed in small scale commercial plantings. Although hot water treatment at 56°C for 30 minutes reduced seed transmission to 0.2%, this level of seed transmission in a commercial crop could initiate an epidemic under favourable conditions.

Reassessment of watermelon mosaic virus (WMV) has shown the prevalence of type 1 in all types of cucurbit crops. Search for resistance or tolerance may have to go well beyond the range of commercial cultivars. A line of the gourd (*Lagenaria siceraria*) is resistant to both type 1 and type 2, but may be too far removed from commercial cucurbits for successful gene transfer.

Seven different strains of cucumber mosaic virus (CMV) commonly occurring in Queensland crops have been identified. Antisera to two of these strains have been produced, facilitating the rapid identification of this virus in plants.

**GINGER.** A close relationship has been established between root-knot nematode (*Meloidogyne* species) infection and rhizome rot in ginger. The percentage by weight of rhizome free of rot was increased from 49% to 89% when the root knot index was reduced from 73.6 to 0.7.

**TOMATO.** Bacterial wilt (*Pseudomonas solanacearum*) caused severe losses in most districts. The F<sub>1</sub> progeny from crossing Floradel with two breeding lines resistant to *Pseudomonas solanacearum* was also resistant.

Foot rot (*Fusarium solani*) of tomatoes affected a considerable area of the Bowen plantings last year and is thought to have reduced yields on seriously affected areas. Attempts to control the disease with broad spectrum soil fumigants were inconclusive.

Bacterial canker (*Corynebacterium michiganense*) of tomatoes was moderately severe throughout the Granite Belt. F<sub>1</sub> hybrids of the tomato breeding line H2990 x Grosse Lisse 45 and H2990 x College Challenger grew without loss in infested soil at Glen Aplin.

## Disease of ornamentals

Carnations are susceptible to root and crown rots caused by *Fusarium oxysporum* f. sp. *dianthi*, *Sclerotium rolfsii* and *Rhizoctonia solani*. In a field trial at Ormiston, losses from these diseases were reduced by drenching every 6 weeks with Terrachlor Super X, captan, or a mixture of benomyl and quintozene.

## Miscellaneous diseases

**NOOGOORA BURR RUST.** Samples of *Puccinia xanthii* received during the year confirm the continuing spread of Noogoora burr rust. The disease was reported west of Quilpie, from the Leichhardt River area south of Burketown, and was common in the Cairns district. Additional natural infections of *P. xanthii* on sunflower in the field were reported.

A plant pathologist examines a trial where tomatoes are being tested for resistance to bacterial wilt.





### New diseases

A rust disease caused by the fungus *Puccinia oxalidis* Diet. & Ell. was newly recorded on the weed *Oxalis corymbosa* in Brisbane's western suburbs.

During the year *Cylindrocladium crotalariae* was isolated from peanut plants in the South Burnett. An attempt to determine the spread of the disease was hampered by the drought.

### Extension services

All Plant Pathologists were involved in extension activities including attendance at growers' meetings, field days, radio interviews and preparation of extension literature. The major extension activity has been the preparation of a Plant Disease Handbook containing colour illustrations of important plant diseases occurring in Queensland with notes on causal agent, source of infection, method of spread and control.

### Diagnostic services

More than 3 000 enquiries requiring disease diagnosis were handled at Indooroopilly and field stations.

The specialist bacteriologist handled 280 accessions, many of which required detailed laboratory checking. The specialist nematologist processed 600 plant and soil samples. In the virology section, more than 500 specimens were examined with the electron microscope and 240 indexed in the glass-house.

### Taxonomic studies

A new species of *Drechslera* causing leaf blighting in *Chloris gayana* was described. Perfect state connections were demonstrated for the first time in *D. chloridis* and *D. hawaiiensis*.

### Legume bacteriology

During the year, 60 rhizobia cultures were supplied to agronomists and farmers for 12 different legumes for which there are no commercial cultures. The program of sampling for quality of commercial legume inoculants on sale to farmers is continuing. A high quality is being maintained, with no suspect cultures coming from Queensland retail outlets.

## Agricultural Chemistry Branch

THE Agricultural Chemistry Branch has its main laboratory at Indooroopilly and has staff also stationed at regional centres.

The Branch provides agricultural, chemical and allied services to other Branches and Government Departments and to primary industry. In addition, it is concerned with investigations in the fields of plant, soil, and pesticide chemistry, cereal science, soil physics and soil survey, either independently or in co-operation with other Branches of the Department.

During the year, the Branch provided training in atomic absorption spectroscopy for two agricultural scientists from Bangladesh and one technician from Samoa. Branch officers also participated in the International Training Course for agriculturalists from Third World Countries organized by the Department of Foreign Affairs.

The Branch Director represented Australia at the 20th Meeting of the Collaborative International Pesticides Analytical Council and was invited to be a member of the 6th *ad hoc* Meeting of the FAO Panel of Experts on Pesticide Specifications, registration requirements and application standards (Specification Group).

### Research

#### Chemical residues

Surveys of residues on a number of commodities were continued during the year. Results were substantially the same as those found previously and provided more data from which assessments can be made of the effectiveness of spray programs for commercial use. With very few exceptions, residue levels were well below the maximum limits set down in State Health Regulations.

In conjunction with Entomology Branch, work continued on the residue chemistry of bromide-based fumigants.

The Agricultural Chemicals Distribution Control Board is concerned by the problems of drift damage which occur with the use of esters of 2,4-D and 2,4,5-T. A literature search following a request from the Board for information on the volatilities of the 11 esters registered in Queensland revealed values for only three esters. Accordingly an investigation is in progress to ascertain the vapour pressures of these compounds. This work is nearing completion and will permit a rational classification of these herbicides for potential hazard.

A dip of naphthalene acetic acid (NAA) is used to prolong the shelf life of pineapples. A study of residue levels made in conjunction with Horticulture Branch showed that dipping pineapple fruit in a solution of twice the recommended strength of NAA produced residues less than the Maximum Residue Limit set by the National Health and Medical Research Council.

In a joint effort with Horticulture and Standards Branches, a Handbook for the identification of plant disorders is being compiled which will describe with text and colour plates symptoms of herbicide damage to plants. This booklet is almost ready for the press.

A study is under way with Entomology Branch to determine rates of decay of an organophosphorus insecticide on cabbages. This work is part of the Department's commitment to phase out the use of persistent organochlorine insecticides.

#### Plant chemistry

The predictive relationship developed between linoleic acid concentration, refractive index and iodine value of sunflower seed oil attracted wide attention when reported last year. The method was developed in the laboratory, but it can be used with relatively simple apparatus for field assessment of oil quality in the seed. This work is supported by the Queensland Graingrowers' Council Grain Research Fund.

Work is continuing on a number of projects reported on last year. An extract of the toxin produced by the maize fungus *Marasmius saccharii* var. *hawaiiensis* has been made and is now being tested for activity by the Plant Pathologist at Cairns.

Studies on the gossypol content of cotton plants continue in conjunction with plant breeders and entomologists in order to develop *Heliothis* resistance in cotton.

The survey of selenium levels in poultry feed ingredients supported by the Australian Chicken Meat Research Committee is continuing. Samples of wheat and other grains from the Darling Downs and the Biloela district show results in line with previous findings.

MEAN VALUES SELENIUM

Grain	Locality	Se concentration p.p.m.
Wheat .. .. .	Wandoan ..	0.07
Wheat .. .. .	Toobeah ..	0.12
Wheat .. .. .	Hermitage ..	0.09
Sorghum .. .. .	Biloela Research Station	0.42
Sorghum .. .. .	Kokotungo ..	0.09
Sorghum .. .. .	Brigalow Research Station	0.19

On the other hand, the selenium levels in prepared broiler feeds are higher than the levels found in many Queensland grain samples. This is due in large part to the fact that other feed ingredients contain selenium at much higher levels than those in the grains.

In conjunction with the maize breeder, an attempt is being made to improve the lysine content of maize seed. Since lysine is a critical amino acid for poultry this work will benefit the industry.

#### Regional soil fertility assessment

The definition of soil nutrient status, the correction of deficiencies and the monitoring of any changes in nutrient status are being studied in several regions of the State.

FERTILITY SURVEY OF CENTRAL QUEENSLAND SOILS. Laboratory measurements and glasshouse experiments with duplex soils of the Callide and Dawson Valleys and the Central Highlands have been completed. Phosphorus and sulphur appear to be the most important deficiencies. Similar conclusions are reached for the soils of the Brigalow Research Station which were studied in another project.



**NUTRIENT STATUS OF BRIGALOW SOILS AFTER DEVELOPMENT.** A study was made of duplex soils which originally supported brigalow-Dawson gum communities. Many chemical properties were affected by cropping or pasture establishment. Some nitrogen depletion was reported previously. For the range of other properties measured, there are no consistent relationships with age, and factors such as land clearing method, whether burnt or not, and depth of ploughing have probably been responsible for changes.

**FERTILITY OF PASTURE SOILS OF THE WET TROPICS.** The changes in soil phosphorus and potassium are being monitored in commercial pastures. Very few pastures were fertilized during the year because of the slump in the beef industry. Soil phosphorus decreased while potassium did not: this is the same trend as in previous years. The higher the soil phosphorus status, the greater is the annual decline. As a general recommendation, it is suggested that 300 kg ha<sup>-1</sup> of superphosphate are required every second year to maintain 300 p.p.m. of acid-extractable phosphorus.

**SOIL FERTILITY CHANGES, ISIS JUNCTION.** At the Department's experimental site at Isis Junction, changes in soil fertility are being monitored. Over the first 12 months of stocking, there have been only small changes in soil chemical properties except for some saline patches where salinity has decreased.

**CHARACTERIZATION OF RED AND YELLOW EARTHS OF THE MT. GARNET DISTRICT.** Red and yellow earths cover a large area of tropical Queensland. Samples for chemical analysis have been collected from 27 sites in the Mt. Garnet area. Further samples will be taken. In addition, glasshouse experiments have begun using soil from four representative sites.

### Soil and plant diagnostic criteria

Before soil and plant analyses can be reliable in predicting the response of plants to fertilizer, correlations need to be established between the response of plants in field experiments and the soil and plant chemical analyses. Pastures and crops are being studied in the current program. Much of the work is being done co-operatively with officers of Agriculture Branch.

**GRASS-LEGUME PASTURES.** Results of experiments with the tropical pasture legume Siratro (*Macroptilium atropurpureum*) have been published and have significance to the pastoral industry. Once established, Siratro has been shown to grow well on soils of relatively low phosphorus status and the responsiveness of grass-Siratro pastures to phosphorus has been related to the two extractable soil phosphorus tests commonly used in Queensland. Responses are likely below 10 p.p.m. bicarbonate extractable or 13 p.p.m. acid extractable phosphorus but unlikely above 14 p.p.m. or 22 p.p.m. by the respective extractants.

White clover and Greenleaf desmodium pastures are now being examined so that similar relationships can be established. Results so far suggest that both species are more responsive (higher critical soil test levels) than Siratro, and that clover is more responsive than Greenleaf desmodium.

**SWARD LUCERNE.** The response of sward lucerne to sulphur fertilizer was measured in 21 experiments on the eastern Darling Downs. The best correlation between response and soil test was when sulphate sulphur to a depth of 90 cm was considered. This indicates the importance of subsoil sulphur in lucerne nutrition. A critical figure of 3.5 p.p.m. sulphate sulphur was established for the 0 to 90 cm depth. Above this figure, no responses were measured while below this 75% of the experiments gave responses.

**SOYBEANS.** In the South Burnett district, 24 experiments have been conducted since 1973-74. Pending detailed inspection of the data, a tentative soil phosphorus test level of 25 p.p.m. P by either acid or bicarbonate extraction has been set as a critical level for the red soils. Chemical analysis of whole plants showed that applied phosphorus was taken up by the plant and uptake increased with fertilizer rate. Previous work with leaf tissue only had not shown this relationship.

On the Darling Downs, two experiments have begun to study the calibration of soil tests for soybeans on the dark clay soils.

**NAVY BEANS.** A project aimed at measuring the responsiveness of navy beans to phosphorus in the South Burnett has begun, and five experiments are under way. The project will continue over a number of years.

### Crop and pasture nutrition

**FACTORS AFFECTING THE SUPPLY OF NITROGEN TO WHEAT.** In the laboratory, the effects of soil water content and soil temperature on nitrogen mineralization, immobilization and denitrification have been studied. Multiple regression equations

have been derived from these data. These relationships are now being used to simulate changes in mineral nitrogen levels under field conditions.

An experiment on the rates of decomposition of wheat stubble was conducted. Nylon mesh bags were used and gave interesting results. Stubble in zero-tilled plots was retained on the soil surface and decomposed only 20% of its original weight in the 46 weeks. Stubble that was buried in mechanically cultivated plots decomposed 40% in 46 weeks. Decomposition rates were slow, especially during winter and were not influenced by nitrogen content of the original wheat straw.

**RESPONSE OF NAVY BEANS TO RESIDUAL PHOSPHORUS.** Navy beans were grown on a Krasnozem soil at Kingaroy which had received various rates of phosphorus 4 years previously. The original 80 and 160 kg P ha<sup>-1</sup> rates increased navy bean yields by 63% and 83% respectively when compared with the unfertilized control. At rates of 40 kg P ha<sup>-1</sup> and less yields did not differ from the control yields. Soil phosphorus analyses also showed residual effects at the 80 and 100 kg P ha<sup>-1</sup> rates but all levels were low.

**LEAF ROLL DISORDER IN POTATOES.** A condition called 'leaf roll' has become apparent in potato crops in the Lockyer Valley over the last few years. Reductions in yield of up to 40% in some autumn crops have been estimated. A survey of 30 farms was carried out in an attempt to define the problem more closely and to obtain leads for further work. There were no clear cut nutritional differences between affected and unaffected areas, but there was a suggestion that boron deficiency could be involved.

To follow up this possibility, boron fertilizer has been applied to soil in two experiments which are currently in progress. Other Branches are investigating non-nutritional factors implicated in the disorder by the survey.

In association with this problem, a solution culture experiment was set up in the glasshouse and boron deficiency symptoms induced in potato plants. The symptoms were described and photographed.

**PHOSPHORUS SORPTION BY TOBACCO SOILS IN NORTH QUEENSLAND.** In a glasshouse experiment, it was shown that the phosphorus buffer capacities of six tobacco soils determined the amount of applied phosphorus necessary for maximum growth of test plants (tomatoes). Soil was then sampled from a further 19 sites in the Mareeba-Dimbulah tobacco area and phosphorus buffer capacities determined.

These sandy soils had only low buffer capacities and the range in values was so small that it was concluded that field application rates would not differ between soils. There was evidence that where contents of clay or sesquioxides are higher, fertilizer requirements would also be much greater.

**PHOSPHORUS REQUIREMENTS OF PASTURES IN NORTH QUEENSLAND.** Glasshouse experiments with Greenleaf desmodium and a range of soils from the Atherton Tableland have continued to show the range in ability of these soils to fix applied phosphorus in forms unavailable to plants. The phosphorus concentration required in the soil solution to give near maximum yields of desmodium has been relatively constant across different soils and also may offer a means of predicting amounts of phosphorus fertilizer required.

This would be an advance on extractants commonly used in soil testing which do not predict amounts of fertilizer and which require a different interpretation for different soils. Field experiments were begun this year to test these findings.

A similar soil on the wet tropical coast has been shown to absorb phosphorus strongly. While most of the applied phosphorus remains near the surface, soil extractable phosphorus values were only increased where more than 80 kg P ha<sup>-1</sup> was applied. Dry matter yields of grass and legume were not affected by applied phosphorus until the end of the first year when there was a response by centro to the 160 kg P ha<sup>-1</sup> rate.

**NITROGEN AND PHOSPHORUS REQUIREMENTS OF WHEAT.** Nitrogen and phosphorus fertilizer experiments are being conducted in the Central Highlands and in the Western Downs.

In the last few years, more than 30 sites have been fertilized and planted to wheat in each district. On the western Downs, there have been no responses to nitrogen but a wide range of soil phosphorus levels has been found and some marked responses have been measured to low levels of applied phosphorus. The residual value of phosphorus fertilizers is also being followed.

In the Central Highlands, recent work has confirmed the earlier findings of widespread nitrogen and phosphorus responses.



## Environmental studies

Practices such as land clearing, irrigation, fertilization, and waste disposal could have harmful effects on the environment. Several projects have been initiated to obtain information on possible side effects of some of these management practices and to monitor any changes which do occur.

**UNDERGROUND WATERS OF THE CALLIDE AND DEE VALLEYS.** Within these valleys, 56 underground and 12 surface sites have been chosen for at least 6-monthly sampling of water for chemical analyses. The variation of chemical properties with time and with position in the valley will be followed.

**SOIL SALINITY STUDIES, BURDEKIN.** The study of the effects of clearing and irrigation of Dalrymple and associated soils on down slope salinity has continued at sites near Home Hill. The salinity problem appears to be related to rising groundwater in the lower slope position. In recently cleared land, seepages are non-saline, but rising water tables could bring deep subsoil salinity to the surface. The level of the water table and the movement of salts in the soil profile will continue to be monitored at selected sites.

**DISPOSAL OF ANIMAL WASTE.** Heavy rates of fowl manure are being spread on kikuyu grass pastures in an experiment being conducted at Gatton in association with the Queensland Agricultural College.

Results in the second year have followed the same pattern as in the first year. Soil mineral nitrogen levels increase rapidly after manure application but soon return to low levels. There is no evidence of accumulation of nitrate in the soil profile. Pasture yields were depressed by rates of fowl manure above 60 t ha<sup>-1</sup> year<sup>-1</sup>. Plants did not accumulate high levels of nitrate. Some of the plots have been set aside to monitor ground water and surface run-off for nitrate.

At Rocklea, a similar experiment with cow manure is being sampled but to date only low levels of mineral nitrogen have been found in the soil.

## Soil and land use surveys

Soil surveys are being undertaken both for feasibility studies and project planning (1:100 000 surveys) and for farm development (1:25 000 surveys) in irrigation development. A detailed reference area survey is also being undertaken.

**1:100 000 SOIL SURVEY OF NORTHERN LEFT BANK LOWER BURDEKIN VALLEY.** A semi-detailed reconnaissance survey is in progress using selected traverses to provide data on the morphological and chemical characteristics of the soils and their distribution. The detailed (1:25 000) soil survey of the Burdekin Rural Education Centre, within the northern left bank area, was used as a reference area to obtain information on soil distribution at a scale realistic for irrigated land use.

**1:100 000 SOIL SURVEY OF SOUTHERN LEFT BANK LOWER BURDEKIN VALLEY.** A traversing technique is being used in this semi-detailed reconnaissance soil survey in preparing a provisional mapping legend and for the selection of reference areas, to be mapped in greater detail at 1:25 000. Completion of the surveys of the southern left bank and northern left bank will provide a 1:100 000 soil survey, with 1:25 000 reference areas, for the whole of the lower Burdekin Valley land which is potentially irrigable with the development of dams.

**1:25 000 SOIL SURVEY OF EMERALD IRRIGATION AREA (RIGHT BANK).** A grid survey is in progress on the lands of the right bank of the Nogoia River east to Winton Creek. This survey is being used for the subdivision of irrigation farms.

**1:25 000 SOIL SURVEY OF KALBAR REFERENCE AREA.** A soil survey of this reference area in south-east Queensland is in progress. In the development of a provisional mapping legend in this survey, numerical analyses were used to assist in sorting soils into more discrete groups. These techniques have proven useful in this survey.

This survey will provide detailed morphological and chemical data on an important area of agricultural land.

## Method development

Method Development is a continuing part of Branch work and covers all aspects of Branch activity.

The Soil Survey group, with the assistance of colleagues in the disciplines of Soil Fertility and Soil Physics, have drawn up a series of recommendations and methods to enable the collection of soil data to be streamlined and to make these data more accessible once recorded. Methods and techniques for pre-analysis handling have also been standardized.

At the Queensland Wheat Research Institute, a unit for examining the malting quality of barley has been set up and is at present being calibrated. This service, when established, will be used to help the plant breeders better to select suitable strains of barley.

The Soil Physics group has developed a machine to carry out particle size analyses of sand and silt in soils. Mechanization eliminates the inherent variation introduced by human operators and gives more reproducible results. This group, too, has developed a portable machine for measuring the permeability of soils; a property which is of importance in irrigation.

In purely chemical fields, a method for the analysis of esters of 2,4-D and 2,4,5-T has been completed and is in press.

Other methods studied during the year included an automated method for the determination of sodium and potassium in soils, plants and waters, and a flame emission method for boron. This method will permit boron in plants to be measured in the range 2 to 200 p.p.m., in soils from less than 2 p.p.m. to 8 p.p.m. and in waters from 0.2 p.p.m. to 8 p.p.m.

Methods currently being studied include ones for the analysis of cobalt in plants and molybdenum and cadmium in plants and soils.

A compilation of outlines of pesticide residue methods used in the laboratory has been completed.

## Soil physics

**SOIL PHYSICAL PROPERTIES.** Laboratory measurements are being made on soils from a number of experiments. The main emphasis is on measuring the effects of soil management practices (pasture rotations, fallow treatments, cultural treatments, irrigation) and amelioration treatments on soil physical properties.

As an initial step in investigating a seedling emergence problem in the Oakey district, soil samples were taken from 24 sites representing both affected and unaffected soils. The results indicate that soil dispersion due to exchangeable sodium may be an important factor limiting seedling emergence.

There was no indication that low organic matter or high exchangeable magnesium was involved. A dispersion ratio greater than 0.30 or the occurrence of spontaneous dispersion separated those soils with the seedling problem. Further work is required to define the extent of the problem and to test the effect of gypsum applications.

In a laboratory experiment, the effect of poor quality irrigation water on heavy clay soils from Dalby was studied. The results showed how under-watering with salty water not only increases the salinity in the root zone but also leaves a narrow band of very high salt concentration near the wetting front. However, only a small amount of leaching below the root zone is necessary to remove soluble salts.

The real danger of using saline irrigation water was shown when the soil was leached with rain water after the irrigation water. Infiltration was high until salt had been removed from the surface soil but was then suddenly reduced and no water passed through the soil. This is due to the dispersive effect of exchangeable sodium in the absence of a high soluble salt concentration.

**ASSESSMENT OF SOILS FOR IRRIGATION.** Projects in the Lower Burdekin Valley have continued to study infiltration characteristics and subsequent distribution of water in soil profile as well as assessing the availability and extraction pattern of this water to plants. The soils examined cover the range from grey cracking clays to solodized solonetz. Irrigation bays 9 m<sup>2</sup> in area with walls sunk to 1 m were established at a number of isolated sites and various measurements made following irrigation. The results of the first bays were reported in last year's report and further sites have been studied in 1976-77.

As found in the previous year, most duplex soils were poorer than the cracking clay soils for rooting depth, infiltration and irrigation increment. In gilgai areas, mound and depression areas show considerable variability in depth of wetting.

## Cereal chemistry

**WHEAT.** The highlight of the year was the approval for registration of the crossbred UQ7401A as the variety Cook. Cook combines excellent grain appearance and milling quality with very good baking quality. It also has the strong dough characteristics which are required in the South-east Asian Prime Hard markets.

Five other crossbreds were evaluated from the Regional trials, the final stage of testing. Registration for one of these SUN 23A is being sought by the University of Sydney, three, UQ7414, UQ7410 and SUN 27B have been discarded while SUN 27A is to be tested for at least another year.



Several hundred samples were evaluated from breeders' strain trials. Seven of these have been selected for inclusion in this year's regional trial series.

The quality of Oxley, a variety released from the Institute in 1973, was criticised during the year. A detailed analysis of all data available suggested that there was no justification for the criticisms and that the poor quality being experienced was largely a result of the season.

One paper was published and four conference papers presented on the use of near-infra-red reflectance spectroscopy for the analysis of cereals.

BARLEY. Micromalting equipment which was imported from Germany arrived during December. The equipment is at present being evaluated and it is expected to be fully operational in time to evaluate samples from this year's harvest.

A method was developed to identify the presence of the feed variety Corvette in mixtures with the malting variety Clipper.

## Services

Analytical and diagnostic services are provided at Indooroopilly for the research and extension activities of the Divisions of Plant Industry and Land Utilisation. The Branch also makes comments on the suitability of waters for irrigation based on figures supplied by the Irrigation Department. More than 1 000 such comments were made last year. Most of the samples handled are plant and soil samples from research projects, but there is also a substantial number of waters, soils and miscellaneous samples handled for primary producers.

In addition to the chemical analyses mentioned, other service work relates to diagnosis of mineral deficiencies in plants, advice on soil physical and soil classification problems.

At Mareeba, using funds provided from the Tobacco Industry Trust Account, a continuing Branch program gives service to tobacco research and extension. Similarly, at the Queensland Wheat Research Institute, an analytical service is provided for wheat and barley research using funds provided mainly by the Queensland Wheat Industry Research Committee.

The service for trace metal analyses made 13 400 determinations last year on 6 350 samples.

Samples analysed at the Indooroopilly laboratory were:—

### SAMPLES

Plants .. .. .	18 412
Oil seeds .. .. .	3 106
Waters .. .. .	1 377
Soils .. .. .	11 844
Fruit protection dips .. .. .	90

A breakdown of the soil samples analysed showed that 246 were from sporting clubs and schools, 3 903 were advisory, 2 062 were from surveys, and 5 633 were from projects.

Miscellaneous analyses carried out during the year covered a wide range of materials and substrates: export wheats, grain sorghum for farmers' competitions; fatty acid constituents of safflower seed and linseed, fumigants, waters, soils, and plants for a wide range of pesticides, tobacco for sugars, alkaloids and residues, in all some 500 samples.

