Queensland
AGRICULTURAL JOURNAL

NOVEMBER-DECEMBER 1975 Vol. 101 No. 6

Wool is a winner

As this issue's cover so clearly shows, wool is a clear winner in the high fashion stakes. Indeed, if we were to list the advantages of wool, we could fill seven pages - or more. These seven reasons alone, however, emphasise the supremacy of this wonder fibre.

WOOL is a natural body covering.

The only animal fibre that can be easily spun and woven and which has tiny scales that inter-lock. Wool cloth fits but does not restrict body movement.

WOOL is thermostatic.

It protects from both heat and cold. A wool fibre has a group of enclosed air chambers, and wool acts as a natural regulator of body temperature.

WOOL is absorbent and porous.

Wool allows perspiration to evaporate slowly. Wool fabrics never stick to the skin when damp, and never feel clammy. Wool absorbs up to 33% of its own weight of water without even feeling wet.

WOOL is fire resistant.

Exposure of our clothing to open flames is a frequent hazard. Wool therefore protects. Prove this: touch a match to an all-wool fabric, and then to rayon, silk or cotton yarn. Wool will not burn. The other fibres burn quickly.

WOOL is elastic and resilient.

A single fibre can be stretched 70% beyond its own length. Wool fabrics, therefore, hold their shape, drape gracefully, do not wrinkle easily and are easy to care for. This in turn means convenience and economy.

WOOL is strong and durable.

Wool fibre and gold wire of the same thickness will each support the same weight. For resisting heavy wear, wool is 'worth its weight in gold'. Wool's strength is in its fibre, not in its bulk.

WOOL is light, soft.

A delicate, aristocratic fibre - as soft and light as down, and chosen for its sheer luxury. This lightness is revealed even in modern wool blankets and the newest wool fashion fabrics.

QUEENSLAND AGRICULTURAL JOURNAL

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Taking a Closer Look

Livestock

"Beef carcass judging has been approached in an objective way"

In this article, two officers who have been closely associated with the Departmental Beef Carcass Competition at the R.N.A. look at the trends in judging. This article begins on page 651.

A.B. helps upgrade beef herd

On page 659, a report of how a Condamine cattleman has used Charolais semen to carry out an upgrading programme on his property.

Silage in Queensland

A comprehensive cover of techniques of silage making starts on page 708.

Agriculture

A home-made mobile field bin drier

A Monto graingrower who built himself a grain-drier three harvests ago is finding that he's solved grain drying problems. The story starts on page 645.

Berken—a new mung bean variety

This new mung bean variety has a seed larger than Celera, the present important variety. Page 657.

Zinc foliar sprays increase yields of navy beans

These increases can be as much as 73%. The story starts on page 705.

Forage sorghums on the Darling Downs

A comprehensive cover of all forage sorghums available together with notes on their cultivation starts on page 721.

Horticulture

How to extend the vase life of cut flowers

Of interest to both the commercial grower and the housewife, this article starts on page 753.

Lettuce all year round

Notes for the farm gardener, on page 759.

Entomology

Honeybees, giant toads and hive stands

Toads can cause beekeepers severe losses. However, these can be minimised with simple hive stands. Page 689.

Control of Tobacco Pests in the Field

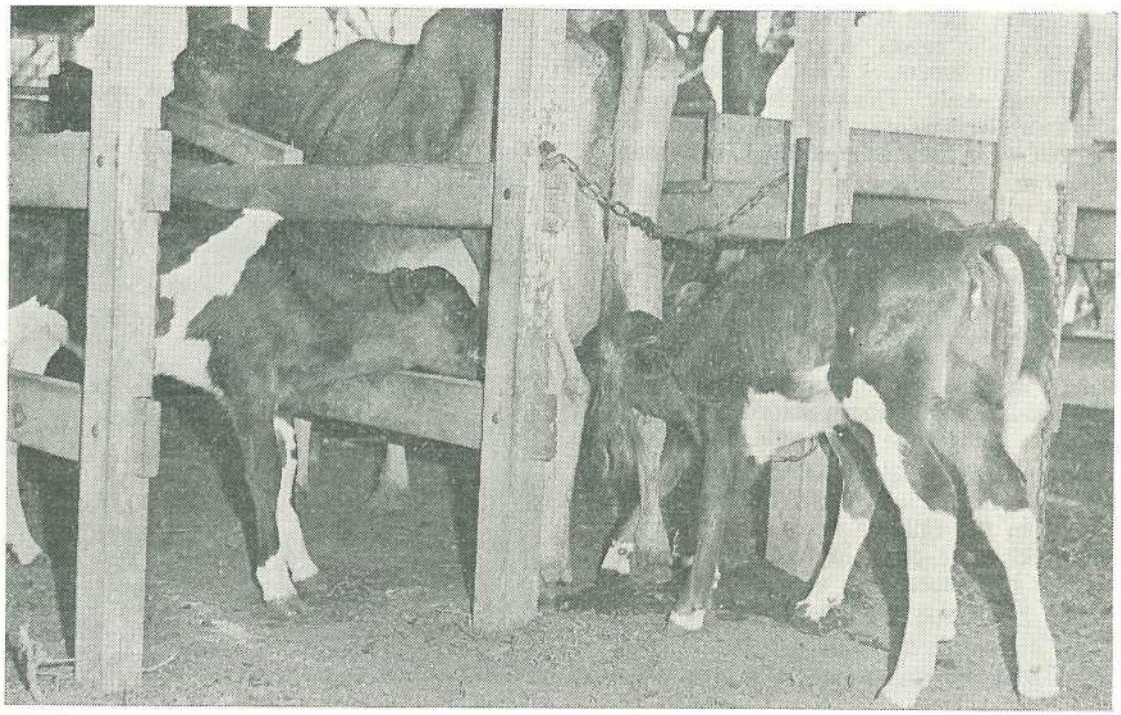
In this, the third article on tobacco pests, Roger Broadley looks at their control in a field situation. On page 693.