Samples of cassava were analysed for suitability as a stock feed. The results were:—

—	Moisture	Crude Protein %	Crude Fat %	Crude Fibre %	Ash %	Carbo-hydrate by diff. %	Ca %	P %
Leaf	4.6	19.3	3.3	16.5	7.0	49.4	1.4	0.07
Stem	5.6	4.7	0.3	35.0	3.4	51.5	0.8	0.07
Petiole	4.6	6.0	0.7	35.6	6.2	47.0	1.4	0.07

Depending on palatability and the absence of cyanogens, the leaf and petiole would be useful as a stock food.

A recent publication by U.S. National Academy of Sciences on under-exploited tropical plants of promising economic value suggested that the channel millet (*Echinochloa turneriana*) would be a suitable stock feed in drought areas

since it grows from seed to full growth with one watering. A sample of whole seed was examined and the analysis is given below:—

—	Proximate analyses	Amino acid composition g amino acid/16 gram Nitrogen
Moisture .. .. .	8.3%	Aspartic 5.7
Nitrogen .. .. .	1.87%	Theonine 3.3
Crude protein .. .. .	11.7%	Serine 5.0
Phosphorus .. .. .	0.51%	Glutamic 18.6
Potassium .. .. .	0.48%	Proline 6.4
Calcium .. .. .	0.48%	Glycine 2.5
Ash .. .. .	8.4%	Alanine 8.1
Crude fibre .. .. .	14.2%	Cystine 0.8
Crude fat .. .. .	2.1%	Valine 4.3
Carbohydrate (by diff.)	55.37%	Methionine 1.8
Copper .. .. .	0.22 p.p.m.	Isoleucine 3.7
Zinc .. .. .	1.8 p.p.m.	Leucine 8.4
Manganese .. .. .	2.2 p.p.m.	Tyrosine 3.1
Iron .. .. .	2.7 p.p.m.	Phenylalanine 5.4
		Lysine 1.8
		Histidine 1.7
		Arginine 3.2

This material is somewhat similar in amino acid composition to sorghum grain.

A sample examined by the soils laboratory, which could be used either for making up nursery potting mixtures or as a top dressing of lawns, is worthy of comment because of its excellence.

The sample originated from a deposit of decomposed Lower Triassic granite (Enoggera granite) which had been crushed, washed and sieved. The sample supplied to the laboratory is best described as a sand and had the following particle size distribution:—

	Size in mm			
%	<1.5>1.0	<1.0>0.5	<0.5>0.25	<0.25
	8.2	28.6	51.5	12.5

This distribution compares favourably with that recommended by Hewitt for sand culture experiments. It has a pH of 6.5 and a large amount of acid-soluble phosphorus. Other nutrients are minimal. However, as a product for the uses envisaged, its excellent physical properties make it the best sample submitted to the laboratory for many years.

There is a large source of the material close to the metropolitan area.

It had two advantages over other samples tested; it contains very little silt size particles and no noxious weed seed.

## Regulatory

The regulatory activities of the Branch concern, in the main, the provision of chemical and physical analyses of agricultural produce and agricultural chemicals, under provisions of the Agricultural Standards Act and the Agricultural Chemicals Distribution Control Act. In addition, the Branch is involved in the certification of fruit fumigation chambers and in the setting of standards for pesticide analytical methods and specifications both nationally and internationally.

The analyses provided for administrative purposes of the Agricultural Standards and Agricultural Chemicals Distribution Control Acts were:—

Pesticides .. .. .	178
Veterinary medicines .. .. .	28
Fertilizers and limes .. .. .	181
Stock feeds .. .. .	701
Pesticide residues .. .. .	52

During the year, the chemical testing of stock feeds and fertilizers was reviewed and, as a result, the number of separate measurements made on each sample was greatly increased. In addition to the usual measurements of the proximate analysis, trace elements determinations are now performed routinely.

As a service to citrus exporters, the Department certifies the effectiveness of fumigation chambers. There has been a rapid rise in the number of chambers and the Branch made 11, 2-day tests on chambers during the year.

There have been changes in handling agricultural chemicals, from bagged to bulk handling of fertilizers, for example. A study has begun to check the efficiency of sampling techniques used to see whether modern handling methods necessitate changes in the sampling techniques.



## Botany Branch

THE main objectives of Botany Branch are to acquire and store knowledge on the vegetation and flora of Queensland and to provide a service to other branches of the Department of Primary Industries, universities, other State and Commonwealth organizations and the general public by providing information and assistance on these subjects.

Three groups operate within the Branch. A Taxonomy group deals with questions concerning individual species growing in Queensland; an Ecology group studies the vegetation of the State; and a Supporting Services group provides assistance to other groups and maintains the Queensland Herbarium.

### Research

#### Taxonomy

Major objectives of the taxonomy group are the correct naming and description of all native and naturalized vascular plants in Queensland.

A joint project, with an officer of the Wheat Research Institute, to study the taxonomy of wild oats (*Avena* spp.) continued. Wild oats are the most serious weed problem associated with winter cereal crops in Queensland as the plant is difficult to control effectively.

During the year, about 280 replicated samples of wild-oat seed from throughout Australia were grown in pots under uniform conditions. About 50 characteristics were recorded for each individual and the data analysed using various numerical taxonomic programs.

Excellent progress has been made towards the compilation of a flora of south-eastern Queensland. A manuscript of the first of the three-volume work, which will be well illustrated, will be completed by the end of 1977. Completion of the whole work by 1981 is anticipated. A handbook to the ferns and fern-allies of Queensland is almost finished and will be published in the 1977-78 financial year.

Taxonomic studies on *Cordyline* spp. and *Dianella* spp., groups with interesting pharmacological properties continued. There is a vast amount of variability in both groups. In the case of *Dianella*, cytological data helped to explain some of the variability, and an account of its cytotaxonomy has been prepared.

Studies on the tropical legume *Atylosia* were completed and an account of the genus is being prepared for publication. Other groups of plants studied during the year were the families Convolvulaceae and Sapindaceae, and Queensland species of wire grass (*Aristida*), *Tephrosia*, *Comesperma* and *Homoranthus*.

#### Ecology

Four botanists were engaged on the Western Arid Region Land Use Study being co-ordinated by Development Planning Branch. The study aims at producing an inventory of the natural resources and land use practices of south-western Queensland. An inventory of this type is needed for the planning of land use in the area. Work on Part 2 of the study area, which extends from Adavale to Blackall-Isisford and west to Betoota, is nearing completion. The map of the land-systems has been published and the vegetation map is ready for printing.

Field work in Part 3, which extends from Charleville to the New South Wales border, is well advanced. The land systems and vegetation maps of Part 4, which is to the east of Part 2, are in an advanced stage of production and text of the report is being prepared. Some field work in Area 5 (Maneroo, Winton, Longreach, Muttaborra and Tangorin map sheets) was completed but further work in the field is necessary.

A map and account of the vegetation of the granite-traprock country of south-eastern Queensland were published as part of a report of the land-use survey of the area.

Mapping and description of the mangrove communities of Queensland continued. This project is being carried out in association with the Queensland Fisheries Service, which is conducting a Biological Resources Survey (Estuarine Inventory). Information from the survey will be used to establish priorities for future fisheries reserves and for management policies.

Three maps of the mangrove areas between Tannum Sands and Round Hill Head were printed and the notes will be published soon. Initial photo-interpretation and field work of the area Round Hill Head-Woodgate have been completed.

The mangroves of Moreton Bay were mapped as part of the Proposed Brisbane Airport Environmental Study. With financial support from the Queensland Fisheries Service, it is expected that maps and accompanying notes will be published in the 1977-78 financial year.

The Beach Protection Authority is preparing reports on Dune Surveys for Beach Erosion Investigation Reports. Patterns of the beach-dune system, vegetation maps and dune

Western Arid Region Land Use Study. Sand dune country on 'Tanbar', western Queensland: spinifex (*Triodia basedowii*) running down to an ephemeral lake fringed with scattered mulga (*Acacia aneura*).







Mangrove rehabilitation on North Stradbroke Island. Mangroves planted after the sand-mining dredge had passed through the area in 1970.

profiles are needed for reference reports. Vegetation maps and profiles for the Livingstone Shire are being prepared. The work will extend to other Shires.

In co-operation with the Beach Protection Authority, studies into the ecology of coastal sand dunes continued. Data on the hairy spinifex (*Spinifex hirsutus*) life-cycle trial were analysed and a report on the trial is being prepared for publication.

### Special projects

Two projects are being funded largely through Commonwealth Government grants. They are the Queensland Herbarium Data Storage Project (HERBRECS) supported by the Australian Biological Survey, and the Inventory of Plants and Plant Communities Project funded under the National Estate Program.

1. The HERBRECS project is aimed at the compilation of a computerized data bank of information about the plants of Queensland from labels on herbarium specimens. About 66 000 records were entered for the year bringing the total number to 176 000. The program is progressing ahead of schedule as substantially more entries than anticipated are being processed.

An increase of 20% was achieved this year, despite delays in having replacement staff appointed following resignations. Delays resulted in a decrease in work time of about 8% over the year and caused problems in fully utilizing the data entry terminal installed in the building. Retrievals were kept to a low level because of their high cost. The cost is expected to decrease when new computer facilities are available.

2. The Inventory of Plants and Plant Communities project will result in the preparation of vegetation maps of the Moreton region with accompanying structural and floristic description of the plant communities. The Brisbane map sheet has been printed and the explanatory notes will be completed soon. The vegetation map of the Beenleigh sheet is being prepared, and field work for the Murwillumbah and Caloundra sheets is in progress.

As well as maps of the vegetation of the Moreton District, vegetation surveys of Fauna and Flora Reserves were commenced. These reserves are now under the administration of the National Parks and Wildlife Service. Photo-interpretation of the Palmgrove Reserve (80 km NW of Taroom) and Grant Reserve (50 km ENE of Barcaldine) were completed, and some field work was done in the Palmgrove Reserve.

### Service and extension

The Branch has two major service functions. The taxonomy group maintains a plant identification and advisory service, and the ecology group assists in the preparation and examination of Environmental Impact Statements. About 11 000 specimens were identified for the public, other Branches, Departments and organizations. Identification of large collections from Lizard Island and Weipa resulted in two officers each being joint authors in papers published on the vegetation of these areas.

The identification of *Cannabis sativa* continues to make heavy demands on the staff, with 844 identifications of the plant being made for the Police Department by three officers of the group. This required approximately 48 officer-days of laboratory time, and 97 court appearances by the three officers occupied another 60 officer-days. Two officers were appointed State Botanists for the purposes of the Health Act. They are able to issue a 'Certificate of Identification', which should reduce the number of court appearances needed.

A total of 84 animal stomach contents was examined for the suspected presence of poisonous plant material. Little evidence of cause of death was obtained by these examinations and, after consultation with officers of the Animal Research Institute, it has been decided to restrict botanical examination to cases where plant poisoning is definitely suspected. Examination and identification of roots which had blocked drains were undertaken on 22 occasions.

An article on the possible source of genes for the 'Shatter-cane' characteristics in grain sorghum cultivars in Queensland was prepared for publication in the *Queensland Agricultural Journal*. A description of *Bothriochloa insculpta* cv. Hatch was prepared for registration of the cultivar and assistance was given in preparing an article on the plant.

The ecology group continued to act as an advisory body to the State Government, examining prepared Environmental Impact Statements and providing critical comment on their botanical content, and preparing the botanical sections of Statements for other Government bodies.

Studies of the impact of two developmental projects, namely, the proposed development of Admiralty Island, Cairns, and the construction of Half Tide Tug Harbour near Hay Point, were carried out. Comment on the botanical aspect of nine other projects, including canal developments, transmission lines and open-cut mining was provided.

Portion of the Government submission to the Committee of Inquiry on future use on Moreton Island was provided by the Branch and an officer, together with an officer of the Beach Protection Authority, gave evidence to the Committee on aspects of rehabilitation of dune areas after mining of heavy minerals. This officer also represented the Department on two inspections of revegetation of sand-mining leases in southern Queensland. In most cases, the standard of revegetation work was good.



During the year, the last issue of *Contributions from the Queensland Herbarium* was prepared for publication. This series will be replaced by a new series *Austrobaileya* the first part of which is being printed. Publication of a continuing series of Technical Bulletins was launched with the issue of the first two bulletins—'Vegetation of Moreton Island' and 'The Ecology and Control of *Eremophila mitchellii*'.

Production of the handbook *Weeds of Queensland* is well advanced. Publication should be before the end of 1977. Another three articles on the wildflowers of south-eastern Queensland were published in the *Queensland Agricultural Journal*. Articles published before 1976, with some additional material, have been put together in book form as *Wildflowers of South-eastern Queensland* volume 1. Publication is expected early in the 1977-78 financial year. The introductory article on wattles of south-eastern Queensland has been submitted for publication.

An account of the floristics of the Blackdown Tableland, central Queensland, and a check-list of species of the area were published.

## Queensland Herbarium

The program of maintaining and improving collections in the Queensland Herbarium continued, but fewer specimens than last year were incorporated. Efforts are being made to determine accurately what space is available for storage of specimens so that the space can be used most efficiently. Even so, lack of space will become a critical factor in the management of herbarium in the next few years.

Approximately 12 000 specimens were incorporated in the herbarium during the year. About 2 000 specimens were received and 4 000 sent under exchange agreements with overseas and interstate herbaria. In addition, more than 7 000 specimens were processed in inward and outward loans. Requests for loans totalling more than 3 000 specimens have not been met. The time lag between receiving loan requests and despatch of material is now 7 months. Staff within the services group has been reorganized in an attempt to reduce this waiting time.

The herbarium continued to be a major centre for taxonomic study, with 91 visiting botanists using its facilities during the year.



Siratro can be successfully oversown into a spear grass pasture, increasing its productivity and utilization. This is clear from a comparison of the rank, uneaten grass in the paddock in the foreground with the heavily grazed paddock behind.



# Division of Dairying

THE major activities of the Division of Dairying in the year were designed to assist industry to cope with the challenge of the unfavourable economic circumstances, to maintain high quality in dairy products to retain consumer sales, and to provide technical advice to producers in dairy cattle feeding, breeding and management.

The dairying industry in Queensland again underwent major changes during the year. The number of dairy farmers declined by 8% from 4 672 to 4 293; the quantities of butter, cheese and casein which were manufactured were lower than in the previous annual period; and the amount of milk consumed as liquid milk increased by 3%. Butter manufacture was terminated in four plants because of low output.

During the year, the Report of the Committee of Inquiry into the Dairying Industry was presented to the Government. Decisions arising from consideration of the recommendations resulted in acquisition of a milk pool for redistribution to a number of country factories thus increasing their amount of milk consigned to the Brisbane market. A total of \$571 574 was paid as compensation to those producers who lost market milk entitlement.

Close co-operation was maintained with the Lands Administration Commission in the administration of the Rural Adjustment Scheme, both for dairy farmers and processing plants; with the Commonwealth Department of Primary Industry in the orderly implementation of the Australian Code of Practice for Dairy Factories; and with the Foreign Affairs Department in the presentation of training programs for overseas personnel.

Particular activities of the Branches of the Division which were of major significance were—

## Dairy product quality

**TOTAL COUNT.** The program designed to test all farm milk supplies destined for the liquid milk trade by the Total Bacterial Count test was concluded during the year. Beginning in July 1977, all factories in the State will be undertaking this test procedure which indicates the attention which is being given to marketing high quality products. A standard of 50 000 colonies per ml was adopted for farm raw milk destined for the liquid milk trade.

**CHEMICAL RESIDUES.** There is a continuing program of analytical and advisory services to maintain freedom from undesirable chemical residues in dairy products. During the year, attention was given to analyses for antibiotic residues, insecticide residues arising from tick control practices on dairy cattle, and iodine residues from sanitization procedures on animals and equipment.

A rapid method of testing the incidence of iodine contamination in milk was developed. This enabled a full-scale examination of milk from suppliers and this has highlighted those with high levels and allowed follow up visits by officers. As a result of the testing at 11 factories and the advice from officers, both by advisory circulars and visits, there has been a general reduction in the levels of iodine residues, particularly in market milk.

The problem of residue contamination requires a continual vigilance to assure consumers that adequate attention is being given by industry to effective control measures. It is expected that greater attention will be given to heavy metal residues in the future.

**SUB NORMAL COMPOSITION.** Milks with elevated freezing points but containing no added water continue to pose problems for producers. To date, data have been collected and collated to show the effect of seasonal, nutritional, weather and managerial factors. Depression constants have been determined for lactose, chloride, phosphate, citrate and lactic acid. The value of the Vapour Pressure Osmometer for the detection of adulteration in milk was demonstrated.

**QUALITY MONITORING PROGRAM.** Markets for dairy produce are becoming increasingly discerning and demanding in respect to quality, and it has become necessary to give attention to developing programs for monitoring quality by the Department and quality assurance programs for adoption by industry.

To provide data to assess quality of dairy products, 103 883 bacteriological analyses were performed on 37 718 samples and 74 335 chemical analyses on 23 395 samples. In addition, analyses on 1 005 samples were performed and 252 N.A.T.A. certificates issued for dairy produce being exported to various countries or required for special purposes.

It has become clear that much more attention must be given in future to methods of packaging and presentation of dairy products. To furnish factual information on consumer needs, programs have been mounted to probe areas which will yield data sufficiently reliable to provide guide lines for industry.

## Mastitis

The Mastitis Cell Count Program which began in 1972 using the Wisconsin Mastitis Test (W.M.T.) continued in 30 centres during the year.

In almost every region there has been some reduction in the incidence of mastitis as measured by the W.M.T.

During the year, a Fossomatic Automatic Cell Counter was purchased and, after initial calibration and testing, some 1 000 samples per month were tested on a trial basis. This was expanded in March to cover the testing of milk samples from all Queensland suppliers. As from July 1977, the advice to farmers will change from W.M.T. score to cell counts and the computer program has been modified accordingly.

In 1973, a Mastitis Baseline Survey was undertaken among dairy farmers to determine their knowledge of mastitis and to ascertain the level of adoption of mastitis control practices. A follow up survey has now been completed.

The principles of diagnostic enzymology have been utilized in the development of a new procedure for monitoring the state of health of the bovine udder. This procedure, called the NAGase test, involves the measurement of the level of a certain enzyme in either quarter, composite, bulk or tanker milk samples.

## Pasture production and utilization

The environmental conditions in Queensland have resulted in a dairy cattle industry which is based on grazing of pastures and crops. Because of the continual increasing costs of supplementary feeds, it has become necessary to ensure maximum efficiency from pasture establishment, and management investigations into the role of irrigating and fertilizing grasses and legumes, and the systems of grazing which are employed, were continued during the year.

Studies at both Kairi and Ayr have shown that there is very little benefit in milk production from rotational grazing systems. The same appears to apply to the management of rank-growing summer pastures. Despite a lack of experimental evidence, many farmers and animal husbandry advisers believe that milk production will be maximized by keeping grasses in a short leafy condition.

In the West Moreton, Wide Bay, East Moreton and North Queensland regions, attention was directed towards increasing winter feed supplies by strategic fertilizer application accompanied by irrigation. Several successful field walks were conducted on properties which adopted this system.

Planning and preparation of a guide for producer discussion meetings on pasture feed supplies for dairy cattle continued during the year. This material, designated Project P, has been prepared by a joint inter-Division group and was field tested in the Wide Bay region. It was also evaluated by north Queensland officers and, as a result, major changes in approach have been made to include more technical information. It should be ready for use in late 1977.

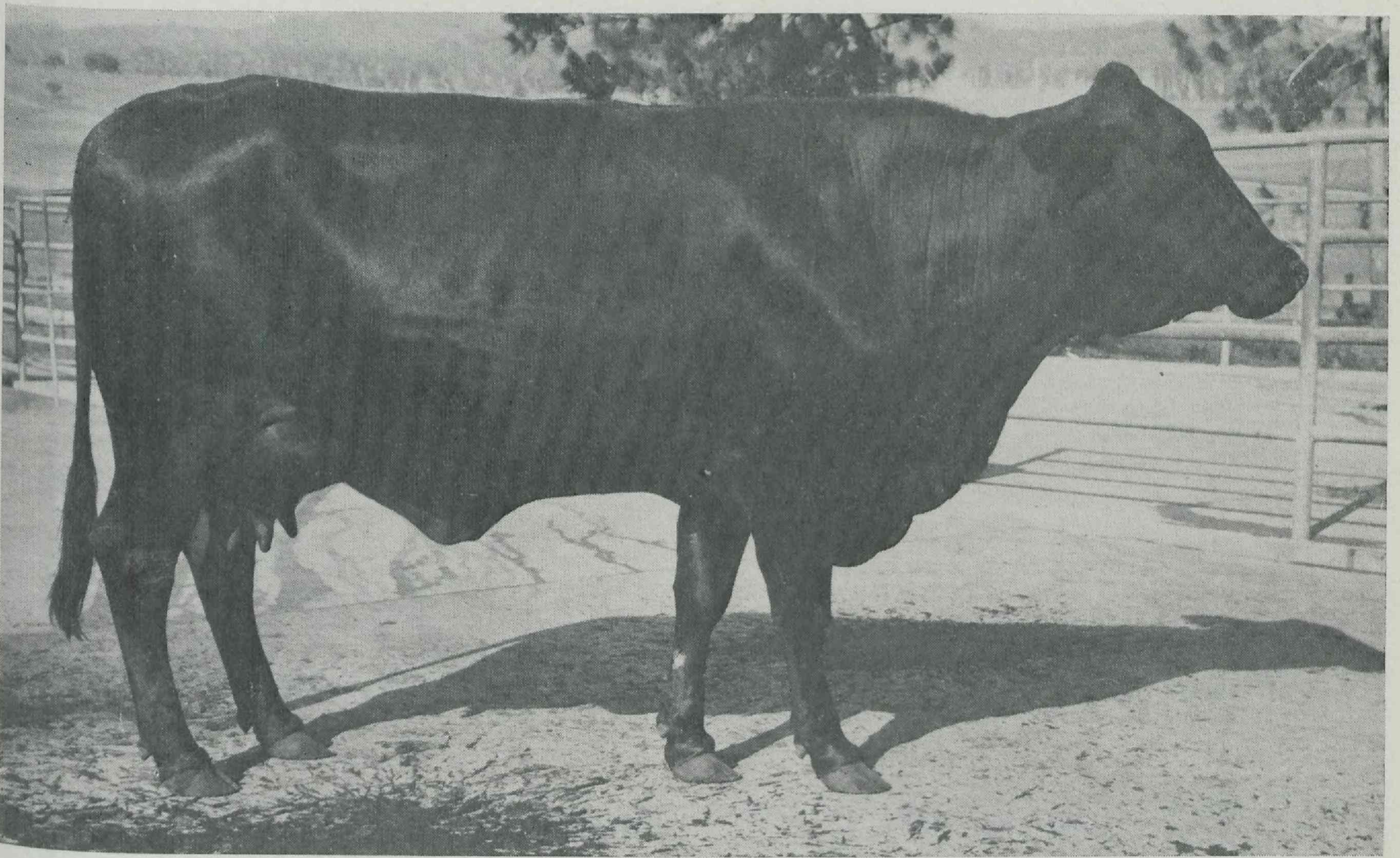
## Sahiwal x Friesian crossbreeding

Both dairying and beef industries, as well as the Department, are becoming more and more concerned with inadequate control of cattle ticks achievable by chemical means. The spread of tick infested areas, and the numbers of infested cattle, together with the occurrence and persistence of resistant strains of tick, have highlighted the need to further develop tick-resistant breeds of cattle. The Australian Friesian Sahiwal (A.F.S.) being developed by the Department is an example of such a resistant dairy breed.

This program of breed development is rapidly gaining support within the industry. It has been extended to south-east Queensland by transferring production-tested A.F.S. animals from Ayr Research Station. Dairymen were able to see the cattle at a field day at Beaudesert in May.

It is expected that, by 1980, the A.F.S. breeding herd will consist of approximately 300 tick-tested and production-evaluated A.F.S. cows. More than 400 calves and yearlings will be in the rearing, tick-testing and mating stages of the program.





A mature Australian Friesian Sahiwal (A.F.S.) cow typical of the breed. The sleek, shiny coat and tick resistance are ideal for the tropics. These animals are now being introduced into herds in south-east Queensland for evaluation by farmers.

### Herd improvement

**DAIRY HERD PRODUCTION RECORDING.** A total of 454 800 milk samples was tested for butterfat and protein at the Dairy Laboratories at Wacol this year. This represents an increase of 69 200 over the number of samples tested last year. The highest number of samples tested in any month was 42 820 in September 1976.

Employing 45 contractors to replace herd recorders in performing the field work of herd recording has stabilized the cost of field operations. It has also allowed a regular service to be maintained to dairymen isolated from the main dairying areas.

Following the recommendation of the Industries Assistance Commission, initial plans have been formulated to adopt a National Dairy Herd Improvement Scheme. This scheme is designed to extend the progeny testing programs among States, to integrate the mastitis monitoring programs, and to provide a herd health recording service to industry. Plans are being formulated to integrate the Divisional programs with the national scheme.

### Artificial breeding

The total movement of semen from Wacol sires increased by 16% to 95 278 doses. This increase is due to sales of Sahiwal and A.M.Z. semen and an increase in movement to New South Wales, South Australia and Victoria.

One hundred and sixty-six technicians were trained at A.I. refresher schools held at Quinalow, Rockhampton, Mackay and Wacol. The number of individual A.I. operators has continued to increase and at least 15 courses are expected to be conducted in 1977-78.

A.I. refresher courses at Mackay, Rockhampton, Wacol and Quinalow were attended by 166 persons. A total of 37 persons undertook the examination for issue of an A.I. certificate and 32 were successful. The successful candidates had received training as follows: 26 Wacol-trained, 3 trained by other A.B. organizations and 3 self-trained.

Studies in artificial breeding of animals other than cattle continued during the year. Progress in chromosome identification in swine was achieved during the year. Success in equine insemination with deep frozen semen was obtained with the birth of three foals.

**TECHNOLOGICAL DEVELOPMENT.** In many areas, industry is unable to carry out its own exploratory work as far as technology is concerned. The Department has accepted this role and, in a number of ways, has made significant contributions.

**WHIPPED CREAM UNIT.** Equipment which whips cream under pressure was developed and fabricated in the pilot plant workshop. The cream is whipped as it ejects from a stainless steel ejection gun similar to the type used for beer.

The dispensing gun fitted with flexible tubing is easy to operate by means of a trigger-controlled valve which responds with instantaneous flow of cream.

The equipment was displayed at the International Catering Trade Fair in Sydney, and the first commercial unit has operated at the Sunshine Plantation, Nambour, since August 1976. Units are now being used throughout Australia, with keen interest displayed by the catering and cooking industries.

A 'cream whipping' unit designed to facilitate the addition of cream to food portions.





**NEW CHEESE.** New varieties of cheese completely dissimilar to cheddar and yet capable of being made with cheddar equipment have been developed initially by the Department. More work requires to be done on the technology of these processes and the assessment of public appeal, but the development is significant.

**CHEESE SCHOOL.** A very successful school for cheese manufacturers has been held in collaboration with industry organizations and the Queensland Agricultural College. Such schools achieve a great deal in enabling industry personnel to keep abreast of developments and retain a clear perspective of their role in a changing industry.

**CODE OF PRACTICE.** There has been a constant demand from industry for advice on matters emerging from the adoption of the Australian Code of Practice for dairy

factories. It seems clear that the Department will be called upon to an increasing extent in factory design and planned operation.

### Milk vending

**MILK LICENSING.** There has been a consolidation of all legislation relating to orderly licensing and distribution of milk to consumers in Queensland. This has required considerable activity by field officers in the major cities of the State outside of the capital. Fully insulated milk vending vehicles are now required for distribution and by May 1977, a total of 545 vehicles representing 91% of all vehicles was constructed in this style. It is expected all vehicles will comply during 1977. In addition, officers were responsible for the co-ordination of licensing of 3 060 milkshops throughout the State.

## Dairy Field Services Branch

THE number and types of supply of registered dairies supervised by officers are detailed in the following table. Details for 1975-76 are included for comparison.

Type of Supply	1976-77	1975-76
Cream .. .. .	1 010	1 185
Market milk .. .. .	50	37
Manufacture milk .. .. .	138	611
Market + manufacture milk .. .. .	3 069	2 603
Cream + market milk .. .. .	0	74
Cream + market M + manufacture M .. .. .	0	138
Milk—raw .. .. .	26	24
<b>Total .. .. .</b>	<b>4 293</b>	<b>4 672</b>

This shows a decrease of 8%, which is a similar reduction to that of the previous year. Some of the group supplying milk for manufacture only were given a share of the market milk trade and there are now only 138 milk suppliers not receiving some share of this trade. The decline in the number of cream suppliers continued.

In keeping with the decrease in the number of suppliers, there has been a decline in levels of production of most manufactured dairy products. Total butter production decreased by 29.8%; cheese production decreased by 13.4%, total market milk sales increased from 233.6m litres to 240.9m litres (which indicates a stable per capita consumption), combined milk powder production and casein output also decreased.

A total of 7 635 tonnes of butter was imported from Victoria and Tasmania to supplement local supplies. This is less than in the previous year, despite the low Queensland production, and is due to a change in policy of the Dairy Corporation preventing long-term storage of interstate butter in Queensland.

### Branch activities

In a review of Branch programs, it is important to appreciate that the present morale of the industry is at a lower ebb than in previous years. The recent price increase for market milk has widened the gap between the returns from market and manufacture milk and has further highlighted the plight of the supplier with little or no market milk entitlement.

### Dairy cattle nutrition

Emphasis has been given to this program through the 11 'whole farm development' demonstrations throughout the State. The feed year plans on these properties provided excellent commercial examples for advisory programs. It is unfortunate that the small financial support provided from C.E.S.G. funds has terminated, as this acted as a stimulus to co-operation. An evaluation of these and previous demonstrations is currently being undertaken.

In the West Moreton, Wide Bay, East Moreton and North Queensland regions, attention was directed to increasing winter feed supplies by strategic fertilizer applications accompanied by irrigation. Several successful field walks were conducted on properties which adopted this system. In north Queensland plantings of ryegrass and oats have increased markedly over those of the previous year.

A detailed costing analysis in the West Moreton region showed that the price paid for manufacture milk was below production costs, even on farms with the lowest cost of production.

Planning and preparation of a guide for producer discussion meetings on pasture feed supplies for dairy cattle continued during the year. This material, designated Project P, has been prepared by a joint inter-Division group and was field tested in the Wide Bay region. It was also evaluated by north Queensland officers and, as a result, major changes in approach have been made to include more technical information. It should be ready for use in late 1977.

### Mastitis

The Mastitis Cell Count Program which began in 1972 using the Wisconsin Mastitis Test (W.M.T.) continued in 30 centres during the year.

A summary of the results of testing in the several regions is listed below.

### 12-MONTH W.M.T. MEANS OF ALL SUPPLIERS ON REGIONAL AND STATEWIDE BASIS

Region	1974	1975	1976
North Queensland .. .. .	14.23	14.98	14.24
Central Queensland .. .. .	14.14	13.78	14.53
Maryborough .. .. .	14.17	12.24	11.17
Wide Bay .. .. .	11.85	12.78	13.47
South Burnett .. .. .	15.76	14.86	14.89
East Moreton .. .. .	14.32	14.12	12.53
West Moreton .. .. .	14.10	14.23	12.38
Darling Downs .. .. .	15.04	13.40	12.62
State .. .. .	14.05	13.72	13.00

Means are calculated on the basis of continuing suppliers only.

In almost every region, there has been some reduction in the incidence of mastitis as measured by the W.M.T.

Although the full program of milk sampling and analysis, computation and return of results, and field advisory meetings and farm visits was implemented, one of the main activities has been the preparation for a change in the testing methods.

During the year, a Fossomatic Automatic Cell Counter was purchased and, after initial calibration and testing, some 1 000 samples per month were tested on a trial basis. This was expanded in March to cover the testing of milk samples from all Queensland suppliers. As from July 1977, the advice to farmers will change from W.M.T. score to cell counts, and the computer program has been modified accordingly.

As a consequence of the installation of the Fossomatic, the use of the Coulter Counter has decreased, and samples from one factory only are counted on both the Coulter Counter and the Fossomatic. Both units are used in an Australia-wide Cell Count Standardization program, from which valuable information has been obtained. Excellent co-operation has been experienced with other State Departments in this program.





The Fossomatic somatic cell counting unit used in examining herd milks in the mastitis detection and control program.

### Mastitis investigations

**TEAT DIP AND DRY COW THERAPY TREATMENTS.** A variety of combinations of treatments to compare the efficiency of recommended procedures has been employed on 18 commercial herds. Final reports have been submitted on 10 of these, one has been abandoned and seven are continuing. Variable responses to treatment have been obtained.

**RELATIONSHIP BETWEEN W.M.T. AND ELECTRONIC CELL COUNT.** Several linear regression analyses of the relationship between W.M.T. Score and Fossomatic Cell Count have been carried out throughout the year. The results show there is only a fair relationship between the two techniques.

### Mastitis survey

In 1973, a Mastitis Baseline Survey was undertaken among dairy farmers to determine their knowledge of mastitis and to ascertain the level of adoption of mastitis control practices. A follow-up survey has now been completed and preliminary results show the percentage of farmers using recommended practices as follows—

	1973	1976
Teat dipping .. .. .	18	33
Dry cow therapy .. .. .	13	61
Running water for udder washing ..	31	52

### Herd improvement

In view of the impending changes in the Herd Recording program, there has been a wait-and-see attitude by both producers and officers which has limited the amount of promotion work undertaken by field staff.

In the area of artificial breeding, the program of self-training for producers by special Herdsman courses has continued. A total of 13 courses for 107 people was completed with district staff supporting the training team from the Dairy Cattle Husbandry Branch. The interest in this program has somewhat minimized the declining usage of artificial breeding, which has occurred because of the present economic difficulties in the industry.

### Statistics

The following tables summarize activities in the several subject areas described above.

#### FARM VISITS

	Darling Downs	West Moreton	East Moreton	Wide Bay-South Burnett	Burnett	Central Queensland	North Queensland	Total
Routine .. .. .	1 127	406	785	1 084	420	527	210	4 559
Quality Improvement	952	783	722	1 498	435	301	167	4 858
D.P.S.S. .. .. .	632	364	222	402	88	49	33	1 790
Husbandry .. .. .	1 035	407	439	1 246	144	340	534	4 145
<b>Total .. .. .</b>	<b>3 746</b>	<b>1 960</b>	<b>2 168</b>	<b>4 230</b>	<b>1 087</b>	<b>1 217</b>	<b>944</b>	<b>15 352</b>

Two semen depots at Mackay and Rockhampton are operating satisfactorily and certainly assist with distribution.

The use of show exhibits has continued.

### Calf rearing

To complement the program in herd improvement, special attention was given to young stock management. A special discussion guide on calf rearing, Project CR, has been used successfully in several districts. This program is now moving into the heifer management phase following the considerable success which was achieved with the calf rearing program.

### Dairy Farm Assistance Scheme

In association with the Department of Lands, officers in many centres were involved in farm development and bulk milk conversion programs. These programs were financed by both the Commonwealth Dairy Adjustment Program and a State financial scheme. Although less use of them is now being made for the change to bulk milk, and the installation of new machines, there is still interest in the schemes, particularly in loans for carry-on finance and farm build up. Good liaison has been maintained with officers of the Land Administration Commission. Field officers have expressed satisfaction with the impact of this program in their districts.

### Industry Liaison Committees

Following a pattern developed over several years, officers continued to liaise directly with local producers on seven Dairy Extension Advisory Committees, and with industry representatives on 11 Milk Vending Advisory Committees. This association is regarded as extremely important to formulation of programs and subsequent adoption of recommended procedures. In addition, officers have been closely associated with eight active district Discussion Groups and several Q.D.O. branches in their extension advisory work.

### Australian Development Assistance Bureau

In association with this Commonwealth agency, Branch staff were responsible for servicing an International Training Course in Animal Husbandry in 1976 for 15 overseas officers, and one in Dairy Technology in 1976 for 17 overseas officers. Each required detailed organization for a 3-month period with course curriculum, published material and practical field attachments.

A further course in animal breeding is being prepared for presentation late in 1977. Participation in these courses is a valuable in-service training function for participating staff.

### Newsletters

As a phase of the extension program in all regions, Branch officers have contributed materially to regional information news sheets. Staff participate in publications in north Queensland, Mackay, Wide Bay, East Moreton, West Moreton, Darling Downs, Bundaberg and the South Burnett. It is considered these publications form an important avenue of communication with producers.

A sub-committee of officers from East and West Moreton has revived the 'Happy Jack Calendar' which will be published in 1978. Sponsors for nine months have been received from commercial firms.

### Special investigations

Apart from those reported elsewhere, officers were involved in the following investigations—

Artificial induction of lactation of dairy heifers in Wide Bay region using injections of progesterone and oestrogen.

Evaluation of milk replacers in Gympie and Cooroy areas.

An extensive sampling program to give information on the changes in Total Bacterial Count of milk in the normal course of storage at Booval, Woodford and Beaudesert factories and subsequent tanker transport to Brisbane.

Use of 'Hi-En' as an energy supplement.



## EXTENSION ACTIVITIES

Description	No.	Attendance
Farm walk-Field day-tour .. .. .	45	1 394
Method demonstration .. .. .	7	78
Film-lecture evenings .. .. .	23	580
Project clubs-Junior Farmer .. .. .	19	517
Farmer schools .. .. .	25	391
D.E.A.C.-Q.D.O.-disc. group .. .. .	100	2 488

These levels of association with industry are somewhat lower than the previous year. This year, greater emphasis has been placed on quality improvement, and there has been a large increase in the number of farm visits for this purpose.

**Dairy product processing**

There are 46 dairy product processing centres operating throughout the State. Several of these are functioning as multi-product plants. The dairy products manufactured are—

Butter .. .. .	15
Cheese (cheddar) .. .. .	10
Cheese (other than cheddar) .. .. .	11
Pasteurized milk .. .. .	22
Powders .. .. .	12
Casein .. .. .	4
Ice cream .. .. .	6
Yoghurt .. .. .	5
Other dairy .. .. .	3

Officers have serviced this section of the industry with routine visits to review quality control programs and special surveys to identify causes of problem conditions. This service co-ordinates with the official gradings undertaken on manufactured products and the bacteriological and chemical analytical programs undertaken by the Dairy Research Branch. A total of 1 279 visits and 160 investigational surveys was completed during the year. A total of 95 inspections was undertaken of milk depots and dairy product stores.

**Rationalization and modernization**

In the course of routine duties, officers have been associated with the following actions by factory management—

**CLOSURES.** The Nanango and Kingaroy butter factories ceased manufacturing at the end of the year and now act as milk receival depots. Butter manufacture also ceased at Bundaberg and Caboolture factories during the year.

**MILK PACKAGING.** The trend away from bottles continues, and cartoning equipment was updated in six factories. There is also a move away from cans for bulk milk, and two more factories now use 20-litre plastic bags for this trade.

**BUILDINGS.** The main expenditure on buildings has been the provision of tanker bays at five factories with these being financed largely by Dairy Assistance programs. A major undertaking which is nearing completion is a new milk depot in Cairns featuring the cargon system of handling, the first in Australia.

**Code of practice inspections**

The joint Commonwealth-State review program continued during the year. All factories have now received a report following the first joint inspections. Very few factories comply completely with the many requirements, but there has been a wider acceptance of the value and need for these inspections and standardization to satisfy market specifications.

Examination of building plans and specifications, together with associated consultation, is becoming an increasing responsibility of section staff, particularly as factories apply for permission to alter or extend buildings and to install new equipment.

**New dairy foods**

There was interest by a few factories in the marketing of new dairy products. Consultations were held with six factories in this regard and two of these have introduced new lines. Two other factories have signified their intentions to produce new products.

**Factory operative training**

In association with the Australian Dairy Factory Managers' and Secretaries' Institute, two successful staff training programs were completed. These were held in Brisbane and gave tuition to 12 factory operatives who were sitting for factory certificates in milk and cream testing and milk grading.

Officers also assisted at a workshop held at the Queensland Agricultural College where 16 operatives discussed Total Count Testing of milk and a follow up school for 10 operatives was held at Gladstone.

This training is an important phase of industry development and will continue to be a service function of the Branch. The co-operation of the staff and facilities of the Queensland Agricultural College is acknowledged. A workshop for cheesemakers was held in June 1977.

**Dairy Products Bulletin**

This successful publication continues to provide an important means of disseminating information on industry practices and new technology. Contributors were drawn from a wide field of industry experts. It is now reviewed by Mr Ernest Mann for 'Dairy Science Abstracts'.

**Investigational program****Slime growth defect on blue vein cheese**

A comprehensive identification and control program was carried out into the incidence of slime growth on blue vein cheese during the year following a request from the production manager. Dairy Research Laboratory staff identified the causative organism as *Bacillus licheniformis*. This organism was found to be spore-forming and thus difficult to kill with any of the available sanitizers on the market. The incidence of the organism was widespread; it was found in the manufacture room, cold rooms and whey tanks.

The defect formed by the bacillus was that of a reddish-brown slime growing on the outside of the cheese and establishing itself approximately 2 weeks after manufacture.

This slime has always been present on Blue Vein cheese and appears to contribute partially to the ripening process of the cheese. However, growth has always been controllable by simply scrubbing the cheese before re-sale and re-wrapping the cheese in aluminium foil.

Several control measures were tested to judge their effect on the growth of slime and, of these, sealing cheese in cryovac bags and freezing the cheese were found to be effective.

However, both of these measures produced undesirable side effects in the cheese and were therefore unacceptable. At present, cheeses are sealed in cryovac bags following salting and needled through the bag.

This method is only moderately acceptable as slime does appear on the cheese ends, but the overall situation is much improved. Steps have also been taken with agents to reduce the size of cheese orders and to improve storage and transport. These measures have resulted in an improvement in cheese quality, but it is felt that the ultimate solution is to package the cheese away from the manufacture area to avoid cross-contamination from infected cheese.

**Dairy Produce Act**

The re-drafting of a new Act and Regulations continued during the year, but the Act was not submitted to Parliament because of the setting up of the Committee of Inquiry into the Queensland Dairy Industry.

Officers supervised the following subject areas during the period under review—

**DAIRY BUILDINGS.** As a consequence of the continuing conversion to bulk milk, particularly in central Queensland, 79 new buildings were erected and 141 renovations completed. Of the 79 new buildings, 63 were herringbones, both high-line and low-line. A total of 133 bulk milk vats was installed under guidance of district staff in accordance with Regulation 220.

**MILKING MACHINES.** In association with the building program, there were 80 new milking machines installed and 80 second-hand units placed into operation. This is considerably fewer than the previous year and represents approximately 4% of all suppliers. In association with this supervision, officers completed performance testing on 763 milking machines (19% of operating units). It is disappointing that a larger number of producers do not avail themselves more widely of this free service.

**CERTIFICATE OF COMPETENCY.** A total of 54 practical examinations was undertaken in connection with the Certificate examinations conducted under this Act. There are operatives in the industry who do not possess the required written qualifications to perform the skilled duties in factories, and officers have undertaken to provide tuition to some of those to assist them in their examinations.

**DAIRY PRODUCE GRADING.** Two officers were engaged full-time performing grading duties. Regional officers grade local sales cheese and butter at factories within their respective regions.



Approximately 58% of the State butter production was examined and the following table shows the overall quality.

	Quantity (boxes)	Per cent
Choice .. ..	57 883	37.76
First .. ..	74 097	48.34
Second .. ..	13 237	8.64
Below Second .. ..	8 072	5.26
<b>Total .. ..</b>	<b>153 289</b>	<b>100.00</b>

The lowered percentage of choice butter appears to be the result of lowered factory intake and blending of creams, as well as oxidized flavours derived as a result of factory separation.

All butter received in bulk from Victoria and Tasmania was graded by State grading officers. A total of 7 635 tonnes of butter was graded, of which 6 608 tonnes were forwarded as Choice and 1 027 tonnes as Second grade butter.

The following table demonstrates the quality of these butters as determined by State graders.

Choice	First			Second		Below Second Grade
	92	91	90	88-89	86-87	
93	92	91	90	88-89	86-87	83-85
82.59%	10.96%	3.62%	1.85%	0.66%	0.21%	0.11%

These figures are for butter submitted as Choice quality. The main defects were oxidized, butyric and rancid flavours, associated with poor quality milk and cream and also due to storage conditions.

Cheese grading was carried out at agents' stores in Brisbane and at some factories where the total production has been graded by State grading officers and regional officers.

The figures given below include cheese graded by Commonwealth export officers.

A total of 8 114 tonnes of Queensland cheese, representing 75% of production, was graded as follows:

Grade	Quantity kg	Per cent
Choice .. ..	1 572 279	19.38
First .. ..	5 936 019	73.16
Second .. ..	568 038	7.00
Below Second .. ..	37 661	0.46
<b>Total .. ..</b>	<b>8 113 997</b>	<b>100.00</b>

## Dairy Cattle Husbandry Branch

THE objectives of Dairy Cattle Husbandry Branch relate to its responsibilities in two major areas: dairy husbandry research and herd improvement services.

**DAIRY HUSBANDRY RESEARCH.** This commitment involves developing technology which will enable farmers to overcome production problems or adopt more efficient production methods in their dairying enterprises.

**HERD IMPROVEMENT SERVICES.** These consist of dairy herd production recording and cattle artificial breeding services; and research and development within these services as necessary to meet the needs of Queensland stock-owners.

In addition to performing research and providing farmer support services, the Branch co-operates with extension staff in encouraging adoption of new technology and effective use of herd improvement services by farmers.

### Dairy husbandry research

#### Current programs

Current studies can be summarized under the following headings: 1. nutritional requirements of different age groups. 2. Investigations into alternative farming systems. 3. Animal and pasture management studies. 4. Development of a tick-resistant dairy breed. 5. On-farm projects.

#### Nutritional requirements of age groups

**PREWEANING.** *Biloela Research Station.* The work on multiple suckling has established that it is possible to rear 16 calves per lactation. Calves are weaned at 56 days. The technology of early weaning for artificial rearing has been

There has been a decline in cheese quality shown by this table. However, the amount of cheese graded has been increased by 64.4% over last year's figures and the gradings have apparently expanded into lower grade areas of the State production.

**RAW MILK QUALITY TESTING.** As a consequence of the proposed amendments to the milk quality testing regulations, a comprehensive program relating to Total Count Testing for raw milk has continued.

Attention has been given to standardizing factory laboratory equipment and operations to ensure the industry is fully equipped to adopt this procedure in July 1977. Two workshops for factory technologists and testing operators were held as part of this program. All factories are now regularly testing milk from suppliers.

**RESIDUE CONTAMINATION OF MILK.** As detailed in another section of this report, continued attention was given to undesirable contamination with pesticide levels in dairy products.

The incidence of iodine contamination in milk was again reviewed during the year and a rapid method of testing developed. This enabled a full-scale examination of milk from suppliers, which has highlighted those with high levels and allowed follow up visits by officers.

As a result of the testing at 11 factories and the advice from officers, both by advisory circulars and visits, there has been a gradual lowering of the incidence of high residue levels in both farm milk supplies and pasteurized milk. From an initial testing of 1 436 milks, the per cent. with levels below the maximum residue limit of 500 micrograms per litre increased from 32.9 to 45.2 in the follow-up testing of 1 525 milks. There is, however, an urgent need for remedial action by industry.

**MILK LICENSING.** There has been a consolidation of all legislation relating to orderly licensing and distribution of milk to consumers in Queensland. This has required considerable activity by field officers in the major cities of the State outside of the capital. Fully insulated milk vending vehicles are now required for distribution and by May 1977, a total of 545 vehicles, representing 91% of all vehicles, was constructed in this style. It is expected that all vehicles will comply during 1977. In addition, officers were responsible for the co-ordination of licensing of 3 060 milk shops throughout the State.

### The Margarine Act

Action under this Act was confined to limited sampling for analyses and was mainly undertaken by Divisional staff, and samples were submitted to the Dairy Research Branch for analysis.

adopted for the multiple suckling situation. Calves were allowed to suckle twice a day up to 21 days before weaning, and then once a day only. Calves managed by this system have higher weight gains post-weaning than calves suckled twice a day until weaning.

This was the final experiment in several years' intensive study of multiple suckling systems for rearing dairy replacements. The project has established that multiple suckling considerably reduces the labour requirement for calf rearing, the calves have higher growth rates than bucket-reared animals, and are less susceptible to disease.

**POST-WEANING TO PARTURITION.** *Ayr Research Station.* Four years' work has been done on the post-weaning growing of heifers on nitrogen-fertilized tropical grass. This has shown that an average daily growth rate of 0.6 kg is difficult to obtain without supplementation. This year's work examined different levels of grain supplementation.

Response to grain feeding was approximately 0.1 kg gain per day per kg of grain fed.

**Field trials.** On-farm investigations have shown that the growth rate of growing heifers is generally 0.4 kg per day or less. Trials throughout Queensland on kikuyu pastures have demonstrated that, where adequate fertilizer is used on improved dryland pastures, growth rates of 0.5 kg per day can be achieved with heifers stocked to 3.2 per ha. Some supplementation is required to achieve the target growth rate.



On-farm production responses to drenching have been variable. Under wet conditions, drenching has generally been effective in preventing deaths and achieving positive gains. During fine weather, responses have not always occurred. However, a standard monthly 5 ml injection with anthelmintic from birth to 8 months is recommended as a good precaution.

**Lactating animals.** Most recent work into the nutritional requirement of lactating animals has been in the supplementary feeding field.

**Molasses-grain.** Work in the past year indicates that, where maize or molasses are fed for most or all of the lactation, both give between 0.9 and 1.1 kg milk per kg of supplement D.M. fed.

There is an obvious economic advantage in feeding molasses in those districts where its cost is only one-third that of grain. On both the Atherton and Eungella Tablelands there has been a marked swing to molasses feeding over the past 5 years. Much of this cost saving change can be traced to Departmental studies comparing molasses and grain.

**Protected fat.** A further study with lactating animals has examined feeding of 'protected' tallow. This project originated from farmers' problems with low milk fat tests in the July—October period. Many farmers on the Darling Downs were affected.

It has been shown that butterfat percentage in milk can be raised by feeding 'protected' tallow at relatively low levels. Although the supplement is expensive, its use is economic to avoid penalties for sub-standard composition. There is also a possibility of using the supplement at higher levels early in lactation to promote high initial milk yields with acceptable fat levels.

### Alternative farming systems

**GRASS-LEGUME PASTURES.** The bulk of milk produced in Queensland is from grass-legume pastures. The strengths and weaknesses of tropical species have been well defined for the Atherton Tableland.

A trial at Kairi Research Station with Friesians grazing glycine-green panic pastures has shown that, while production of milk per hectare increased almost linearly with stocking rate from 5 194 to 7 750 litres per ha, legumes could not be maintained satisfactorily at higher stocking rates.

Allied to these studies has been the investigation of fertilizer nitrogen as a means of boosting winter feed yields. This has generally been shown to be economic only at higher stocking rates.

**GRASS-NITROGEN PASTURES.** (a) *Research station studies.* A trial in north Queensland is comparing nitrogen-fertilized grass at high stocking rates with the grass-legume system at a lower stocking rate. Preliminary results show that milk production per head is higher from grass-legume pastures than from grass-nitrogen pastures. However, nitrogen-fertilized pastures support higher stocking rates and give increased production per hectare.