Gladstone dairyman, Don Kearney says

"I'll never go back to artificial rearing"

by R. YOUNG, Dairy Adviser, Dairy Field Services, Gladstone and J. EDMUNDS, Husbandry Officer, Dairy Cattle Husbandry, Biloela Research Station.

In this article we report an interview with Mr. Don Kearney of Bracewell, near Gladstone.



Multiple suckling in the feeding stalls.

Mr. and Mrs. Don Kearney.

What problems have you encountered with rearing replacement heifers?

Death of 40 to 50 per cent. of the calves, and poor growth after weaning. This was on bucket rearing using milk replacer, mixed according to the manufacturer's instructions.

We were bucket feeding up to 16 weeks, to try to get the calves to grow. We were also feeding supplementary concentrates at about 250 g twice daily. This was dairy meal. Those which survived were in fair condition to weaning, but went back in condition after weaning, with some deaths.

Why are you rearing replacements?

We are changing to Friesians, from Guernseys as soon as possible, using a son of an A.I. Proven sire bought from Biloela Research Station. So we need all the heifers we can rear. I decided to adopt multiple suckling after I visited Biloela Research Station and discussed the work being done there with John Edmunds

Following his advice, I draft off problem cows, which are unsuitable for machine milking, from the milking herd at milking times, and feed these cows in feed stalls the same amount of concentrates as the milkers.

The calves are released to suckle the cows from an adjacent paddock before milking starts, and drafted back to the paddock after milking. I rear three calves per cow on heifers and lower yielders, and four calves on the average cow in the herd.

Are the calves fed supplements?

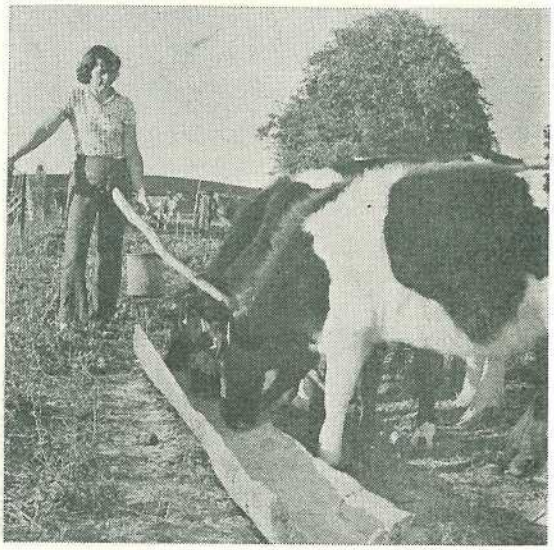
Yes. We feed 300 g twice daily per calf of a 6 parts hammer-milled sorghum grain to 1 part No. 1 Meatmeal mix. This is one 2 gallon bucket to 20 calves. We rear about 25 Friesian and Friesian cross. Weaning age depends on quota needs. If we have over-quota milk we may wean at up to 16 weeks.

If milk is short, we wean at 8 weeks. With 8 week weaning, we get good calves which grow on well, providing that they are eating their grain, and grazing improved pasture. The paddock has good water available, and is mostly green panic, with some Siratro.

The ideal weaning age is about 10 to 12 weeks if the milk is available. The calves need less grain for rearing.

The calves are very quiet, and well grown. John Edmunds advised me that paddock suckled calves running with the cows would be too wild for replacement purposes and this seems to be right. This is why we suckle twice daily in the feeding stalls. They don't drop back after weaning, either.

Mrs. Kearney with weaned 16 week multisuckled heifers.



Since starting multiple suckling this season, we have not lost a calf. We have treated one or two calves for scours, which recovered immediately. Before, no amount of antibiotics helped. As far as work is concerned, it's about a third that of bucket rearing.

Are you thinking of going back to artificial rearing?

I'll never go back.

Would you recommend multiple suckling to other farmers?

Every farmer should rear his heifers this way. They grow on so that you can calve at two years. Costs are less. I agree with the costing that has been done at Biloela that there is a saving of at least $3.00 per calf reared, compared to milk replacer or manufacturing price over-quota milk, when you value the saving in calf losses through disease.

Are there any other farmers in your district multiple suckle rearing?