Under irrigation in north Queensland, nitrogen-fertilized pangola grass pastures with six cows per ha have consistently produced 18 411 litres of milk per ha when a molasses supplement has been fed to the cows.

*Field trials.* Two farms in south-east Queensland, at Grantham and Toogoolawah, have been used to gain further basic information on the productivity of irrigated kikuyu and pangola grass when grazed by dairy cows. Both trials are now in their second year.

At Grantham, the kikuyu sward is now very dense and has smothered out all other grass species. Again this year the 'Government' herd of 20 cows has been fully maintained throughout the 12 months on the 4.8 ha kikuyu paddock with no supplementary feed. Production per ha has been 11 995 litres of milk.

The owners of the property have been so favourably impressed by their success in this project that they are introducing Whittett kikuyu on the rest of the farm.

In 1972, it was considered that pangola grass could contribute to profitable dairying in the Toogoolawah district which supplies milk for the city market. An area of 4.05 ha of pangola was planted and stocked with 4.75 Friesian cows per hectare.

The production of 11 323 litres of milk per ha compares very favourably with other grass species. Clearly, this pasture has a place in an overall farming system in south-east Queensland as it survives the winter and is able to withstand heavy grazing for 7 to 8 months of the year. It will need to be used in conjunction with a winter-growing species such as oats or ryegrass for a whole-year grazing program.

### Animal and pasture management

Studies at both Kairi and Ayr have shown that there is very little benefit in milk production from rotational grazing systems. The same appears to apply to the management

of rank-growing summer pastures. Despite a lack of experimental evidence, many farmers and animal husbandry advisers believe that milk production will be maximized by keeping grasses in a short, leafy condition.

### Tick resistant dairy breed

The Australian Friesian Sahiwal (A.F.S.) program is rapidly gaining support within the industry.

The program has been extended to south-east Queensland by transferring production-tested A.F.S. animals from the Ayr Research Station. Producers were able to see the cattle at a field day at Beaudesert in May. Farmers are becoming very concerned at the problem of efficient tick control with acaricide-resistant ticks becoming more prevalent and production of effective tickicides declining.

A limited number of tick-resistant, production-tested A.F.S. cows have been loaned to Moreton Region farmers on the same terms as apply to north Queensland co-operators. Fifteen farmers are waiting for heifers to become available following lactation testing, and a further 15 have contacted the D.P.I. expressing interest in the program.

More than 150 Friesian cows have been nominated for mating to A.F.S. bulls in the project's bull proving scheme.

Tested A.F.S. cows are also on loan to co-operators in the Atherton Tableland, Eungella Tableland and Sarina areas. These co-operators also provide cows for A.F.S. bull proving.

Bull proving of A.F.S. is now under way and this year 19 A.F.S. and three seven-eighths Sahiwal bulls are available for tick testing and subsequent semen evaluation.

Lactation testing of the heifers has continued with a large variation in milk yield in the 'passed' heifers. The top-yielding heifer this year has produced 4 360 litres of milk in a 300-day lactation.

It is expected that, by 1980, the A.F.S. breeding herd will consist of approximately 300 tick-tested and production-evaluated A.F.S. cows. More than 400 calves and yearlings will be in the rearing, tick-testing and mating stages of the program.

### Herd improvement services

#### Dairy herd production recording

Centralized testing, which replaced on-farm testing of milk for butterfat content in August 1975, is working satisfactorily. Improved cooling and packaging procedures have resulted in an improvement in the quality of milk samples received at the Wacol laboratory.

A total of 454 800 milk samples was tested for butterfat and protein at the Dairy Laboratories at Wacol this year. This is an increase of 69 200 over last year.

Employing 45 contractors to replace herd recorders in performing the field work of herd recording has stabilized the cost of field operations and has allowed a regular service to be maintained to dairymen isolated from the main dairying area.

The change to new production recording systems is continuing. When fully operational, the new programs will allow farmers a wide range of production recording systems. The farmer may choose the type of system best suited to his farm and herd management requirements.

**MILK PRODUCTION RECORDING.** The total number of herds recorded fell from 800 in 1974-75 to 770 in 1975-76. The total number of cows tested increased by 2 800 (6.4%) during the same period.

Some outstanding production performances for the 1975-76 recording year were noted.

A Friesian cow 'Woodlin Reunion Leila' owned by Messrs J. and G. Wood, broke the existing fat production record as a mature cow for all breeds by producing 11 309 litres of milk and 536 kg of fat. She also produced the highest milk yield for all breeds for the year.

Notable A.I.S. performances were—'Wilmington Plum', owned by Messrs L. W., M. J. and G. F. Peters, produced 10 485 litres of milk and 450 kg of fat in 300 days as a junior 4. This cow established new ground milking competition records for milk, fat, and total solids at the Brisbane Royal National Association Show in 1976. She produced 96.6 kg of milk, with 4.29 kg of fat and 12.96 kg of total solids in 48 hours.

'Cedar Valley Plumcott 37th', owned by Messrs L. W., M. J. and G. F. Peters, produced 8 499 litres of milk and 416 kg of fat in 300 days as a mature cow.

**GOAT RECORDING.** Goat recording is still limited to only a few breeders. Unfortunately, most goat herds are small and the high costs involved in recording small herds makes it impossible to record many of them. During the 1975-76 recording year, 61 does completed lactations. Their average production per lactation was 888 kg of milk and 35 kg of fat in 276 days.



## Artificial breeding

The total movement of semen from Wacol sires increased to more than 95 000 doses, an increase of 16% over the previous year. This increase is due to sales of Sahiwal and A.M.Z. semen, and an increase in movement to New South Wales, South Australia and Victoria.

Sale of semen from the depots at Mackay and Rockhampton almost doubled for the 1976-77 year (3 212 doses versus 1 642 doses). These depots have greatly improved the service to clients in these areas.

Sale of semen from consignment stocks held at the Atherton Tablelands A.B. Co-operative fell sharply because of the difficulties of the insemination service in that area.

Export of semen amounted to 16 292 doses, 65% of which was A.I.S. semen dispatched to the U.S.A. in March. Semen of six breeds of cattle was exported, with the Sahiwal and A.M.Z. breeds accounting for about 23% of the exports other than A.I.S. Countries which imported our semen were Hong Kong, New Zealand, Malaysia, Philippines, Panama and the United States.

There are now 105 bulls at the Centre, of which 89 are dairy sires and 16 beef sires. In May 1977, 320 500 doses of semen were in storage at all locations. This is an increase of 12 500 on last year's stocks.

One hundred and sixty six technicians were trained at A.I. refresher schools held at Quinalow, Rockhampton, Mackay and Wacol. The number of individual A.I. operators has continued to increase. Training was provided mainly by on-farm courses and at least 15 courses are expected to be conducted in the 1977-78 year.

A.B. promotion and extension has mainly centred around providing trainees in the insemination courses with information regarding the services and semen supplies available from Wacol A.B. Centre.

Visitors from overseas included diplomats, scientists and primary producers from Malaysia, Philippines, U.S.A., Argentina, British Solomon Islands, Canada, Cuba, Ecuador, Fiji, India, Mauritius, Papua New Guinea, United Kingdom, Zambia, El Salvador and Brazil. Representatives of a number of State Departments of Agriculture have also visited the Centre as have a number of stud breeder groups and farmer groups.

**LICENSED SEMEN PRODUCTION.** Eleven privately-owned bulls entered the licensed semen production unit. One hundred and thirty collection attempts were made with 29 286 doses stored, representing 94.4% success in processing.

**UNLICENSED SEMEN AND CUSTOM FREEZE SERVICE.** Nine bulls were housed at the unlicensed centre during the year. Successful collections were obtained from eight of these bulls. A total of 4 435 doses of semen was processed, with a success rate of 66%.

There was a marked increase in the use of the custom freeze service during the 1976-77 year. In all 16 811 doses were produced in the 1976-77 year compared with 7 092 doses for 1975-76 (an increase of 137%). The overall success rate for freezing of custom-collected semen was 78.4%. A much higher success rate with freezing was achieved with semen collected during the May-October period.

**INSEMINATOR TRAINING.** A total of 115 persons undertook some form of basic A.I. training during the year. At Wacol three herdsman courses were offered during the year and 17 persons were trained. In addition, two commercial inseminator courses were offered and eight persons were trained.

Ten country A.I. training courses were conducted during which 90 persons were trained.

A significant development was the inclusion of a course conducted in conjunction with the Rural Community Extension Service at the Longreach Pastoral College.

A.I. refresher courses at Mackay, Rockhampton, Wacol and Quinalow were attended by 166 persons. A total of 37 persons undertook the examination for issue of an A.I. certificate and 32 were successful. The successful candidates had received training as follows: 26 Wacol-trained, three trained by other A.B. organizations, and three self-trained.

## Dairy sire progeny testing

The program of mating teams of sires of the A.I.S., Friesian and Jersey breeds into dairy herds to select the top ranking (proven) bull by progeny testing was continued during the year.

Each year, the Queensland branch of each breed society is invited to nominate a bull to be a member of the test group of the breed. This encourages stud breeders to participate in the progeny testing scheme, and also acts as a check on the standard of genetic material in the local active breeding population.

In 1976, the A.I.S. team was two locally-bred bulls, one from interstate and a breed society nomination.

The composition of the Friesian team was two locally-bred bulls, two selected bulls from interstate, a check bull and a society nomination.

Three contract-mated, locally-bred bulls and one selected bull from interstate made up the Jersey team. The bull nominated by the society produced insufficient viable semen to be used in artificial breeding.

The system of making bonus semen available to inseminators or insemination services was continued in 1976. The bonus is one dose of semen for every four doses of semen from proving bulls used in co-operator herds. The technician can select the bonus semen from a panel of Wacol bulls.

This year there has again been an increase in the number of dairymen who have been trained to inseminate their own cows. A significant proportion of the owner-inseminators who production record their cows have joined the bull proving scheme. This gain has not, however, compensated for the number of farmers who have been lost from the scheme, mainly through ceasing to production record their herds or ceasing dairying.

Each year, it becomes more difficult to obtain sufficient nominations of cows for bull proving from dairymen who use both artificial breeding and herd recording.

Present economic conditions in the dairying industry have forced farmers to curtail expenditure. There have also been further increases in insemination service charges. This has caused many farmers to reduce considerably the number of cows inseminated for normal breeding and for bull proving.

Low prices for cull cows because of the beef market situation are also resulting in smaller numbers of heifer replacements being reared. Additional animals are not required as herd sizes have increased through retention of old cows. The few heifer replacements needed are often being obtained from a limited number of matings with semen of proven sires.

While Friesian progeny testing has reasonable prospects, the A.I.S. and Jersey schemes will need to be kept under close scrutiny over the next few years to ensure that there are sufficient effective daughters for reliable progeny tests.

**LATEST PROVEN SIRES.** The latest proven Friesian bull is 'Woodlin Charon Noble'. He is by the proven English sire 'Rurik Charon'.

'Airton Vale Plum's Chief' became the A.I.S. production-proven bull. He is a second generation proven sire, being a son of the proven bull 'Kenstan Chief 4th'.

A second generation proven Jersey bull was obtained this year. He is 'Glen Erin Golden Sovereign' sired by 'Mayfair Sovereign 4th'. Farmers assessed the bull as being good for dairy characteristics.

**CURRENT OPERATIONS. Breed society nominations.** Bulls nominated by the Queensland branches of the A.I.S. and Jersey breed societies are being used in bull proving teams in 1977. A suitable bull nominated by the Friesian Cattle Club was not available in time for inclusion in the 1977 test team.

**1976 Matings.** Friesian nominations for 1976 were satisfactory. A total of 2 750 cows was nominated, 25% more than the previous year, and approximately 2 250 cows were inseminated at least once with bull proving semen.

Most herds of Friesian cows are located in milk supply areas so it is easier to obtain nominations for this breed than for the other two. Unfortunately, the wastage between nominations and heifers actually completing 2-year-old lactations is higher than with the other two breeds.

In the A.I.S. breed, a total of 1 700 cows was nominated, which is a 40% increase on the previous year. This has been brought about by an increase in the number of breeders inseminating their own animals and Darling Downs farmers contributing more A.I.S. animals for bull proving after a concentrated effort by the officer for that area. A total of 1 440 cows was inseminated at least once with bull proving semen.

Jersey nominations received were 788 representing a decrease of 7.5% on the previous year. Reports reveal that 702 cows were actually inseminated at least once with bull proving semen. The recovery rate from insemination to completed lactation is higher with Jerseys, but it will be necessary for field officers to maintain close contact with co-operating farmers to keep losses to a minimum.

## Research in animal breeding

### Breed studies

A.I.S. Mr N. D. Herron spent 12 months working at the University on a research project on the A.I.S. breed of dairy cattle. This analysis of the development and structure of the breed is directly relevant to the Department's herd improvement and semen export programs.



Two papers, 'Studies of the Australian Illawarra Shorthorn Breed of Dairy Cattle I Breed Structure' and 'Studies of the Australian Illawarra Shorthorn Breed of Dairy Cattle II Genetic Analysis' have been prepared and submitted for publication.

This work is continuing and it is expected that two more scientific papers will result from the study.

**SAHIWAL.** A similar but less extensive study to that on the A.I.S. breed is also being carried out on the Sahiwal breed. This study was necessary because the Sahiwal is being used in new breed development within Australia and, in particular, in this Department's Australian Friesian Sahiwal project.

A paper, 'The Breed Structure and Genetic Analysis of the Pedigree Sahiwal Breed in Australia' is being prepared for publication.

### Chromosome studies

**CATTLE.** Metaphase chromosomes have been prepared from 175 cattle to date. Studies have been performed using Giemsa staining, Giemsa banding, C banding and Q banding.

An article 'Giemsa Banding of the Chromosomes of Male Cattle (*Bos indicus* and *Bos taurus*)' was prepared and submitted for publication.

**PIGS.** Metaphase chromosomes have been prepared from boars from the Hermitage Research Station and the Rocklea Performance Testing Station.

Two articles, 'Identification of Pig Chromosomes by Giemsa Banding' and 'Chromosome Studies of Performance Tested Boars' were prepared and submitted for publication.

Mr W. L. Potter spent a month's study tour of New Zealand mainly at Massey University. While at that institution, he worked with Professor Bruere on chromosomes of domestic animals.

### Swine A.I. and reproduction

There are 12 sows and 3 boars presently on hand. The sows were purchased from a commercial pig producer.

A.I. trials using chilled semen on sows which displayed oestrus resulted in 70% conception rate with average litters (foetuses present at slaughter 6 weeks after insemination) of 8.9.

### Equine reproduction

This year, three foals were born as a result of inseminations using deep frozen semen. Two of these foals, being twins, created a great deal of publicity for the Centre. These twins are both healthy and are still thriving.

Only three mares were inseminated with deep frozen semen during the year. They are expected to foal in the coming year.

Of the deep frozen semen held in storage, some batches have shown a steady decline in quality while most have maintained their quality. Most of this semen has now been in storage for 3 years.

### Reproductive performance monitoring

In the dairy herd reproductive performance monitoring program, a herd of approximately 300 cows is being monitored in the Beaudesert area. The data are being processed on the Werribee (Victoria) Computerized Herd Health Program. The farm is visited monthly and the program has been in operation 7 months. This project is designed to test the suitability of this existing herd health program for Queensland dairy herds.

## Dairy Research Branch

THE Dairy Research Branch through its facilities at Hamilton, and supported by its regional laboratories at Malanda, Murgon and Toowoomba, provides technological services to the dairying industry, the consumer and the importers of Australian dairy products.

### Quality evaluation

To provide data for quality assessment of dairy products, almost 140 000 bacteriological and chemical analyses were performed on 60 000 samples. Results were used by producers, manufacturers and field staff to improve or maintain quality control systems. Recourse to legal samples was required but rarely.

In addition, 1 000 samples were analysed and 252 N.A.T.A. certificates issued for dairy produce being exported to various countries or required for special purposes.

### Raw milk

In general, raw milk samples complied with the standards for methylene blue and thermiduric count. The thermiduric test was replaced as from 1 December 1976 by the total bacterial count as a means of assessing bacteriological quality of milks sampled from factory to factory tankers.

Results for total count testing depended on the source of the samples, farm supplies complying with the standard (fewer than 50 000 organisms per ml) in 80.4% of samples, farm to factory tankers in 31.5% of samples, and factory to factory tankers in 14.6% of samples. The incidence of sub-standard solids-not-fat and total solids was higher than for the previous year, as was the failure rate for freezing points on individual farm supplies in the Brisbane district.

### Pasteurized milk and cream

Almost 100% of the samples analysed were efficiently pasteurized; most samples passed the keeping quality test and complied with the total count standard. Coliform results varied more widely between factories and between products. These organisms were present in a significant proportion of the samples and indicate post-pasteurization contamination.

Most products complied with the legal compositional requirements but pasteurized skim-milk samples from one factory often failed the fat content requirement.

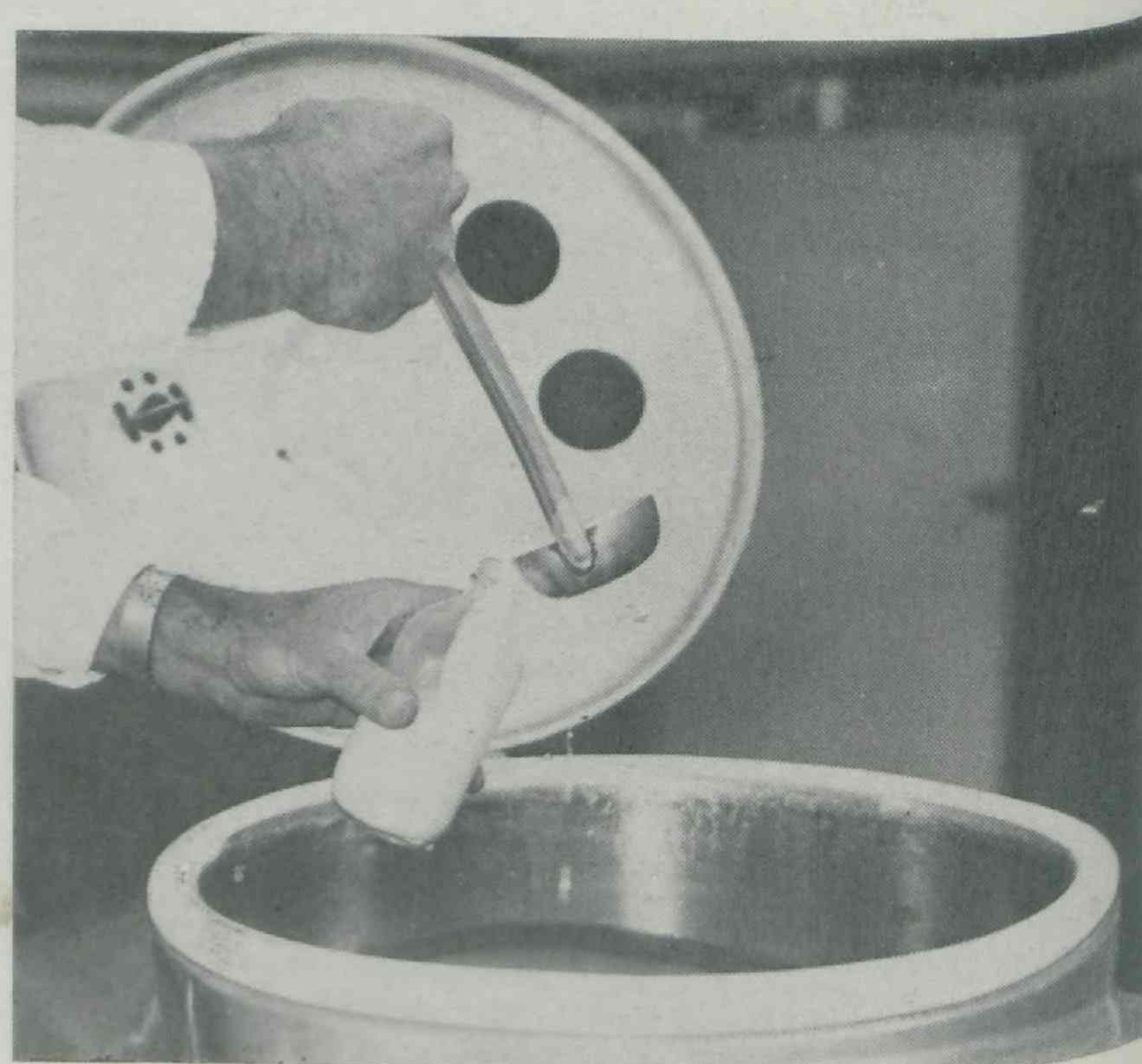
During the year, the incidence of sub-normal freezing points declined but that of sub-standard solids-not-fat and total solids was higher than for the previous year.

### Butter

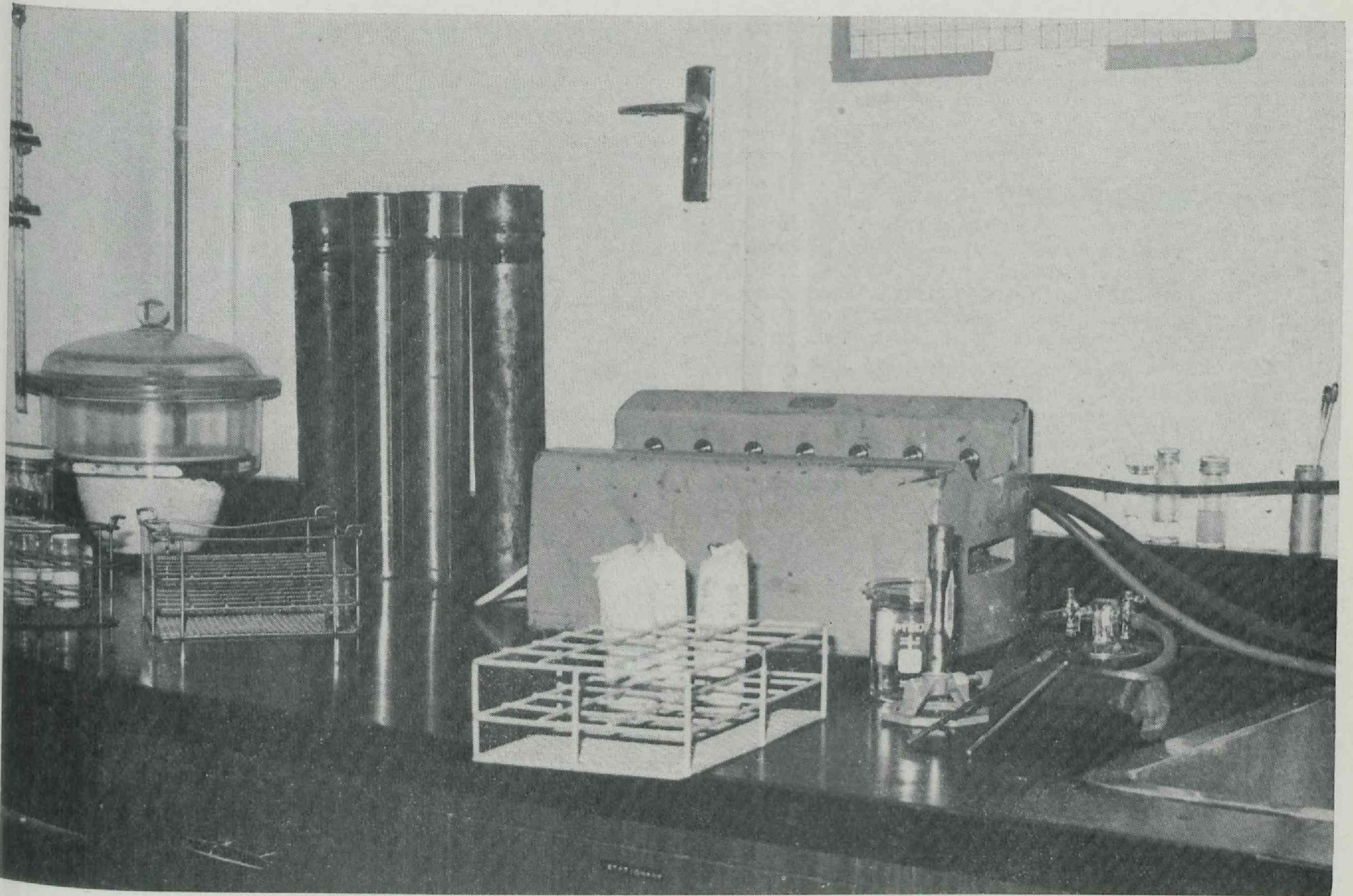
Queensland butter production was again inadequate for local requirements, and additional supplies were imported from Victoria. To ensure butter quality was maintained, representative samples of all bulk and pat butters were analysed regularly and comprehensive bacteriological and chemical testing carried out on behalf of the Queensland Butter Marketing Board.

Numbers of over-moisture butters have declined, with 5% of the Victorian butters failing the legal standard compared with 3.5% of the Queensland samples. In

A tanker driver sampling bulk farm milk from a farm-to-factory tanker.







A laboratory attached to a market milk plant.

In addition, 94 check tests by the official method were performed at the request of the Butter Marketing Board. Approximately 33% of the Victorian butters showed some degree of underworking compared with 21% of the Queensland butters. The incidence of copper contamination was low with butters from two Queensland factories exhibiting sporadically high results. Bacteriological quality of the Victorian butters was good, but Queensland supplies have shown an increase in spoilage counts exceeding the recommended limit.

### Cheese

Composition of cheddar cheese sampled as part of the Cheese Improvement Service showed a slight deterioration of composition compared with that of the previous year. The incidence of extraneous matter was also higher.

The elevated numbers of cheese sampled before export to Japan, compared with the previous year, reflected increased sales to that country. Bacteriological and chemical quality was satisfactory. Cheddar curd for export to the Philippines was also sampled and tested for a short period.

### Dairy factory water supplies

The survey of water supplies from Queensland dairy factories to determine compliance with the Australian Code of Practice for Dairy Factories was completed. Total counts varied from below 1 per ml to more than 1000 per ml. Coliform and *E. coli* contents were also absent or low.

### Residues monitoring

Comprehensive monitoring programs for the detection of antibiotics and other residues continued throughout the year. More than 31 000 samples were examined for traces of antibiotic residues, with less than 1% being positive.

### Iodine analysis

A monthly iodine analysis of market milk suppliers' samples has been carried out during the past 12 months. A total of 365 analyses was performed and there appears to be a slight overall improvement in the level of iodine residues in the samples from the various factories tested.

An autoanalyser has been ordered from a C.E.S.G. grant and should be in operation within the next few months. This will enable a greater number of analyses to be carried out so that individual suppliers can also be checked regularly for iodine residues in their bulk milk.

This should provide rapid information for field staff, so that control and overall reduction of iodine residues to an acceptable value can be obtained in the near future.

### Margarines

Margarine samples have been collected monthly from Queensland margarine plants for chemical and bacteriological testing. All samples complied with compositional standards including those for cholesterol and for fatty acids. Bacteriological quality of interstate margarines was inferior to that of the locally produced products, although compositional standards were met.

### Co-operative projects

**BRUCELLOSIS.** A survey of the extent of brucellosis infection in dairy herds on the Atherton Tableland begun in 1974 on behalf of Veterinary Services Branch continued throughout 1976-77 with 77% of the samples reacting negatively to the Ring Test.

**FEEDING PROTECTED FAT TO DAIRY COWS.** Sampling of milk from cows fed protected fat at Ayr Research Station continued from July to December. In early August, the level of linoleic acid in the test milks increased from approximately 4 to 10%. The reason for this increase was eventually found to be due to a change in the type of protected fat fed to the animals. Experiments were conducted to identify the fat component. This was tentatively identified as a 50-50 mixture of tallow and soybean oil and later confirmed by the manufacturers. Data are now being collated.

**INVESTIGATIONS INTO SUB-NORMAL MILK COMPOSITION.** The objectives of this project, funded in part by the Dairying Research Committee (\$900), are to determine the factors affecting the freezing point of milk and to determine the milk constituents which contribute to the abnormal elevation of freezing point in milk containing no added water. To date the following work has been completed—

1. Data have been collected and collated to show what effect the various seasonal, nutritional, weather and managerial factors have on the freezing point of milk in Queensland.

2. Freezing point depression constants have been determined for the constituents lactose, chloride, phosphate, citrate and lactic acid. These constituents account for approximately 90% of the total freezing point depression.



3. The use of the Vapour Pressure Osmometer for the detection of adulteration of milk has been investigated. The instrument has proved reliable for the detection of added water and is a suitable alternative to the Thermistor Cryoscope.

### Trouble-shooting services

A trial to investigate the poor quality of cheddar cheese manufactured at a commercial factory was carried out. The trial involved parallel manufacture of cheese at the factory and at the Otto Madsen Dairy Research Laboratory with common milk, starters and controls as appropriate. The result of the trial appeared to indicate that the cheese starter being used by the factory at the time was contributing to the poor quality of the cheese.

A 'pinking' effect occurring on blue vein cheese manufactured locally was caused by a yeast which was identified by an overseas reference laboratory as *Rhodstorula* sp. Another defect of this product was the development of a surface slime on retail packs during distribution and retailing.

An organism, *Bacillus licheniformis*, isolated from surface slime was shown to be capable of producing copious slime on a blue vein cheese medium. The pH of the substrate had a marked effect on the amount of slime developed, maximum development occurring at a pH of mature cheese. Vacuum packaging or frozen storage prevented slime development. Factory surveys showed that cheese could be contaminated during manufacture or subsequent handling by cross-contamination from slimy matured cheese or other reservoirs of the organism around the factory.

**QUARG.** Manufacture of quarg was carried out to provide information about soft lumps in a commercial quarg product as this defect is a problem in cheesecake manufacture.

**ICE CREAM.** A coarseness and sandiness defect occurring in a manufactured ice cream product was investigated. Work, which is continuing, centred around the rates of hardening of the packaged and stacked ice creams.

## Research

Research supported by the Dairying Research Committee involved studies of enzymes in milk (\$5 750) and cheese ripening (\$9 000).

### Enzymes in milk

**HEALTH OF BOVINE UDDER.** The principles of diagnostic enzymology have been utilized in the development of a new procedure for monitoring the state of health of the bovine udder. This procedure, called the NAGase test, involves measuring the level of a certain enzyme in either quarter, composite, bulk or tanker milk samples. An elevated level of this enzyme in milk indicates that there is a secretory disturbance in the mammary gland and therefore the milk from that gland has an abnormal composition. This concept can be expanded to cover a herd (bulk milk) situation where the extent of secretory disorders in a herd can be estimated by this simple enzymatic analysis of the bulk milk.

The NAGase test has now been adapted so that in the future it can be fully automated. This will enable wider application of this new test in mastitis control programs and in research projects so that a more definitive measure of the pathological and physiological state of the bovine udder can be obtained.

**MILK FAT GLOBULE MEMBRANE.** Bovine milk fat globule material has been separated into three major lipoprotein classes by density gradient centrifugation procedures. A chemical and enzymatic analysis of these classes has shown that they differ considerably in a number of important constituents. This technique of membrane separation will enable a better understanding of the structure and stability of the milk fat globule membrane in a variety of dairy products to be obtained.

**LIPOLYSIS IN DAIRY PRODUCTS.** Factors affecting the extent of lipolysis in milk and dairy products have been investigated. Lipolysis in milk caused by excessive mechanical agitation has been found to be largely influenced by the severity of agitation and the temperature and age of the milk. The effect of mastitis on the level of lipolysis has been studied in a large number of quarter milks. A strong positive correlation was obtained between the severity of the mastitis and the free fatty acid levels in these milks.

An investigation of defects in butter arising from lipolysis has indicated that considerable lipolysis may occur post-manufacture and cause flavour defects without causing a significant increase in ADV, the commonly used measure of free fatty acids.

### Cheese ripening (enzymology)

This work is designed to gain a better understanding of the inter-relationships between various enzyme activities in cheddar cheese, and to apply the knowledge to the development of accelerated ripening techniques. The controlled ripening of cheddar cheese could allow for production of mature cheese after much shorter holding times. Since lengthy storage contributes greatly to costs, this reduction would be of great financial benefit to the industry. Some success has been achieved with the addition of cheddar cheese slurries, the addition of non-acid-producing mutant starter strains, and the hydrolysis of lactose in milk before cheesemaking.

### Other projects

**WHIPPED CREAM.** Equipment which whips cream under pressure was developed and fabricated in the pilot plant workshop. The cream is whipped as it ejects from a stainless steel ejection gun similar to the type used for dispensing beer. The dispensing gun fitted with flexible tubing is easy to operate by means of a trigger-controlled valve which responds with instantaneous flow of cream.

Pilot plant and commercial trials to test the performance of the whipping equipment were successful.

The equipment was displayed at the International Catering Trade Fair in Sydney, and the first commercial unit has operated at the Sunshine Plantation, Nambour, since August 1976. Units are now being used throughout Australia with keen interest displayed by the catering and cooking industries.

**RECOMBINED YOGHURT.** Recombined yoghurt manufactured from skim-milk powder as the source of milk solids was found to have a greater viscosity than control samples made from normal milks. Specifications were prescribed for this product as well as a low calorie yoghurt (fresh or recombined) made with artificial sweeteners.

**CONCENTRATED AND DRIED PRODUCTS.** Trials were conducted to determine methodology and manufacturing control for spray-dried yeast extract, a by-product of yeast manufacture. By controlling drying temperatures, feed rates, solid levels and moisture uptake of the spray dried product, products containing initial moisture content of 58% were spray dried.

**PROCESSED CHEESE.** Exploratory trials produced a highly spiced spread suitable to the palates of ethnic groups of people in the Near East and which would provide acceptable sources of cheese protein to peoples who do not readily accept cheddar cheese flavour. These products were evaluated in overseas countries, with encouraging results.

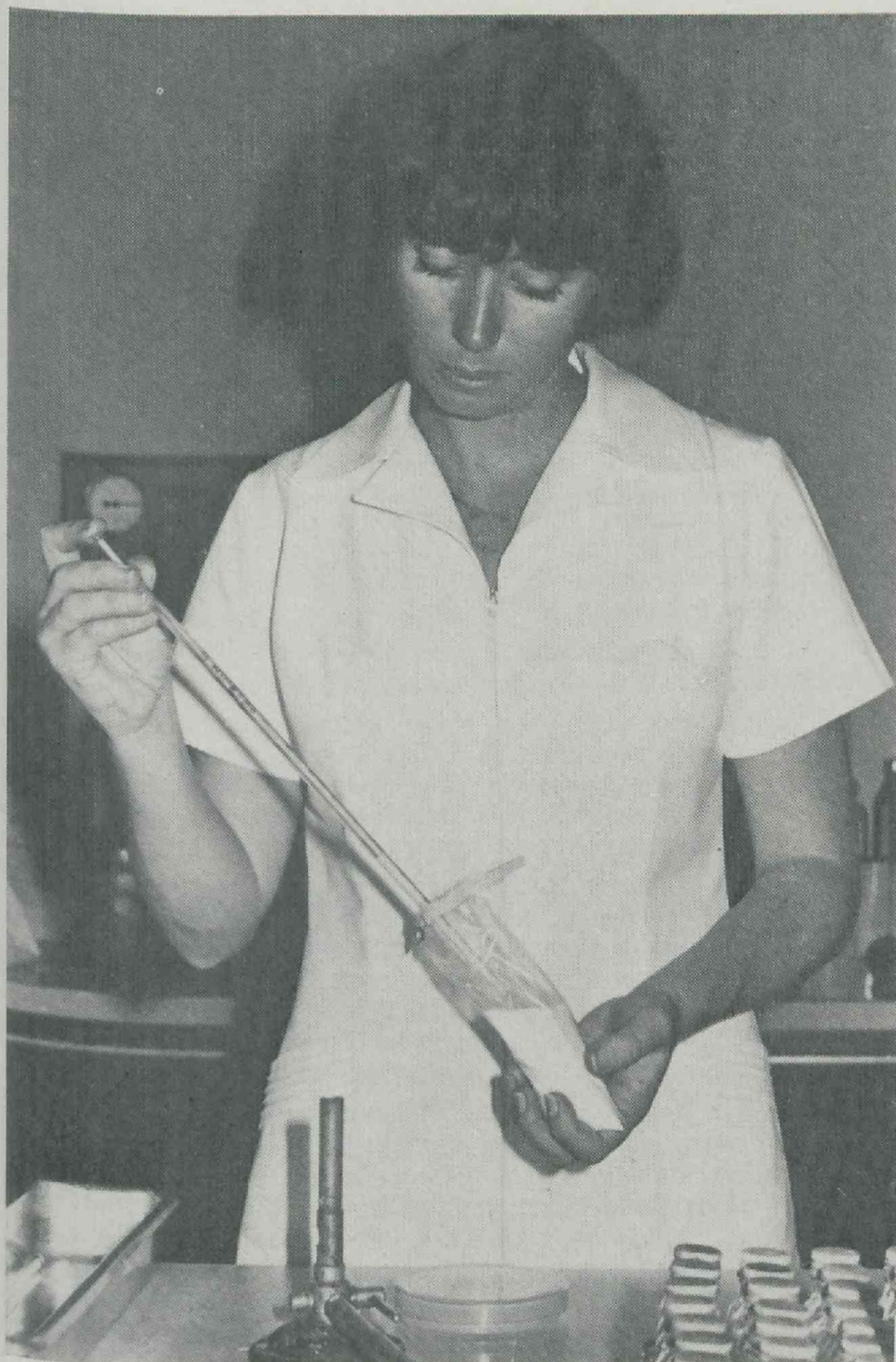
**RAW MILK QUALITY: TOTAL BACTERIAL COUNT.** The total bacterial count has been included in the Regulations under the Dairy Produce Act and is now the major microbiological quality control test for raw milk in Queensland. Realistic standards are required by both the Department and industry, and investigation of the method highlighted the levels of total bacteria at various stages of handling, and the effects of temperature and time of storage under commercial conditions. There also appears to be no significant increase in count between farm vat and the first factory; and there is little further development during transport in factory to factory tankers.

Within the processing factory, significant increases occur during storage at 4°C between receipt and pasteurization. It appears that, if milk leaves the farm with a total count below 50 000 per ml, the count on arrival at the first factory will not be significantly above 50 000 per ml. After overnight storage at <2°C and subsequent transport to a second factory, the raw milk should be capable of complying with a <100 000 per ml standard. Milk arriving at the second factory with <100 000 bacteria per ml should reach the pasteurizer with counts of <200 000 per ml after 11 hours' storage at temperatures between 3 and 4°C.

After considerable experimental work, a simple reliable and economical method for factory use employing a platinum-welded 1/1 000 ml loop has been recommended for factories where the standard method of testing for bacterial populations is not practicable.

Studies carried out so far have shown that either or both of the principal mastitis pathogens can contribute to the total bacterial count of a farm milk, although the extent of the contribution varies greatly from sample to sample.





A technician testing raw bulk milk in the Dairy Research Laboratory. She is using the standard plate count method.

### Pasteurized milk and cream quality

**KEEPING QUALITY TEST.** The Mosley keeping quality test which measures the increase in bacterial count of a sample stored at 7°C for a predetermined number of days has been compared with the methylene blue keeping quality test currently used for advisory purposes in Queensland. The Mosley test was found to be more sensitive and reliable for refrigerated milks than the latter test and applicable to a wider range of products.

**SIGNIFICANCE OF PSYCHROTROPHIC SPORE-FORMING BACTERIA.** Most of the bacteria which survive pasteurization are unable to grow at refrigeration temperatures, that is, they are not psychrotrophic. However, it has now been demonstrated that some of the *Bacillus* spp. produce spores which survive the pasteurization process and are then able to germinate in and grow in milk stored at 4°C. This poses a threat to the quality of packaged milk.

### Modified butter products

A new process developed for the manufacture of modified and soft melting fraction butters incorporates mixing, blending, UHT treatment, cooling, storing, churning. This method is preferred to the direct method used for the manufacture of recombined butter, because the tendency to deteriorate on storage has been overcome, uniformity of plastic properties has been increased, brittleness and traces of free oil have disappeared, and high throughput is facilitated. Furthermore, existing factory equipment can be used.

### Dairy Research Committee Project

**STUDIES ON COLD RIPENING OF RAW MILK (\$900).** This project was concluded in late 1976. It was found that the rate of growth of psychrotrophic bacteria in raw milk could be reduced by the addition of starter cultures. When cheddar cheese was manufactured from treated milk, renneting times were reduced, yields were apparently not affected, and ripening rate was increased by up to 6 weeks after 6 months' storage, with flavour usually equal to or better than that of the control cheese. The increased ripening rate would be of benefit to commercial manufacturers, allowing a reduction in the storage period for a cheese of similar maturity.

### Training

Considerable attention has been given to the retraining of officers, particularly at the Malanda laboratory where the work emphasis has changed from quality control to a stronger commitment to the Kairi Research Station. Unfortunately, the laboratory is poorly equipped to undertake testing based on new technological advances. However, the senior officer from that laboratory has already spent a week at Hamilton to study new techniques.

Other officers have attended in-service training courses, in biometrics, extension methods, computer techniques, management development, and technical external courses of 1 or 2 days' duration arranged by various instrument suppliers.

### Fishing industry

#### Quality services

Ninety-two samples were tested as a service to the Queensland Fish Board. The bulk of the samples were cooked prawns destined for export to New Zealand. This quality service work is increasing as are requests from private individuals and companies for information on the handling of seafoods and quality defects they encounter.

#### Research

The project 'Studies on the Bacteriology of Prawns' was supported by a grant of \$8 700 from the Australian Fishing Industry Research Committee. The objectives of this project are principally to gather information on the bacteriology of the prawning industry as well as to develop simple techniques for prawn quality assessment.

Investigations completed in the past 12 months include a survey of the quality of cooked prawns available from retail outlets, studies on bacteriological changes in eastern king prawns during storage in refrigerated brine and a bacteriological survey of prawn handling in the Gulf of Carpentaria during the banana prawn season. Additional research compared the suitability of various chemical indicators used for the quality assessment of prawns. A rapid dip-stick procedure for determining prawn quality is in the process of development.



# Division of Marketing

THE major function of the Division of Marketing is to assist the primary producer in maximizing returns on his units of production, over time.

This role of upgrading the producers' marketing expertise is achieved through the integrated operations of the Division's three branches, Marketing Services, Economic Services and Agricultural Standards, and through consultation and liaison with other Departmental branches, other organizations and agencies.

The Division's function involves the basic activities of extension, research and regulation of specific activities. The Division provides also assistance to the Department in matters relating to Acts administered by the Department and in general policy matters.

At the end of 1976-77, 194 staff were employed in the Division of Marketing. Research, extension and regulatory duties accounted for approximately equal shares of the Division's activities.

The Division of Marketing is currently conducting a poll on the question of the establishment of a statutory organization of pig producers.

Following on a request from industry representatives seeking the establishment of the organization and the subsequent receipt of some objections to the proposal, the Minister decided the fairest method of ensuring that all commercial producers could voice their opinion on the question would be by holding a poll of producers who, at some time in the 12 months preceding the election, held 70 or more pigs.

The result of the poll will be known at the end of August 1977.

It is interesting to note that the United Graziers' Association of Queensland has also indicated its members' interest in establishing a similar organization to look after the interests of its cattle and sheep members. An initial approach has been made to the Minister who has indicated that he will give the proposal every consideration if sufficient evidence of cattle and sheep producers' desire for such an organization is placed before him.

From an industry viewpoint, the major Divisional commitment was directed towards the beef, dairy, poultry and tobacco industries. All other industries received attention as required.

Advice and general extension support were provided to all of the State's statutory marketing boards and related organizations and to any co-operative association requesting assistance.

Probably the most important development by Marketing Services Branch during 1976-77 was the decision to expand and upgrade the marketing intelligence service. This is being done in the realization that accurate, up-to-date marketing intelligence is a vital part of our services to the primary producers of Queensland.

## Price reporting service

The Branch is well advanced in the development of a meat and livestock price reporting service for the beef, sheep and pig industries. This service, when implemented, will be tied in with the objective carcass classification scheme at present being tested by the Australian Meat Board. The continuing depression in the beef industry has highlighted the need for such a service.

Marketing intelligence services, at present quite extensive, are being bolstered by a new publication, the 'Marketing Newsletter'. Initially, this publication will be circulated mainly among Departmental extension staff but may be given wider distribution in due course.

Submissions to the Industries Assistance Commission hearings into various industries were undertaken by the staff of Marketing Services Branch during the year. Such hearings involve a considerable amount of work in the researching, preparation and presentation of material for the submissions. Industries for which this work was undertaken included the dairying industry, and the citrus industry. Towards the end of the year, a major submission on vegetable oilseeds was in the preparation stage.

In addition to the expansion of the marketing intelligence services, other aspects of agricultural marketing extension were pursued. Last year preparatory work was begun on training courses in rural marketing. The first of such courses was conducted in September 1976. This was attended by elected members and executive staff of commodity marketing boards. A similar course was also given for Departmental extension staff. Further similar courses are planned.

An interesting development with considerable potential was the emerging possibility for using satellites in assisting our crop forecasting program. One of the Branch's Marketing Officers has undertaken a study tour of the U.S.A. to become better informed on the possibilities of the 'Landsat' program.

Consumer-oriented research programs made some progress during the year. In particular, the egg industry sought our assistance in investigating aspects of egg control procedures. A scheme designed to improve egg quality at the retail level has been implemented by The Egg Marketing Board.

The Economic Services Branch continues to play an important role in the extension services provided by the Department. Twenty-four regional economists are now stationed at 17 country centres throughout Queensland. These officers maintain close contact with the farming community and are an important source of information on problems facing the various industries in the State.

A second economist was appointed to Atherton to concentrate on the north Queensland tobacco industry.

During the year, the basic farm management training program for Departmental officers was completed. Since the program was begun in the early 1960s more than 700 officers have received this training. Future courses will concentrate on providing follow-up training at regional centres.

Schools in farm business management continue to be in demand by the rural community. Another 23 schools were held last year mainly in central and north-west Queensland with an attendance of more than 500. Almost 2 000 farmers and their wives have now participated in this program over the past 2 years. Topics covered include farm office management, budgeting, taxation, rural credit and estate planning.

The publications by the Economic Services Branch are much in demand both in Queensland and interstate. The fifth edition of the *Farm Management Handbook* is being printed. Four hundred orders for this popular book are waiting to be filled.

The second edition of *Accounting and Planning for Farm Management* is still widely used by educational institutions throughout Australia. Since reprinting in January 1976, 1 100 copies have been sold.

At the request of the Australian Tobacco Board, the Branch again participated in an Australia-wide study of certain aspects of the tobacco industry. The results were incorporated in the Bureau of Agricultural Economics 1977 Tobacco Cost Index. Since 1970, the Branch has fulfilled this expert role in the Tobacco Industry.

Testing bean seed in a controlled micro-climate.





Assistance was provided to the Egg Marketing Board in assessing the movement in egg production costs as a factual basis for price determination.

The Branch continues to supply support services in programming and the analysis of survey data required by other sections of the Department.

An economic assessment was undertaken of the Lower Mary River irrigation project with the long-term aim of establishing a \$20 million sugar-cane industry at Maryborough.

For the third year in succession, export grain shipments have exceeded 1 million tonnes. Shiplside inspections carried out by Standards Branch inspectors on behalf of the Commonwealth have involved 98 vessels, mainly at Brisbane. Similarly, export fruit has broken record figures, with 43 vessels being loaded with 418 000 packages of mandarins and apples.

The Fruit and Vegetable Marketing Extension Service, which provides a feedback to individual producers on the

quality of fruit and vegetables marketed, has experienced a most successful second year of operations.

Chemical Services Section of Standards Branch has developed up-to-date and widespread information on agricultural chemicals for field officers. This information, in the form of data sheets, is now in demand by country officers.

The Seed Testing Laboratory, Indooroopilly, has recently installed a germination growth room at a cost of approximately \$20 000 to promote seed quality in the bean seed industry and is awaiting the completion of a \$60 000 glasshouse for seed certification and research work.

Guinea grass varieties Riversdale and Makueni have been added to the Seed Certification Scheme. A new rust-resistant oats variety Stout has been included in the Approved Oat Seed Scheme.

## Marketing Services Branch

THE overall function of Marketing Services Branch is to provide to Queensland's farmers, both to individuals and their organizations, supporting services relating to all aspects of marketing rural products.

The Branch supplies a variety of such services including marketing intelligence, advisory services, marketing research and financial management advice. A recent innovation was the commencement of Extension Training Courses in Rural Marketing for marketing board personnel, both Board members and executive staff. Similar courses have been also designed for Departmental extension staff.

The Branch is concentrating on improving its marketing intelligence service in the firm conviction that up-to-date, accurate and useful marketing information is vital to the State's rural industries.

### Beef industry

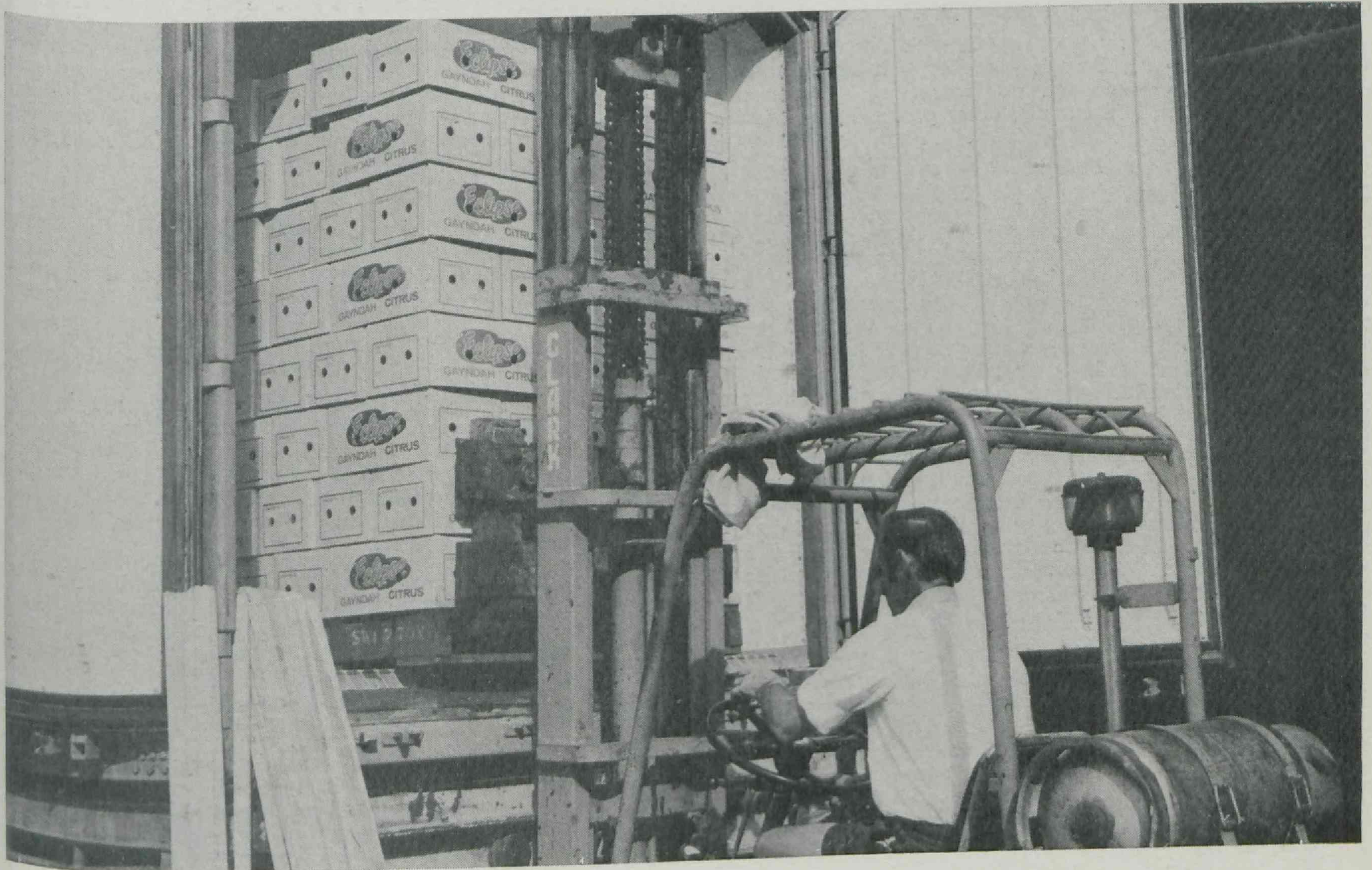
The continuing depression in the beef industry once again occupied a good deal of the attention and energy of Branch staff. In addition to further work towards the establishment of a viable stabilization scheme, Branch officers are well advanced in planning for a meat and livestock price reporting service. This service, when established, will cover other animal industries besides beef.

Cabinet approved the proposed beef stabilization scheme of the Queensland Beef Industry Committee on 9 September 1976 and the scheme was submitted to the Australian Agricultural Council in October 1976. The scheme is still under consideration by the A.A.C. The staff of the Branch are closely involved with working out the details associated with a stabilization scheme.

### Dairying

Unfortunately, little or no improvement occurred in the depressed world markets for dairy products. Skim-milk powder, casein and butter prices remained at low levels, and there appears to be little likelihood of any firm recovery in the immediate future. With the investigation by the Industries Assistance Commission into marketing arrangements for dairy products, Marketing Services Branch was closely involved in the research, preparation and presentation of a submission to the Commission.

'Containerization' of Queensland export citrus.





Early in the year, Cabinet established a Committee of Enquiry to examine the Queensland dairy industry and, if necessary, to make recommendations to improve the economic viability of the industry. The Branch presented a submission to the Committee, including a recommendation that a Dairy Products Marketing Board be established to replace the present separate Cheese and Butter Marketing Boards.

Towards the end of the year, one of the members of the Committee of Enquiry, Mr A. P. Beatty, was seconded to the Division of Marketing to carry on the work of further analysis of the dairy industry's problems. Several members of the Branch are involved in providing assistance to Mr Beatty, including secretarial, technical and statistical support services.

Staff of the Branch were also associated with the legislative aspects of the extension of access to the Brisbane milk market to those milk suppliers in south-east Queensland who had had little or no access to this market in the past.

### Poultry industry

The effectiveness of the demand-supply management scheme in the egg industry was amply demonstrated during the year with considerably improved returns to producers and the virtual elimination of surplus production. In south Queensland, production fell by 16% in 1976-77 and net returns to producers rose by more than 30%. This result of demand-supply management had been forecast by a research paper written by one of the Branch's marketing officers.

The results of a comprehensive study into regional differences in egg production and consumption were published by the Branch towards the end of the year. The field work for this study was financed by The Egg Marketing Board.

### Fruit and vegetables

Marketing Services Branch is heavily committed to servicing the fruit and vegetable industry in Queensland mainly through the provision of a Daily Market Report and a Weekly Market Review which were fully discussed in last year's Annual Report.

During the year, a request was received from the Queensland Chamber of Fruit and Vegetable Industries for an increase in the commission rate charged by Farm Produce Agents. An investigation was carried out by Branch staff into this request and the findings did not support an increase.

The Industries Assistance Commission conducted an investigation into the citrus industry in Australia and Branch staff compiled and presented a submission to the hearing. This submission followed an earlier one to the Temporary Assistance Authority in relation to citrus juice imports. As a result of these hearings, the citrus industry has been able to gain some protection from cheap imports.

The Branch now has direct representation on the National Vegetable Panel, which is responsible for keeping under continuous review the production and marketing of processing beans and peas and, if necessary, other processing vegetables.

### Branch extension

The Branch is becoming more and more aware of the necessity for adequate agricultural marketing extension programs. With only one Marketing Officer located in a provincial centre (Townsville) most of the extension activities of the Branch must, of necessity, be carried out through the written word. Last year's report outlined the traditional and well established methods by which agri-marketing information is disseminated. Some new developments occurred during the year.

The Branch now publishes a 'Marketing Newsletter' which is circulated to Departmental officers working in provincial centres. Initially, circulation has been aimed at Regional Agricultural Economists, Regional Extension Leaders and District Extension Committee Secretaries. The purpose is to provide these 'front line troops' in the extension field with comment on the latest developments and news from a marketing point of view. The Newsletter may be eventually given wider distribution.

Each week, the Branch also produces a 'Weekly Trend Report' which aims at giving senior Departmental management an up-to-date picture of the current situation in the State's major rural industries, and commentary on significant developments in other industries as appropriate. As with the Newsletter, circulation of this Report is largely restricted to Departmental staff, but consideration is being given to wider circulation in the near future.

In line with its express aim of improving the overall marketing intelligence service to producers and all others connected with rural industry, the Branch is planning to introduce a meat and livestock market price reporting service when the current financial stringency permits. This scheme will be tied into the carcass classification scheme for beef, sheepmeats and pigmeats which is being developed by the Australian Meat Board. Initially, the service will begin in Brisbane but eventually will be extended to country centres as appropriate.

### Training

A continuing and expanding role of the Branch is in the area of training. For some years, the Division of Marketing has been involved in conducting courses in the marketing of agricultural products for students from overseas countries. These courses are sponsored by the Australian Development Assistance Bureau. One such course was conducted from March to early May 1977 and was attended by 17 participants drawn from Asian, Pacific and African countries. Lecturing staff was drawn largely from Marketing Services Branch. The course participants also took part in a study tour of tropical agricultural areas, arranged by Branch staff.

A new development in training programs began during the year in the field of Extension Training Courses in Rural Marketing. Two separate but similar courses have been developed. One is aimed at the members and staffs of the various commodity marketing boards while the other is designed for Departmental extension officers. One of each type of course was held during the year. Funds are provided under the Commonwealth Extension Services Grant scheme. More such courses are planned and a similar program has been suggested for Primary Producers' Co-operative Associations.

Following the establishment of a financial and managerial advisory service, the Branch has also developed a type of 'finance workshop' for primary producers' organizations. The first of these short courses was due to be held soon after the end of the year and pre-course observations indicate that such a workshop should be of considerable benefit to rural organizations.

Late in June, one of the Branch's marketing officers went to the U.S.A. to study the latest methods in crop forecasting using satellite surveillance techniques. Mr J. L. Bell, who has been responsible for the issue of the Department's crop forecasts for some time, will visit a number of locations in the U.S. where Landsat Imagery research is being carried out. This study tour is being funded from C.E.S.G. sources. The aim of the tour is to improve our crop forecasting service, in line with Branch policy of constant improvement to our marketing intelligence service.

During the year, various Branch officers attended a variety of training courses, including Kepner-Tregoe Government Management Seminars, Public Service Board Courses at various levels, and a number of intra-Departmental Courses. Other officers attended the National Agricultural Outlook Conference, various other particular industry conferences and numerous seminars and meetings both inter and intra-State. These duties included, for example, participation in Working Parties set up under Standing Committee of the Australian Agricultural Council.

The regular attendance at the meetings of the various commodity marketing boards enables many graduate officers to become much more closely acquainted with the particular marketing problems of industries which are served by such organisations.

### Research

Because of the increased Branch involvement in the various training programs outlined above, pure research activity was somewhat curtailed this year. However, a considerable amount of background research was undertaken in relation to the proposed beef stabilization scheme. At present, the results of this research are confidential but may be published in due course.

Research was also extensive in the preparation of submissions to the I.A.C. on the dairying and citrus industries. Research results were issued as Branch publications on the egg industry, and a non-technical approach to soil types in the Mareeba-Dimbulah area of north Queensland. A study on optimum location for new agricultural facilities is due for issue shortly.

Two other studies into marketing aspects of the egg industry will be issued in 1977-78 and a study on the development of supply-demand management in the tobacco industry is also ready for publication. A thesis on crop forecasting methodology has also been completed.



## Economic Services Branch

THE functions of Economic Services Branch can be listed as two major undertakings. These are—

1. To play a major role in farm business management extension to the rural community.
2. To undertake economic research and provide advice on the rural sector of the State to primary producers, industry organizations and government.

To fulfill these functions, the Branch has 24 regional agricultural economists stationed in 17 centres throughout Queensland with a support staff of 10 economists in head office who are mainly involved in research and administration.

### Inservice training

Two regional workshops for Branch officers were held in Toowoomba and Rockhampton in May-June 1977. These area workshops replaced the annual 1-week Branch Workshop in Brisbane, discontinued as an economy measure. Officers also took part in other training workshops conducted by Information and Extension Training and other Branches.

### External conferences and courses

In February 1977, Brisbane was the venue for the annual conference of the Australian Agricultural Economics Society. The Branch was actively involved in the organization of the conference, which attracted more than 150 delegates from interstate and overseas, and was represented by five officers.

Officers also attended the National Outlook Conference conducted by the Bureau of Agricultural Economics in Canberra, and the Australian Farm Management Society Conference in Roseworthy, South Australia.

### Overseas study tours

The Director of Economic Services (Mr R. B. Bygott) was overseas on a 9-week study tour during June-August 1976, when he visited the United States, Canada and the United Kingdom. The purpose of the trip was to look at the economic field services provided to the rural community in the countries visited.

The Assistant Director (Mr J. van Haeringen) was in New Zealand for 3 weeks in March 1977 to examine the integration of the economic and technical advice provided to New Zealand farmers.

### Farm management extension

INSERVICE TRAINING FOR EXTENSION OFFICERS. During the year, a 1-week school was conducted for Departmental officers to provide basic training in farm management. Nearly 700 officers in the Department have now received this training and the backlog of officers requiring this training has been cleared.

It is proposed to shift the emphasis of the training in farm management from central to regional workshops preferably conducted by local economists in consultation with regional extension leaders.

SCHOOLS FOR PRIMARY PRODUCERS. The farm office management schools continue to be in demand within the rural community. The schools for 1 or 2 days cover farm recording, cash flow budgeting and topics such as estate planning, taxation, insurance and rural credit. Twenty-three schools were conducted during the year with an attendance exceeding 500 men and women. Most of the schools were held in central and north-western Queensland. This attendance brings the number of producers who have undertaken the training program over the past 2 years to more than 1 700.

Excellent support continued to be received from local solicitors, bankers and accountants who actively participate in lecturing.

The schools are conducted in association with local organizations, mainly the Queensland Country Women's Association.

GENERAL EXTENSION ACTIVITIES. All regional economists are closely involved with the extension service provided by the Department. They are represented on all District Extension Committees and on sub-committees formed to deal with specific problems in industries. In this aspect of his work, the economist acts largely as a resource officer and provides specialist support to officers of other branches.

Regional economists are also members of the research stations committees for the stations administered by the Research Stations Board.

The economists at Atherton and Rockhampton serve as deputies for the Director of Marketing on the local Maize, Sorghum and Egg Marketing Boards.

Regional economists produced a large number of local leaflets and articles published in the local papers on such widely ranging topics as machinery costs, life assurance, taxation, estate planning and death duties and market prospects.

On average, country economists made 31 farm visits as a result of requests or for the purpose of obtaining information from producers and addressed a wide cross section of farming organizations on topics such as beef futures, dairy nutrition, costs of production of beef, profitability of small crop farming, and pasture improvement.

The average number of office inquiries requiring follow up work was 87. Forty-three of these came from farmers, the remainder from Departmental officers, industry organizations and agri-business.

Regional economists prepared a number of formal budgets, an average of 23 per economist. Most of these were concerned with gross margins and cash flow analyses. Relatively few development budgets were processed, indicating the uncertain economic situation prevailing in many of the State's rural industries.

EXTENSION PUBLICATIONS. The Branch published further booklets and reports aimed at improving the understanding of farm management among a wide cross section of the rural community and those associated with it.

In the Extension Series publications, two additional booklets were published during the year: No. 11 Estate Planning Workbook (D. M. D. Mills) and No. 13 Syndication in Property Management (C. Campbell).

The estate planning workbook was developed in close co-operation with the accountancy profession and was tested with about 100 producers in western Queensland. To date, 500 copies have been distributed and reprinting is under way.

The booklet, *Consider the Alternatives—A Guide to Profitable Pig Farming* (Extension Series No. 12) is being revised. It is hoped to publish it in association with the Australian Pig Industry Research Council as a national publication.

Additional material published during the year dealt with grain crops in the Wambo Shire and in the North Burnett, and horticultural crops in the Gympie district. Regional economists also produced a large number of local handouts on a wide range of crops. Such material is often prepared on a joint authorship basis with technical officers of other branches.

The film 'The Farm Office' produced last year continued to be in demand at the farm business management schools.

The Branch is actively promoting the use of Refnote material in the Department. Nine Refnotes were issued during the year.

In addition, in late 1976, a leaflet series, titled 'Farm Info' was commenced. This series is specifically directed towards primary producers. Four issues were made dealing with sales tax, death duties and rural credit.

### Research

IRRIGATION PROJECTS. The economic assessment of irrigation projects was again an important part of Branch activities. The Lower Mary River Irrigation Project based on sugarcane production was assessed during the past year. In the economic analysis, use was made of the results of the Northern Region Input-Output study to evaluate the regional impact of business and government programs and policies.

The analysis indicated that, for a likely range of sugar prices and yields, the project was viable.

The completion of the Condamine River Flood Evaluation Study was deferred awaiting further hydrological data.

REGIONAL STUDIES. The report on the economic study of major enterprises in the Traprock-Granite area of south-east Queensland was published during the year. The profitability of grazing activities in the area is low. Agriculture is a minor activity because soil types are generally unsuitable. Horticulture provides more reasonable, but fluctuating, returns to capital and management and is confined to a small area.

A report on the Northern Region Input-Output study is being prepared for publication during the coming year. Through involvement in this study, the Branch is represented on a steering committee, with the Economics Department of the University of Queensland and the Co-ordinator General's Department, to develop better methods of establishing regional input-output tables.

Economic sections of the Wambo (2nd Edition), Etheridge and Atherton Shire Handbooks were published during the year.



**TOBACCO INDUSTRY.** At the request of the Australian Tobacco Board, this department and a consultant employed by the Victorian Tobacco Leaf Marketing Board undertook a further survey of the Australian Tobacco Industry. This survey related to the cost advantages of plant position sorting and the effect on costs of changes in the use of fertilizers and similar inputs. The results were incorporated in the Bureau of Agricultural Economics 1977 Tobacco Cost Index.

The economics of a change-over from conventional updraft curing of tobacco to bulk curing is also being investigated. A report is in the course of preparation. The profitability of the change-over is sensitive to the level of tax payable, and the condition of existing curing facilities.

A report on the economics of mechanical harvesting of tobacco was completed during the year. It was found that mechanical harvesting is economically feasible but its adoption will depend on complete acceptance of non-aligned leaf and the presentation of leaf by plant position.

**PIG INDUSTRY.** Publication of the report on the Pig Industry Survey was delayed, but is now ready for printing. A chapter was prepared for the *Manual of Pig Husbandry*. It is expected that the Australian Pig Industry Research Council will be responsible for collation, printing and distribution of this manual.

**BEEF INDUSTRY.** In beef industry research, progress has been made in the design of a model to examine spatial diversification compared with intensification of a western area beef property in the Monto Shire.

The static model of a beef herd used to investigate the profitability of various forms of pasture development in the coastal Burnett has been completed and is being prepared for publication.

The Branch is represented on a working group to examine property economics in the Wandoan Shire. The simulation technique will be used and preliminary planning has commenced.

The relationship between store and fat prices for beef cattle on the Darling Downs has been studied. The nature of the relationship is to keep the average fattening margin stable regardless of whether cattle prices are booming or depressed. The results will be very useful in planning and budgeting further production and fattening activities.

Fat cattle prices at Cannon Hill saleyards have also been examined. The results will be of use in further studies.

**SHEEP INDUSTRY.** The simulation study of decision making in the pastoral zone is being finalized and a report is in the course of preparation. A working model has been produced, but the project has emphasized the problems associated with this type of modelling—data collection, conceptualization of the decision making process as related to this environment and application of the resultant model.

During the year, a firm of consultants (Kinnard, Hill, deRohan and Young Pty Ltd) was commissioned to prepare a feasibility study for a wool processing plant. A total of 20 centres in western Queensland was examined in detail. This Branch exercised a supervisory co-ordination role in association with the Department of Industrial Development in this study. An assessment was made of the consultants' report and submissions prepared for State Cabinet.

## Standards Branch

THE objectives of Standards Branch are to enforce official standards and, by so doing, exercise a quality control service over a number of rural commodities offered for sale in Queensland.

Legal protection of the buyer against the purchase of an inferior product remains the main aim of this form of quality control. A wide range of commodities and preparations is covered by legislation administered by the Branch, chief among which are fresh fruit and vegetables, seeds, fertilizers, stock foods, pest destroyers, veterinary medicines and other prescribed agricultural requirements.

Standards Branch is also an agent for the Commonwealth Government in enforcing standards prescribed for the quality of grain, seeds, flour, fresh fruit and vegetables exported from Queensland. In addition, the Branch accepts responsibility for maintaining the accepted quality levels of imports of pasture and forage seeds.

To give effect to the various responsibilities as outlined above, the Branch is divided into four sections: Administration, Field Services, Chemical Services and Seed Services. Basic administration is centred at Indooroopilly, together with the main Seed Testing Station, but a substation is located at Toowoomba for the convenience of Darling Downs' producers.

Inspectorial services are also available from Rocklea (Brisbane Market), Eagle Farm (export produce), as well as four major country centres: Cairns, Townsville, Rockhampton and Toowoomba.

The functions and major achievements of each service component of the Branch during the year under review are summarized below.

**POULTRY INDUSTRY.** At the request of the Egg Marketing Board Suppliers' Organization, the viability of egg farms at various size of hen quotas was examined. Assistance was also provided to the Egg Marketing Board in assessing the movement in egg production costs as a factual basis for price determination.

**SOIL CONSERVATION.** The economic evaluation of pasture as an alternative to cropping on zones 3 and 4 land on the Darling Downs was completed. The evaluation indicated that pasture could not provide an economic alternative to cropping and that savings to government would amount to only a few dollars per hectare.

**MISCELLANEOUS.** The study of costs and returns in the ginger growing industry was completed. The report indicated relatively low returns on investment and suggested a number of ways in which an improvement could be made.

A report on the costs and returns of rice growing in the Burdekin was prepared at the request of The Rice Marketing Board of Queensland. The study showed considerable differences in costs between years and between individual farms.

The economics of acquiring farm machinery was examined and various methods of financing were considered in a report published during the year. Other aspects of farm machinery being studied are concerned with operating costs, syndication, ownership versus contracting and machinery replacement strategies.

## Farm Management Accounting Service

The Farm Management Accounting Service has continued to operate satisfactorily while membership declined slightly. A total of 125 annual summaries was prepared for both the monthly and annual services.

During the year, a number of information sheets and an introductory booklet were prepared. These are designed to stimulate interest in the scheme and to explain the various options available to members. In addition, the information sheets will prove helpful to members in their interpretation of the various accounting reports which can be produced. A new cash flow option is being introduced in 1977-78.

## Support services

Two officers continue to supply Departmental support services in computer analysis. Work continued on the spear grass, beef industry and dystocia surveys. All are nearing completion and a draft report has been prepared on the dystocia survey.

In addition to these surveys, the Branch has been involved in the transfer of the Animal Pathology Disease Reporting System from the ICL Bureau to the Treasury installation; the preparation of a program to calculate the wholesale price index for fruit and vegetables; assisting the Dairy Research Branch in designing a computer system to report to dairy factories on the quality of samples of milk and cream; and the development (with Poultry Section) of a pullet rearing recording scheme.

## Field Services Section

Field Services Section is made up of 24 inspectors and four technologists stationed in the Brisbane area, as well as nine inspectors in the four country areas mentioned above.

Noteworthy activities of this section during the year were increased inspections of grain and fruit exported from Queensland, an intensified program of sampling fertilizers, limes and stock foods, and the widened impact of the Fruit and Vegetable Marketing Extension Service.

Export grain, mainly of sorghum, wheat and barley, exceeded 1 million tonnes for the third year in succession. Russia and the Far East were responsible for taking most individual increases, the details of which are set out in the following table, covering the past 3 financial years—

Year	No. of Ships	Weight of Grain (tonnes)	Main Importing Countries
1974-75	87	1 060 000	Russia, Indonesia, Japan
1975-76	80	1 241 000	Russia, Japan, Middle East, Egypt
1976-77	98	1 265 000	Russia, Japan, Middle East, Egypt



A similarly improved situation also applies to export fruit due, this year, to both continued increases in containerized citrus movements from the Burnett and a resurgence of exports of apples from the Granite Belt. Details of these shipments over the past 3 years are set out in the following table—

Year	No. of Ships	No. of Containers	Quantity of Fruit (cases and cartons)	Main Destinations
1974-75	15	..	150 000	Europe, Far East
1975-76	36	319	224 000	Europe
1976-77	43	380	418 000	Europe, Far East

There has been long standing concern with the physical quality of fertilizers, chiefly over wide variation in particle size. After some delays, a project has been designed to determine the degree to which heterogeneity of the bulk conflicts with apparent difficulties in taking representative samples by the use of conventional and compartmented triers.

The second fully operational year of the Fruit and Vegetables Marketing Extension Service has seen consolidation and some modest expansion. A total of 437 growers was referred to field extension officers for assistance and advice, mainly in the Granite Belt (108 growers). Both figures are less than those for the previous year (a total of 658 with 221 from the Granite Belt) and suggest that the service is producing results reflected in better quality improved packaging and presentation as well as an overall reduction in the occurrence of damage throughout the marketing channels.

These basic improvements are certainly encouraging but do not suggest any room for complacency. Tomatoes, for example, were again the crop with largest figures responsible for individual grower contacts (148), reflecting the regrettable necessity for inspectors at the Brisbane Market to condemn 6 369 cartons and downgrade a further 3 985 cartons during the year.

A natural corollary of the Fruit and Vegetable Marketing Extension Service is the provision of retail advice located nearer to the consumer level. Emphasis is being placed on this service in major metropolitan suburbs and larger country centres concurrently with similar developments in the wholesale fruit and vegetable marketing area. At the same time, increasing attention is being paid to the unit handling of supplies to reduce transit damage and transshipping costs, together with the optimal use of precooling to retain a 'fresh-from-the-field' condition especially in some ultra-sensitive crops, as well as to reduce disease incidence. Closer attention to all these aspects of handling produce from grower to consumer should, if properly co-ordinated, do much to give maximum benefits to all parties concerned.

## Chemical Services Section

Secretarial and technical support are supplied by the Chemical Services Section to two legally constituted Boards, The Agricultural Requirements Board and The Agricultural Chemicals Distribution Control Board.

An unusual matter involving a widely used chemical, chlordimeform, occurred late in 1976.

The formulation and sale of chlordimeform insecticides in Australia was halted by a voluntary action of Ciba-Geigy Australia Limited and Schering Pty. Ltd., marketers of Galecron and Fundal, respectively. The companies concerned jointly announced that preliminary toxicological findings indicate that chlordimeform may cause malignant tumors in the mouse when fed high daily doses over the major portion of its expected lifetime. There has been no indication or report that chlordimeform causes tumors in human beings.

The decision to withdraw chlordimeform from the market will be reviewed after all the tests have been completed and analysed.

The Director-General has approved a procedure which enables the Agricultural Requirements Board to consider recommendations which do not appear on approved labels but which are needed by Departmental advisers for their service to primary producers. This procedure requires a Departmental submission to the Board.

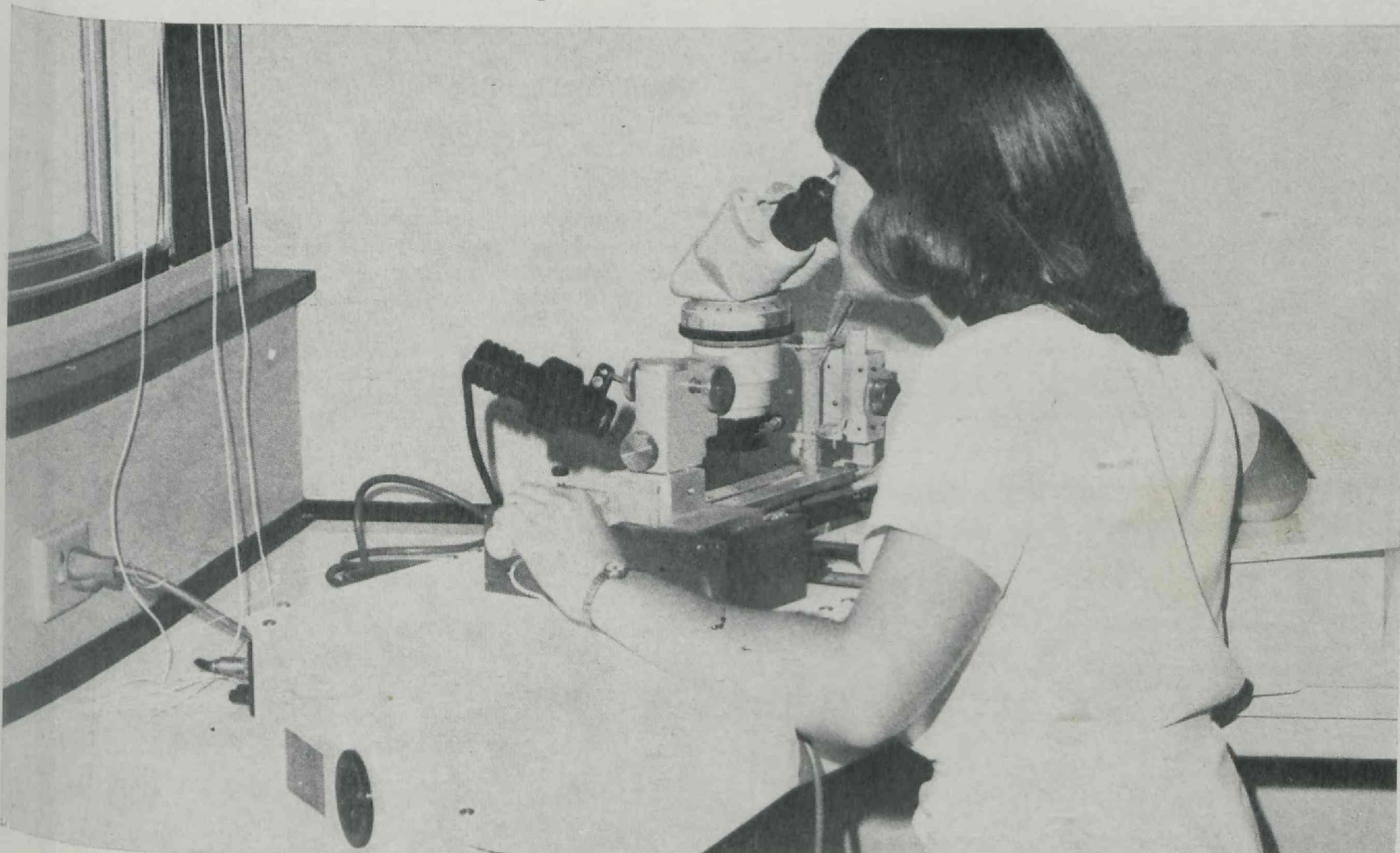
Information needed by extension officers and advisers on many insecticides and fungicides used in Queensland has been extracted from data held in Standards Branch. This has been distributed as Standards Branch Pamphlet No. 74 to Departmental extension and advisory staff. This pamphlet should fill an important role in giving information which Departmental officers need to advise growers on chemical control of pests and diseases. The information is presented as data sheets. Four supplements have been issued. The information in the pamphlet is to be kept up to date and added to by further supplements.

The Agricultural Chemicals Distribution Control Board makes recommendations regarding the licensing of agricultural pilots and weed control operators. It issues statements relating to findings in investigations into complaints of accidental damage to plants and injury to animals.

There were 67 agricultural pilots and 1 315 weed control operators licensed during the year. An application from a pilot for a licence was refused. Eighteen statements on investigations into plant damage were issued during the year.

The third set of amendments to the study and reference book for weed control operators, the Commercial Operator's Manual, was published and issued during the year. This set comprised 17 replacement pages and 29 new pages for new weedkillers or new uses of weedkillers which had been approved since the publication of the second set of amendments. The Commercial Operator's Manual is now a two-volume manual available at a total cost of \$8 for prospective examinees and the public alike.

Modern 'seed flow' machines to aid seed testing.





## Seed Services Section

The primary objective of the Seed Testing Service is to ensure that the end-user of seed for sowing is able to obtain agricultural or vegetable seed of a satisfactory level of quality for his requirements.

This is achieved by regular inspections and official sampling of seed for sowing on offer for sale throughout Queensland by testing, for a fee, samples submitted by merchants and others who wish to sell seed, and by testing, free, samples of seed submitted by farmers for their own sowing.

An important secondary objective is to improve the service in line with advancing technology. This is achieved by research into additional attributes of seed quality, and an endeavour to quantify such attributes, for example, seed vigour, in a way so that they might be applied to existing farming situations. The certification of seed preserves the genetic integrity of cultivars in which overall seed and cropping qualities have been enhanced through plant breeding.

## Seed testing in general

An improvement in the facilities for the germination testing of bean seed was provided by means of a new environmentally controlled growth room at a cost of approximately \$20 000. This equipment permits bean seed to be germinated in compost, a method considered to give a more accurate assessment of germination capacity.

### *Sampling for seed quality control.*



Farmers and merchants were offered a biochemical test of viability in dormant seed as an additional chargeable seed service. This is proving of particular value to producers of sub-tropical and tropical pasture grass seeds who are interested in exporting this seed mainly to Latin American countries.

In February 1977, Queensland was the host State for meetings of the Australian Seed Industry Advisory Committee, the Chief Seed Testing and Regulatory Officers Committee and the Co-ordinating Committee on Seed Certification. Many of the delegates attending these Seed Committees' meetings visited the Queensland Seed Testing Laboratory and discussed seed testing problems.

Overseas students attending three separate International Training Courses also visited the Queensland Seed Testing Laboratory during the year. Although their studies centred upon animal husbandry, marketing, and plant quarantine, the students showed considerable interest in the laboratory demonstrations and brief talks given by staff.

In September 1976, seed testing staff were involved in an exhibit presented as Expo 4 at the Queensland Agricultural College, Lawes. This type of presentation clearly provided information on seed quality in a way appreciated by viewers.

## Seed research

During 1976-77, staff engaged on seed research initiated eight catalogued projects in addition to co-operative ones with other sections of the Department. Although these projects covered widely differing research topics, there was deliberate emphasis to conduct fewer but more detailed investigations.

This attitude is illustrated in two projects dealing with harvesting problems and establishment difficulties in the bean industry. These two investigations were as large as any conducted by this section in the past 5 years.

Substantial losses in bean seed quality during threshing and also during cleaning were documented. The data unmistakably identified low seed moisture content at threshing as a major cause of these losses. Research is continuing to monitor these effects on storage life.

Attempts to obtain a satisfactory vigour test for beans sown at Gatton Research Station were unsuccessful. Although many vigour tests were tried the highest level of correlation between laboratory tests and field performance was 0.65. The situation was vastly different for beans sown at Redlands Horticultural Research Station where all vigour tests gave good correlation with field performance and standard laboratory germination percentage (0.93) was as good as any other vigour test.

The fruits of a successful research program both in 1976-77 and in previous years were evidenced when officers of the Seed Research Section were authors or joint authors of eight of the 36 contributed papers at the 1977 Australian Seed Research Conference held in Tamworth. Three officers attended this conference and participated widely in the proceedings.

## Seed certification

Seed certification activities in Queensland continued at approximately the same level as in 1975-76. There were increases in the quantities of pasture seed navy bean seed and tomato seed certified while small decreases occurred in the quantities of hybrid maize and French bean seed certified.

Noteworthy new developments were the commencement of seed certification schemes for the guinea grass cultivars Riversdale and Makueni; and the entry of the new rust resistant oats variety Stout into the Approved Oats Seed Scheme.

A new Standards Branch glasshouse being erected at a cost of approximately \$60 000 at Indooroopilly will provide much needed facilities for growing-on tests, for checking varietal purity, and for seed research work.



# Division of Land Utilisation

SPECIAL emphasis continues to be placed on the achievement of an increased rate of adoption of soil conservation measures by farmers, and on the cataloguing of land resources in the major agricultural and pastoral regions. Highlights for the year included—

An improved rate of implementation of statutory soil conservation programs on the Darling Downs.

A Commonwealth-States Collaborative Soil Conservation Study.

The public release of reports embracing major land-use studies in the Granite-Traprock area (Stanthorpe), and Maryborough-Elliott River region in south-east Queensland.

The completion of a Land Use Study for the Linthorpe-Aubigny Catchments on the Darling Downs.

Special problems relating to the Beef Industry.

## Progress in soil conservation

The Darling Downs statutory soil conservation programs are now gaining momentum as farmers and staff become more accustomed to the special requirements of the programs. Details for the last 3 years are set out below.

### DARLING DOWNS STATUTORY SOIL CONSERVATION PROGRAM

	Units	1974-75	1975-76	1976-77
Requests from farmers	Number	742	1 327	1 528
New co-operators	Number	64	106	115
<b>Implementation</b>				
Intensive measures	Hectares	4 495	8 197	10 865
All measures	Hectares	7 052	10 704	15 086
<b>Project plans</b>				
Number of farms	Number	138	217	132
Area	Hectares	13 950	31 836	16 573
<b>Provisional project plans</b>				
Number of farms	Number	111	254	347
Area	Hectares	20 000	46 996	66 160
<b>Subsidy payments</b>				
Payments	Number	132	275	524
<b>Total</b>	<b>.. \$</b>	<b>67 942</b>	<b>82 934</b>	<b>182 521</b>

Progress of the soil conservation program for the State continues to show distinct signs of improvement. If the current rate of adoption can be maintained, there are good prospects of achieving control of the erosion problem on Queensland's agricultural lands by the turn of the century.

Requests from landholders for technical assistance have increased from 3 750 in 1975-76 to 3 940 in the current year, a gain of 5%. In terms of all applied measures, there has been a gain from 39 347 hectares to 50 088 hectares representing a 30% improvement. Intensive measures rose by 45%, and the number of new co-operators has continued at a level of approximately 400.

## Commonwealth-States Study

Finalization of the Commonwealth-States Collaborative Soil Conservation Study was delayed for a number of reasons, including the late entry of New South Wales into the Study, and revisions sought by most of the soil conservation organizations to their earlier assessments of the land degradation problem. The assessment methodology developed by the Director of Soil Conservation Branch in collaboration with soil conservationists from the other States and Territories attracted the attention of the United Nations Food and Agriculture Organization as a possible means of assessing soil degradation on a global basis during 1977 and 1978. As a result, the Director was invited to participate in a consultation on the Assessment of Soil Degradation held in Rome 18-20 January, 1977.

## Granite-Traprock Land Use Study report

This major publication took the form of a 300-page report on the physical characteristics and potential use of the Granite-Traprock area of south-east Queensland. Present forms of utilization are detailed and consideration given to

feasible changes. The report indicates there is potential for seasonal vegetable production, wine grapes and apiculture, with opportunity to cater for the open-space recreational needs of nearby urban populations.

## Maryborough-Elliott River study

The report of the Coastal Lowlands Land Use Study, which considered the future use of Crown land in the Maryborough-Elliott River area, is being accepted as a reference document by Government and Local Authorities. Future use is foreshadowed for forestry, nature conservation, agriculture and urban purposes.

## Land use study—Linthorpe-Aubigny catchments

During the year, a group of landholders on the Darling Downs made representations to the Central Darling Downs Soil Conservation Advisory Group Committee requesting that Soil Conservation Branch undertake a detailed study of the erosion problem in the Linthorpe-Aubigny catchments. A comprehensive report was prepared and distributed to all local landholders. A follow-up study to examine the financial aspects of implementing recommended land use proposals is planned for 1977-78.

## Special problems of the beef industry

The Queensland Beef Industry Committee was established by Cabinet in June 1975 to report on the beef market situation, its economic implications for the Queensland producer, the practicability of establishing a successful floor price scheme or an alternative price support scheme, and any other avenues for affording financial relief to beef producers.

During the period under review, four meetings of the Committee were held. The major efforts have been directed towards a market stabilization scheme, expediting a carcass classification scheme, and increasing outlets for sales of beef.

A Beef Stabilization Scheme advanced by Queensland was discussed by the Australian Agricultural Council in October 1976. Council established a Working Group from the interested States to investigate the recognized problems in the implementation of the Queensland proposal. This Group has been able to resolve some areas of difference but some important problems remain. One is to devise a scheme which is legally sound; a second relates to having a uniform and adequate description of the commodity; and the third concerns the relating of the description of the hot carcass back to the live animal, for areas where there is very little direct consignment to meatworks.

## Rural Adjustment Scheme

The Rural Reconstruction Scheme ended on 31 December 1976. Following a requested report from the Industries Assistance Commission, Federal and State Ministers agreed on a Rural Adjustment Scheme to operate from 1 January 1977 for 5 years. This scheme is administered by the existing Rural Reconstruction agencies in each State and consolidates existing schemes, for example, the Dairy Farm Reconstruction Scheme, into one administration.

## Technical reports

Officers contributed to 40 publications, reports and technical papers during the year. Technical papers were presented at nine seminars or workshops.



## Development Planning Branch

THE principal responsibility of Development Planning Branch when established in 1962 was to undertake resource investigations and to identify opportunities for development of rural land throughout Queensland.

The Branch also co-ordinates technical and economic information contributed by other Branches and presents this in the form of reports which indicate the agricultural, pastoral and economic prospects of the proposed development.

Current projects outlined in this report are funded mainly from Consolidated Revenue.

### Development investigations and studies

**COASTAL LOWLANDS LAND USE STUDY.** In November 1972, the Chairman of the Land Administration Commission convened a meeting of Permanent Heads of the Lands, Forestry and Primary Industries Departments to discuss future uses of Crown lands in the Maryborough-Elliott River area. From this meeting, a land use study was undertaken to examine the competing demands for these lands and relative suitabilities of these lands for various uses.

The draft report of the Maryborough-Elliott River Land Use Study was submitted to the Chairman of the Land Administration Commission late last year and then considered by the Permanent Heads of the three Departments involved.

Because of the relevance of the conclusions of the report to the local authorities of Maryborough City, Hervey Bay, Isis, Woocoo and Woongarra, the draft report was discussed with them before its acceptance as an official reference document for Government purposes for State land administration in the region.

The report covered a wide range of disciplines from land resources to environment, industry and social science. It is a valuable reference document for a wide range of administrative, business and development interests as well as students of natural sciences, geography or town and country planning. Copies of the report are available through the Lands Department in Brisbane.

**MARY RIVER-TINANA CREEK STUDY.** This study describes and maps the location and extent of land suitable for growing sugar-cane under irrigation in the Mary River-Tinana Creek area. It is a co-operative effort with the Irrigation and Water Supply Commission and the Bureau of Sugar Experiment Stations.

The land resource assessment stage of this study has been completed for a total area in excess of 30 000 hectares.

The area was mapped in terms of landscapes which were subdivided into land suitability units using a land suitability formula for growing irrigated sugar-cane devised for this particular area. The main suitability criteria were soil depth, moisture-holding capacity, permeability and slope-soil erodibility interaction.

Within the surveyed area, a commandable or benefited area which is to be served with irrigation water was determined. This area of suitable land will allow a doubling of the present cane assignment in the particular area. With this potential for increase in area and the associated increase in yield per hectare from irrigation, the scheme will significantly improve productivity of the whole mill area.

Economic analyses of the scheme were undertaken by Economic Services Branch staff. Depending on the adopted price for sugar and the response to irrigation, the calculated Internal Rates of Return ranged from 5.46 to 15%. The lowest rate was based on a sugar price of \$176 per tonne and a yield response to irrigation of 3.00 tonnes of 94 net titre sugar per hectare.

### Resource investigations and studies

The major activities of this Branch relate to land resource assessments and land use studies over large areas of the State. Basically, these studies aim at providing land use descriptions, maps and specifications for use by extension officers, farmers, graziers, producer organizations and planners from government organizations, so that technical and management recommendations can be tailored to meet the needs of each land type.

They aid in planning for economically viable industries with a minimum of environmental degradation. These studies are also sought as references in teaching programs at primary and secondary schools, universities and colleges of advanced education.

**GRANITE-TRAPROCK STUDY.** A 300-page report on the Granite and Traprock area of south-east Queensland became available during the year. This was originally requested by the Eastern Graziers' Regional Development Committee. Co-operation and assistance were received from many Departmental officers, in addition to Commonwealth, Local Government and other State Government Authorities.

The report is in two parts. The first is a conventional land inventory comprising considerable detail on landforms, climate, soils, vegetation and fauna which are synthesized into land systems. The second part concerns land utilization aspects, including details of present land use and practices, land capability, farm economics and marketing, agroclimatology and the potential for recreational forms of land use. The climatic suitability of the area for wine grapes is discussed in detail, while the importance of the area for honey production is demonstrated by a map of apicultural activity.

The study concluded that there is little further development potential for the traditional forms of production in the area. Activities such as vegetable growing, wine grapes, lucerne hay production and apiculture offer opportunities in a changing market situation. Catering for the open-space recreational needs of nearby urban populations is also likely to become a means of increasing individual and regional income.

**WESTERN ARID REGION LAND USE STUDY.** The study region covering 60 million hectares has now been divided into six survey areas. Progress in each of the survey areas is as follows.

Part 1 has now been completed for some time and requests for copies are constant from a wide range of interested groups. The reports are servicing the initial objectives, early copies being directed at Departmental staff and producer organizations.

The reports for Parts 2 and 4 basically follow the proforma established for Part 1. Part 4 is at an advanced stage with all sections being in final draft form and the maps and diagrams being prepared by Drafting Section. The method of preparation of the land system map has changed for this area. Instead of the coloured map usually prepared, 'Landsat' imagery has been used as the cartographic base and this imagery highlights the variation within land systems. The technique, although cost effective, has led to some problems, due mainly to the uneven quality of the images.

Based on experience of field work in Parts 2 and 4, it was considered that minor changes to field sampling procedures should be implemented in future areas. This led to the introduction of site selection based on a 20 000-metre grid to ensure complete coverage of the area. Free sampling follows to fill in patterns or units not previously sampled.

**NORTHERN BURDEKIN REGION STUDY.** Previous work has been published in the joint State-Commonwealth report, titled 'Resources and Potential of the Burdekin River Basin, Queensland'.

Land unit mapping of 29 580 square kilometres of the adjacent inland areas west to 144°E, north to 18°S and east to the coastal range was completed.

Two land capability maps of the same area have been prepared. One shows agricultural capability with physical unit boundaries, the other pastoral capability with grid cell area boundaries.

The distribution of land for agricultural and pastoral capability in the Northern Burdekin Region is summarized in the following tables.

AGRICULTURAL LAND CAPABILITY  
(EXPRESSED AS A PERCENTAGE OF NORTHERN BURDEKIN REGION)  
(BURDEKIN CAPABILITY RATINGS)

	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total	
	Regular Cropping	Intermittent Cropping	Irregular Cropping	Pasture Improvement	Non-Improvement	%	Area '000 hectares
Upper Burdekin .. .. .	0.3	1.5	15.3	35.3	13.4	65.9	5 706
Adjoining Inland Area .. .. .	0.1	1.7	4.9	18.2	9.3	34.1	2 958
Northern Burdekin Region Totals	0.4	3.2	20.2	53.5	22.7	100.00	8 664



The study shows that little land is suitable for regular cropping, the greatest restriction being the variable climatic conditions. Much of the land is suitable for the less intensive forms of pasture improvement and land development for grazing industries.

### PASTORAL LAND CAPABILITY

(EXPRESSED AS A PERCENTAGE OF NORTHERN BURDEKIN REGION)  
(BURDEKIN CAPABILITY RATINGS)

	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total	
	Fodder Cropping	Intensive Pasture Improvement	Extensive Grazing plus Improvements	Extensive Grazing	Unsuitable Land	%	Area '000 hectares
Upper Burdekin .. .. .	0.9	4.0	31.8	21.0	8.0	65.9	5 706
Adjoining Inland Area .. .. .	0.1	5.5	14.8	8.7	5.1	34.1	2 958
Northern Burdekin Region Totals	1.0	9.5	46.6	29.7	13.1	100.0	8 664

**NORTHERN SHEEP STUDY.** The report on this study has been completed and is awaiting publication. A key section of the study on optimal stocking policy was presented as a paper to the 1977 annual conference of the Australian Agricultural Economics Society. Experiments on stocking policy were performed using a simulation model of a typical Mitchell grass downs sheep property. The assumed management objectives related to mean and variability of income (as a measure of risk) and conservation of the vegetation resource. The experiments showed a possible source of conflict between conservation objectives and income variability.

**BOYNE VALLEY STUDY.** Following the submission of the Preliminary Land Use Study Report in 1975, the Gladstone Area Water Board commissioned a private consultant to study certain areas of the catchment and prepare draft land use regulations and guidelines for monitoring land use practices.

In the main, the Steering Committee accepted the findings and conclusions of the study. Subsequently, Branch officers commenced a more rigorous land resource study of the catchment area. This study aims at improving methodology in such catchment studies and is concentrating on evaluating and improving the techniques of grid cell mapping and automatic data processing.

**WOONGOOLBA LAND USE STUDY.** This project was commenced in July 1976 following a request from the Southern District Sugar Cane Growers' Executive for a detailed land use study in the Moreton and Rocky Point sugar mill supply areas. The objective was to determine additional areas available and suitable for cane growing within an economic distance of the mill.

At present, the Albert Shire is being subjected to intense pressures for housing and hobby farm developments and information pertaining to agricultural capability can be used as a basis for retaining suitable land for rural production.

Land suitability assessment for this type of survey requires some new thinking. The current land capability classifications appear inadequate when large capital expenditure for land improvement is justifiable. Much land in the Woon-goolba area would appear unsuitable for any type of cultivation but, when farmers are willing to spend in excess of \$2 000 per hectare in reclamation, this land can then become agronomically productive. For example, farmers have filled and drained low depressions and are now growing sugar-cane on former mangrove and saltmarsh areas.

New limits for land suitability for sugar-cane had to be defined from examples in the area, taking into account the water-holding capacity of the different soils, workability, yields, and the economics and programs of development of the various land types.

The mapping units and their associated suitability ratings are based largely on topography, since not only does topography determine the drainage requirements (the greatest limitation) but it also is an important indicator of soil type. Water-table fluctuations appear to have been an important factor in profile development.

**WALLOON SOIL STUDIES—GLENALLAN SHIRE.** This project, which aimed at providing soils information for farm planning activities by the Soil Conservation Branch, is one of a number of key area studies being undertaken by the Division. The objectives are to identify agriculturally similar soils and define the land use and management practices necessary to maintain production and stability of the soils. Almost the whole period has been devoted to field work on those Walloon sandstone soils which originally carried scrub vegetation.

**ROSS RIVER DAM INVESTIGATION.** The aim of this project, which is still in the planning stage, is to determine the land capability potential of the catchment area with a view to identifying land uses compatible with the preservation of water quality. Discussions have been held with C.S.I.R.O. Division of Soils at Townsville regarding soils in the catchment and the Department of Local Government on project methodology and time schedules.

**ATLAS OF AUSTRALIAN RESOURCES.** The Division of National Mapping, Department of Natural Resources, is preparing the third series of the Atlas of Australian Resources. In producing the map of distribution of sheep and cattle, it is desired to make the respective dot and shading representations on the map reflect more accurately the actual concentrations of sheep and cattle within the various Local Authority Areas. Such an assignment depends on the collation of the local and personal knowledge of Departmental staff into a map base.

**LAND DISPOSAL OF SEWERAGE EFFLUENT.** Following a request from the Caboolture Shire Council for assistance in designing a sewage disposal scheme near the town of Woodford, a joint investigation with Agriculture Branch was undertaken.

An agricultural drainage scheme combined with sprinkler irrigation application of the effluent was found to be the answer to the situation.

### Special activities

Branch officers have again undertaken special duties in collaboration with other agencies in relation to the effects of natural disasters (for example, floods and drought) and the resolution of problems of the beef industry.

**NATURAL DISASTERS.** The above-average rainfall pattern of the last few years generally continued through the last year and, as a result, only a very small proportion of the State was declared drought-stricken. Parts of Monto and Banana Shires were declared drought-stricken in September and October 1976.

**FLOODS AND CYCLONES.** During the summer, a number of cyclones influenced Queensland weather. Cyclones Ted and Keith resulted in substantial livestock and crop losses in the north-west and on the northern coast. Record February rainfalls were reported in the south-west of the State and in the Babinda-Innisfail area. There were major floods in the far western river systems and on the northern coast.

*Cyclone Ted.* Following a submission to the Commonwealth Government, assistance measures for those graziers affected by Cyclone Ted were agreed to by the Commonwealth and State Governments under the Natural Disaster relief arrangements.

*Cyclone Keith and subsequent floods—assistance scheme.* Cyclone Keith, which affected northern coastal areas over the period from 30 January to 2 February 1977, was followed in the next 2 weeks by weather influences including cyclone Nancy which resulted in record rainfalls in coastal areas between Cairns and Tully. Rainfall totals for the first 2 weeks of February at Babinda and Innisfail were more than 2 000 mm, which exceeds the highest monthly falls ever recorded at these centres.

The record rainfall and associated flooding caused further substantial damage to cane fields and banana plantations which had been flooded or damaged by strong winds associated with cyclone Keith. Further heavy rainfalls in March also resulted in widespread flooding particularly in the Ingham district.

Following the agreement of the Commonwealth Government, a loan assistance scheme was implemented.



## Soil Conservation Branch

THE prevention and mitigation of soil erosion is the main function of Soil Conservation Branch under *The Soil Conservation Act* of 1965. Related functions include research and investigations into the nature and extent of soil erosion.

### Nature and extent of soil erosion

#### Commonwealth-States Collaborative Study

Queensland was the only State not to revise its land degradation assessment carried out in 1975-76 as part of the Commonwealth-States Collaborative Soil Conservation Study. The Study is being reported in two main parts ('An Appreciation of Australia's Soil Conservation Problems' and 'Towards a National Approach to Land Resource Appraisal') and 12 supplementary reports. Publication of the reports is expected late in 1977.

#### Erosion and land degradation investigations

The two main land degradation investigations undertaken during the year were an investigation of landslips in the Moreton Region and an investigation of soil erosion, salinity and landslips in the Bremer and Lockyer catchments.

Recommendations can be made that no clearing should be carried out on slopes greater than 15% on those lands which are prone to landslip. A joint project with Geological Survey of Queensland and university workers has been initiated to delineate fragile areas in the Moreton Region in which restrictions on land use should apply.

#### Field observations

Erosion was not generally as severe as in recent years. Little erosion occurred in those areas which received low summer rainfall, particularly the Near North Coast Region.

Several regions reported severe erosion due to heavy rain in mid May, especially on the southern Darling Downs where large areas of land were in fallow in readiness for the winter grain planting.

In the South Burnett, serious sheet and rill erosion occurred during November and some poorly grassed waterways suffered damage. In the Far North, there was moderate to severe erosion in the inland from high intensity storms, while the coastal areas suffered from flooding streams during the cyclonic weather.

No widespread erosion occurred in the Near South West Region, but isolated storms caused damage near Wandoan and some wind erosion was reported on sandy loam soils.

### Land use and conservation practices

A major objective of the Soil Conservation Branch is to encourage landholders to maintain soil cover and apply conservation land management practices such as stubble mulching and contour cultivation. During the year, increased adoption of these practices was reported from a number of regions. Stubble mulching and stubble retention were more widely accepted on the Darling Downs. Conservation tillage machinery became more popular in the Capricornia Region.

There has been increased interest in growing tree and vegetable crops in the Near North Coast and South Burnett Regions. Terrace mounding for some tree crops was adopted by some landholders as a soil conservation measure.

Increased interest is being shown in the South Burnett in irrigating summer crops. Farm irrigation layouts have included soil conservation run-off control works.

Substitution of steep caneland around Bundaberg and Childers is continuing. Stabilization of de-assigned canelands with green panic and Siratro was favoured by good seasonal conditions.

Soil loss from grazing land around Gatton is considered to contribute the major proportion of the sediment load in Lockyer Creek and associated streams. Burning of native pastures was practised extensively in the Moreton Region this year and there was little use of stubble mulching on cultivation land.

In north Queensland, tobacco stalks left after picking were very successful in reducing erosion.

Earthworks combined with stubble mulching are replacing grass strips in the Near South West.

Reports from many areas indicate that maintenance of contour banks is poor. Grass strips and narrow base banks in the Capricornia Region have been badly neglected, while banks in north Queensland have also been poorly maintained. By contrast, there has been a marked improvement in the quality of earthworks in the areas of soil erosion hazard, due to the standards required for subsidy payment.

### Work programs

District, Regional and State work programs provide the framework for the achievement of prevention and mitigation of erosion. The objective of work programming is the efficient implementation of land use, land management and structural measures by landholders.

Funds for the activities were provided principally from Consolidated Revenue, with some assistance from the Commonwealth Extension Services Grant. A research project on erodibility of wheat soils was funded partly by a grant from the Queensland Wheat Industry Research Committee.

During the year, a major review was undertaken to examine land degradation problem areas and the priorities for dealing with them. Information from the review was used as an input in the submission to the Priorities Review Committee and in formulating the Branch's 1977-78 Work Program.

### Land Resources Assessment

The principal activity in this field was related to the Darling Downs statutory soil conservation program. Field investigations involved in land resource assessment have been completed for all the major agricultural soils of the Darling Downs except the brigalow-belah soils. The projects involved in the Darling Downs land resource assessment program included—

**BASALTIC UPLANDS (SCRUB).** This project was started in early 1975 and is designed to identify, describe and assign land management criteria to the basaltic soils supporting scrub vegetation. Differences between scrub and forest soils in terms of fertility, infiltration rates and erodibility have been investigated.

**WALLOON COAL MEASURES AND MARBURG SANDSTONES.** Draft reports on this project were evaluated by Field Services staff as a guide for farm planning, before redrafting for publication.

**BRIGALOW-BELAH SOILS.** Reconnaissance traverses throughout the brigalow-belah areas were completed. Detailed investigations will be carried out in 1977-78.

**DARLING DOWNS SOIL HANDBOOK.** This draft handbook describes the major agricultural soils and the land management requirements for them.

Other major land resource assessment projects undertaken during the year included the Cooyar Rangelands and Southern Border surveys and the Nambour Canelands Land Suitability Study. The aim of this latter project is to determine additional areas available and suitable, from a soil conservation viewpoint, for sugar-cane growing within an economic distance of the Moreton Central Sugar Mill. Field work in the study was completed during the year.

### Research and investigations

Before 1975-76, the research program was directed mainly at gaining information for the formulation of technical guidelines for field programs. The emphasis of the program has changed to the collection of basic data on soil erodibility, soil loss and erosion control measures. Research projects are now being undertaken on the Darling Downs, in the South Burnett, the Central Highlands, the Mackay district and at Indooroopilly. Research activities for 1976-77 are set out below.

#### ERODIBILITY OF WHEAT SOILS

This project aims at identifying the soil surface properties affecting the erodibility of wheat soils. The rainfall simulator at Indooroopilly, which became fully operational last year, was used to assess the erodibility of a range of soils from the Darling Downs.

#### EROSION INVESTIGATIONS

The erosion investigations, which began in 1975-76 in the Mackay canelands, were continued. In these studies, factors affecting erosion rates such as slope, soil characteristics and land management are being investigated.

Soil erosion in the Medway area of the Upper Nogoa catchment is being monitored in a research sub-catchment. During the summer season, 30 run-off events were recorded, indicating a total soil loss of approximately 200 tonnes per hectare during this period. Up to 5 metres of alluvial flats were eroded away by severe streambank erosion. During 1976-77 the soil erosion measurements were extended to include monitoring of vegetation changes along four paired transects comparing grazed and ungrazed areas. Two paired catchments, one grazed and one ungrazed, were instrumented for the measurement of rainfall, run-off and soil loss.



## Land management investigations

Current research projects in this field include: soil conservation potential of cropping systems; measurement of available soil water capacity; surface management of arable soils; conservation tillage; soil loss under grazing; tree thinning and land degradation; and waterway stabilization investigations.

**SOIL CONSERVATION POTENTIAL OF CROPPING SYSTEMS.** During 1976-77, two trial sites were established on the Eastern Darling Downs where surface hydrology, soil erosion and crop production are being monitored. In spite of a relatively dry summer, a total of 18 run-off events were recorded from five contour bays under different crop and fallow conditions.

**AVAILABLE SOIL WATER CAPACITY.** This project is designed to measure the available soil water capacities of the major agricultural soils of the Darling Downs and to relate these capacities to soil profile characteristics. The information will be used in devising cropping and land management systems which reduce soil loss and make better use of rainfall.

**SURFACE MANAGEMENT PROGRAM.** A joint program was formulated by Agriculture Branch and the Division of Land Utilisation to develop ways of using plant cover and tillage practices to reduce soil loss to acceptable levels within the constraints imposed by economic land use. A core research group was established at the Queensland Wheat Research Institute. The project is now being expanded to include trials in the Kingaroy and central Queensland areas.

**CONSERVATION TILLAGE.** The aim of this project is to devise cropping systems for the South Burnett which utilize minimum tillage methods. This work follows on from the successful development of techniques for sod-seeding of fodder crops into summer and winter pastures in the South Burnett. Increased production was demonstrated in trial plots and the results are now being incorporated in extension programs. Two contour bays are being monitored to compare conventional tillage with conservation tillage.

**SOIL LOSS UNDER GRAZING.** Soil loss measurements under different grazing systems are being studied at Brian Pastures Research Station at Gayndah. A soils map of the trial area was completed and representative soil profiles analysed.

**TREE THINNING AND LAND DEGRADATION.** A joint C.S.I.R.O.-Department of Primary Industries experiment was set up near Kingaroy to study the effect of tree clearing and thinning on pasture production, land degradation and vegetation changes. Research staff completed a bench mark soil survey of the experimental site. Low level air photography of the site was carried out by C.S.I.R.O.

**WATERWAY STABILIZATION INVESTIGATIONS.** Difficulties in establishing and maintaining vegetative cover in soil conservation waterways occur in many areas of the State. A project was established during the year to determine the causes of failure and identifying methods, both short-term and long-term, of rectifying the problem.

## Data collection, processing and analysis

The computing group in the Division of Land Utilisation acts in both research and service roles. The research role involves the development and investigation of computer techniques, while the service role involves the storage, retrieval and manipulation of survey data and the analysis of meteorological data.

Some projects on which computer techniques were used during the year included the processing of Landsat satellite imagery for identification of different crops on the imagery, as well as the calculation for various centres of the erosive nature of individual storms and the aggregation of these single storm calculations into monthly, seasonal and annual estimates.

## Extension

In most parts of the State, farmer interest remained at the high levels established during 1975-76. The number of requests for services totalled 3 940 this year, the highest such number for any year except 1966-67. Of these requests, 630 were initial requests and 3 310 were requests for follow-up assistance. The most notable increases in requests for services were in north Queensland and the Darling Downs where the increases over 1975-76 were 57% and 25% respectively.

Property visits for the year totalled 7 047, of which 627 were initial visits. These figures represent increases of 6% over the corresponding visits made in 1975-76. A total of 427 new co-operators in soil conservation resulted from these visits, 122 of whom were Darling Downs farmers. The Mackay and Rockhampton Districts each recorded 30 new co-operators.

Every effort was made to stimulate the interest of landholders by numerous personal discussions on farms and by use of mass media and group extension activities. Extension to landholders and the general public through mass media was based on 101 press articles, 40 radio talks and six television segments. Extension activities to groups of landholders were carried out through 31 field days, 10 show displays and 79 meetings.

Landholders' interest in soil conservation is usually translated into action only if they have the financial capability to apply the required measures. Since soil conservation is seen by farmers as reducing rather than increasing income in the short-term, this activity is given lower priority for investment by them at financially critical times. The dollar-for-dollar subsidy scheme, with a maximum of \$1 000 per farm, which is operative on the Darling Downs, has undoubtedly helped to stimulate interest in soil conservation activity and increase the area of intensive measures applied. An amount of \$182 521 in subsidies was paid during the year on contour banks, diversion banks, waterways, grass strips, tillage machinery for conservation farming, and dozer blades purchased for contour bank construction.

## Planning

Special emphasis was continued during the year on planning activities for the statutory program on the Darling Downs and in the Isis and Gin Gin areas. In these programs Project Plans or Provisional Project Plans form the basis for the implementation program and payment of subsidy. During the year, 347 individual farm plans on the Darling Downs comprising an area of 66 160 hectares were prepared as Provisional Project Plans. In addition, 13 Project Plans covering 16 573 hectares and involving 132 farms were prepared and advertised. The area of the Project Plans advertised during the year was lower than the 32 000 hectares advertised during 1975-76, due chiefly to increases in demand for provisional planning and implementation.

Since the start of the Darling Downs statutory soil conservation program in 1973, plans covering 193 000 hectares have been prepared, and include 1 200 farms or almost 20% of the Darling Downs farms likely to require run-off control measures.

The first Project Plans within the Isis Area of Soil Erosion Hazard were advertised in April. The first Project Plan for Division 4 in Rosalie Shire in the South Burnett is nearing completion.

## Implementation

The increased rate of implementation of soil conservation measures has further confirmed the reversal of a downward trend which has been evident for some years.

A total of 50 088 hectares was treated with various combinations of intensive and simple soil conservation measures. This represents an increase of 27% over the corresponding figure for 1975-76. However, the area treated is less than the record of 59 696 hectares achieved in 1969-70.

The area treated with intensive soil conservation measures, such as contour banks, was 37 678 hectares, 45% increase over the corresponding figure for 1975-76. Increases were recorded in six of the eight regions. The most outstanding increase was in the Capricornia Region where 16 230 hectares were protected with contour banks compared with 8 559 hectares in 1975-76. The greatest part of the implementation took place in the Central Highlands. However, significant increases were also recorded in the Mackay, Moura, Rockhampton and Theodore districts.

Construction of contour banks on the Darling Downs continues to increase as the statutory program gathers momentum, with 10 865 hectares contoured during the year compared with 8 197 hectares in 1975-76. North Queensland and Near South West also recorded significant rises in implementation over the previous year.

## Special activities

### Liaison activities

Soil conservation activities involve considerable liaison with other Departments, authorities and organizations. One meeting of the State Advisory and Co-ordinating Committee on Soil Conservation was held during the year.

Two Advisory Group Committees (Southern Darling Downs and Northern Darling Downs) were elected by postal ballot. The Central Darling Downs Advisory Group Committee was elected in the previous year. The purpose of the Committees is to provide advice to the Soil Conservation Authority on the development and implementation of the statutory soil conservation program. Committee members represent a district of contiguous shires, each committee being restricted to 10 members. Elected landholders on the Committees represent the landholders in the different land resource areas in the district. Each local government authority in the district is also represented on the committee for the district.

In August 1976, a group of concerned landholders on the Darling Downs made representations to the Central Darling Downs Advisory Group Committee for a detailed study of the Linthorpe and Aubigny catchments. The Branch was assigned leadership in the study but considerable assistance was given by the Main Roads Department, the Irrigation and Water Supply Commission and the Jondaryan Shire Council. The report was completed in February and has been distributed to local landholders for comment. A follow-up study to examine the financial aspects of implementing the proposals has been planned for 1977-78.



## Engineering Services Section

THE principal function of the Agricultural Engineering Section is to provide technical services to those units of the Department requiring specialist advice, either directly in relation to Departmental activity, or as an extension activity for primary producers requiring engineering advice and guidance.

### Extension activities

Extension activities pose an increasing demand on the engineers' time. Because of the increasing costs of farm machinery, farmers are requiring detailed engineering advice before committing themselves to the purchase of new machines. The previous practice of engineers addressing local meetings of farmer groups has been continued with advantages to all concerned. Participation was extended this year to Meandarra where an engineer arranged a tractor performance field day. An Engineering Services stand was set up at the Toowoomba Farmfest where the distribution of engineering information was well received.

### Workshop activities

The engineering workshop at Toowoomba was occupied in January. The machine shop and large fabrication area has contributed to an increase in workshop productivity and staff morale.

Substantial financial assistance for equipping the workshop has again been provided from the Commonwealth Extension Services Grant.

### Branches served

The appointment of an engineer to service the requirements of Horticulture Branch was a major step forward during the year.

#### Soil Conservation Branch

Soil Conservation Branch is serviced by one full-time engineer and two part-time engineers who were engaged on the following projects—

Two major items of stubble mulch machinery were designed and constructed for the South Burnett Machinery Evaluation Committee.

The Rainfall Simulator project is now nearing completion. Most of the activity involved construction work. However, modifications required by Soil Conservation Branch involved considerable time with re-design.

Apart from a survey of the Biloela Research Station, the Topographic Survey Team concentrated their efforts in Areas of Erosion Hazard on the Darling Downs.

#### Agriculture Branch

Agriculture Branch is serviced by two full-time engineers and one part-time engineer.

Considerable trial work has been completed on the Emergence Enhancement (Press Wheel) Project this summer. Further trials are required during winter and next summer before valid conclusions can be reached.

The level of inquiries relating to on-farm grain drying increased this year. With the co-operation of an energy supply company, a system for controlling gas-fired grain drying systems has been developed for farm constructed dryers, and some of these units are now in operation.

The need to match tractor with implements prompted the design and successful construction of a cheap, accurate and reliable drawbar dynamometer. The next stage of development involves incorporating speed-sensing devices to provide direct measurement of power, speed and wheel-slip. It is hoped to have this unit manufactured commercially in the future.

A grass-seed harvester incorporating a flail cutting head has been constructed for use in forage harvesting and seed harvesting in research plots. This machine features a variable height cutting head.

## Drafting Services

THE Drafting Section is now administered by the Executive Engineer. Draftsmen and Cartographers attached to this section provide a wide range of maps, project plans and farm plans for Soil Conservation and Development Planning Branch officers.

Service drafting and map preparation is also provided for other Branches within the Department.

**RESOURCE MAPS AND PUBLICATIONS.** These activities constitute about 60% of the total drafting time. Important projects serviced or for which maps were provided during the year included: Western Arid Region Land Use Study, Lower Mary-Tinana Creek Irrigation Project, Maryborough-Elliott River Land Use Study, Burdekin River-Elliott River Soils Study, Glengallan Shire Resources Survey and Capricornia Region, Land Use (Suitability Zones).

Unsuitable weather prevented the use of onion harvesting machines this season, with the result that further testing will be required next year.

A mechanical device for applying benzol to tobacco seedlings and thus reducing the high labour content of this operation was constructed. A tobacco misting machine was also constructed.

Engineering research with tobacco harvesting is continuing into aspects of Container Curing developments in both north Queensland and Victoria.

Advice has been sought by the Project Managers responsible for the construction of the Dalby Rural Training School regarding grain handling, drying and storing systems proposed for installation at the school.

#### Pig and Poultry Branch

Pig and Poultry Branch projects are serviced by one full-time engineer.

The project Survey of Existing Methods of Piggery Effluent Treatment Disposal and Utilization was finalized and a report presented to the Australian Pig Industry Research Committee.

The sampling and analysis of data relating to the project Fertilizer Value and Polluting Potential of Piggery Effluent is complete and a report is being prepared.

Inquiries from pig producers have mainly related to the planning of piggery buildings. However, only a small percentage of producers has actually carried out the work planned. Two companies have now produced modular piggery buildings which can be supplied in kit form.

With the installation in Toowoomba of the computer node, a start will be made on computer simulation of livestock building environments to develop better criteria for selecting building materials and environmental control equipment.

Poultry inquiries centred mainly around selection of automatic feeding facilities and selection of exhaust fans, insulation and abattoir equipment.

#### Horticulture Branch

Horticulture Branch is now serviced by one full-time engineer.

A spraying unit and fertilizing unit for use in experimental plots at the Redlands Horticulture Station were designed and components ordered for their fabrication.

Engineering advice and assistance were given to a Caboolture farmer who had developed a prototype banana dehandler and associated fruit handling equipment.

Preliminary design and cost estimates were prepared for the manufacture of a Drop Roll Sizer for grading fruit and tomatoes.

Initial investigations have been carried out into the reasons for the decline in quality of bean seed produced in the Lower Burdekin. These investigations included aspects of harvesting, threshing and seed storage. Seed germination trials have been established at Redlands to indicate the scope and need for further investigations.

A passionfruit harvester has been designed and demonstrated. This machine harvests fruit from the ground, and involves a sweeping action with elevation and conveying of fruit to a bulk container.

#### Division of Dairying

The Division of Dairying is serviced by one part-time engineer. Project work has been undertaken to investigate the feasibility of providing guidelines for use in construction of all-weather on-farm roads which are capable of carrying loads equivalent to a fully laden bulk milk tanker.

Maps prepared for other Branches and organizations included: Moreton Region Vegetation Maps for Botany Branch, Pineapple Growing Areas of Queensland for Agricultural Chemistry Branch, Shire Handbooks for Agriculture Branch, and Biological Resources Survey Map for Queensland Fisheries Service.

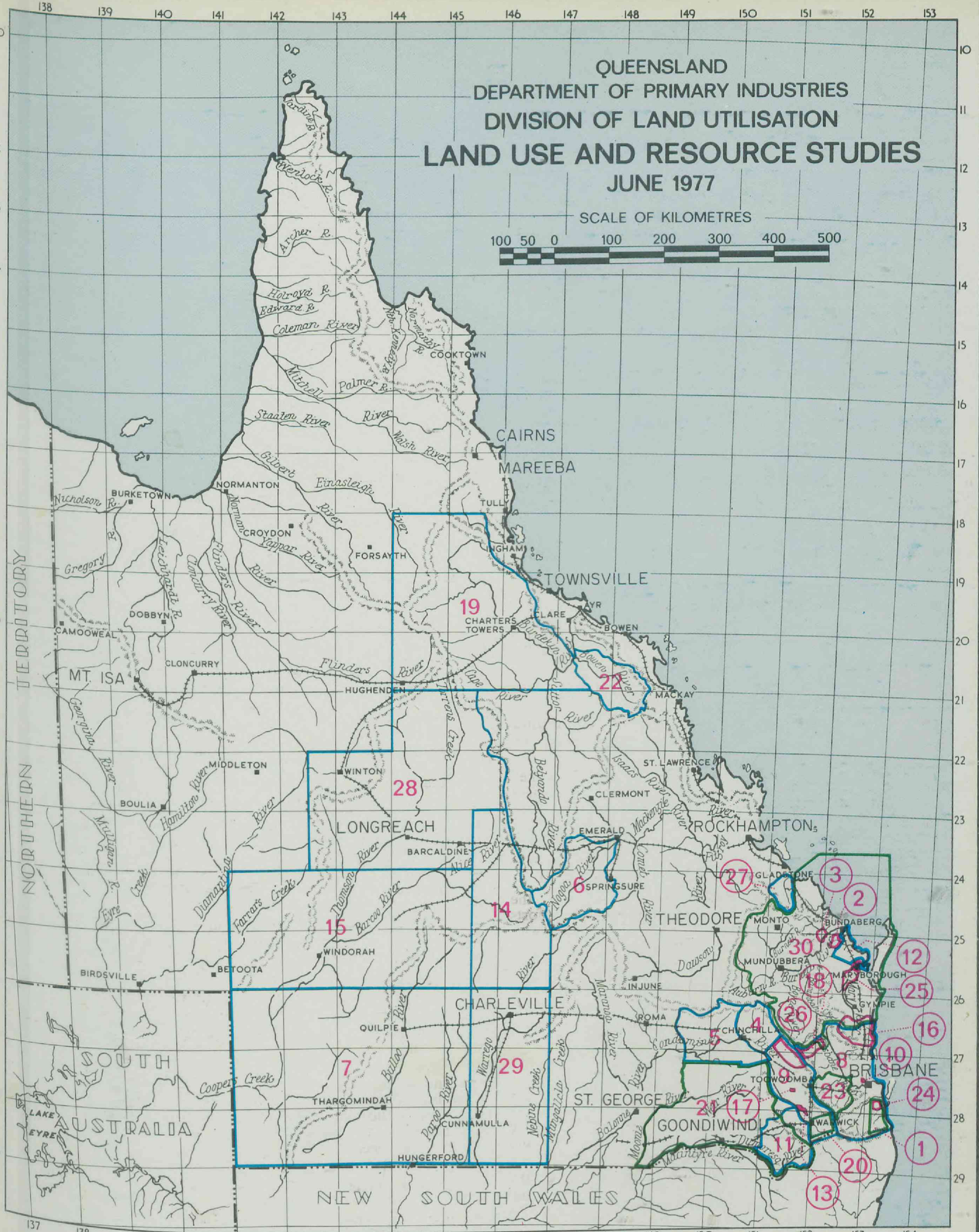
**SOIL CONSERVATION GUIDES AND MAPS.** These activities accounted for 15% of the total drafting time and supplemented the regional drafting offices at Toowoomba, Dalby, Kingaroy, Bundaberg and Rockhampton.

**MISCELLANEOUS DRAFTING ACTIVITIES.** These activities, including work for other sectors of the Department accounted for 25% of the total drafting time.



QUEENSLAND  
DEPARTMENT OF PRIMARY INDUSTRIES  
DIVISION OF LAND UTILISATION  
LAND USE AND RESOURCE STUDIES  
JUNE 1977

SCALE OF KILOMETRES



1 SOUTH COASTAL QUEENSLAND LAND USE STUDY .....	1971	23 BREMER-LOCKYER LAND DEGRADATION STUDY .....	in progress
2 ISIS LAND USE STUDY .....	1971	24 WOONGOOLBA LAND USE STUDY .....	in progress
3 GIN GIN LAND USE STUDY .....	1972	25 MARY RIVER - TINANA CK. LAND USE STUDY .....	in progress
4 JANDOWAE TECHNICAL GUIDE .....	1972	26 BRIGALOW/BELAH KEY AREA MAPPING .....	in progress
5 MILES TECHNICAL GUIDE .....	1972	27 BOYNE RIVER CATCHMENT STUDY .....	in progress
6 EROSION SURVEY OF THE UPPER NOGOA CATCHMENT .....	1972	28 WESTERN ARID REGION LAND USE STUDY PART V .....	in progress
7 WESTERN ARID REGION LAND USE STUDY PART I .....	1974	29 WESTERN ARID REGION LAND USE STUDY PART III .....	in progress
8 MORETON REGION NON-URBAN LAND SUITABILITY STUDY .....	1974	30 WIDE BAY-BURNETT LAND USE STUDY .....	in progress
9 EASTERN DOWNS TECHNICAL GUIDE .....	1975		
10 NORTH PINE DAM CATCHMENT STUDY .....	1975		
11 THE GRANITE AND TRAPROCK AREA OF SOUTH EAST Q'LD .....	1976		
12 MARYBOROUGH-ELLIOTT RIVER LAND USE STUDY .....	1977		
13 MARBURG/WALLOON-KEY AREA MAPPING .....	in prep.		
14 WESTERN ARID REGION LAND USE STUDY PART IV .....	in prep.		
15 WESTERN ARID REGION LAND USE STUDY PART II .....	in prep.		
16 NAMBOUR CANELANDS STUDY .....	in prep.		
17 BASALTIC UPLANDS (SCRUB) - KEY AREA MAPPING .....	in prep.		
18 COOYAR CATCHMENT LAND USE STUDY .....	in prep.		
19 NORTHERN BURDEKIN REGION LAND CAPABILITY STUDY .....	in prep.		
20 GLENGALLAN SHIRE RESOURCES SURVEY .....	in prep.		
21 SOUTHERN BORDER TECHNICAL GUIDE .....	in prep.		
22 SOIL & LAND CLASSIFICATION - COLLINSVILLE REGION .....	in prep.		

NOTE: in prep. .... map and report being prepared.  
in progress ..... field work underway.