Yes. Charlie Wright, a near neighbour, was unable to rear a calf due to coccidiosis until three years ago. He spelled the farm from calves for a year, to break the cycle of infection, and began rearing his replacements by multiple suckling some of his heifers. He has had no trouble since.

Would you have considered other calf rearing methods if you did not have feeding stalls ready constructed handy to the bails and reasonably calf-proof fences?

I think it would have depended on the cost of erecting these improvements in relation of the value to me of the Friesian cross heifer replacements. Calfeteria systems and once a day feeding with early weaning are alternatives, but I don't think that these would have beaten the disease problem. This is a 203 ha farm milking 125 Guernsey cows, that I bought in 1972, and I cannot afford to buy in good Friesian cows, with my improved pasture programme and the conversion to bulk milk that must come in a few months.

Can you sell cull cows?

Not at the moment. They may as well earn their keep rearing calves.

Sheep Dog Training is good Investment

TRAINING a sheep dog is an investment returned in value many times. Given proper care, the dog will reward its master with up to 10 years of service.

The S.A. Department of Agriculture and Fisheries has released a ten page Extension Bulletin dealing with the most important aspects of the training and management of sheep dogs.

Entitled "Managing The Sheep Dog", the bulletin first discusses the type of dog to select and the rules to follow when choosing a puppy.

Discussions follow on housing, training, introduction to sheep and training with sheep, and health and feeding.

The bulletin is available at the department's head office in Adelaide and its country centres.

A Monto graingrower who built himself a grain-drier three harvests ago is finding that he's solved grain drying problems with his

HOME MADE MOBILE FIELD BIN-DRIER

by I. ROMANO,
Agriculture Branch.

GRAIN drying has now become an accepted practice on many grain farms throughout the State. In sub-coastal areas, such as the Upper Burnett, it is relatively easy to get grain moisture of a standing sorghum crop down to 14%. However, the crop may take weeks to lose that last 1 to 2% before it can be harvested and sold.

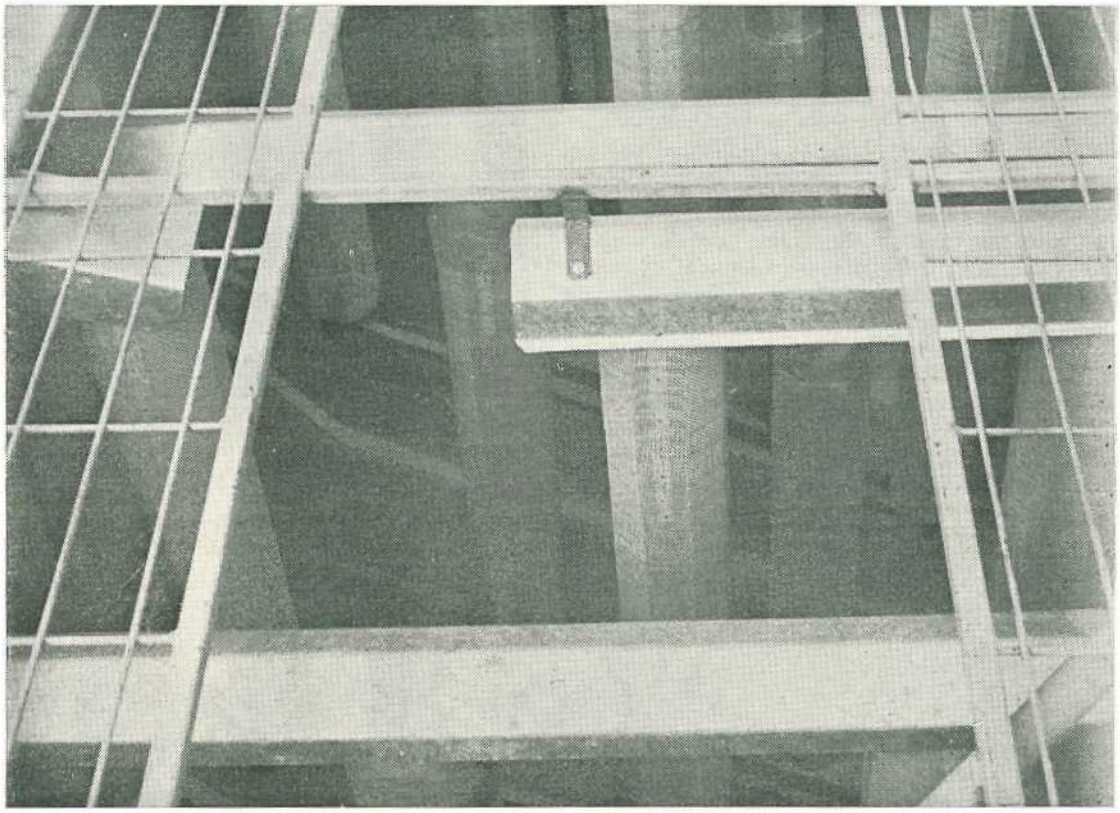
This position can be aggravated by light showers, heavy dews and foggy mornings as was the case during the 1975 harvest in the Upper Burnett. This meant sorghum was left in the field for weeks until it had dried out to a safe level.

Yield losses occur if grain crops are left in the field after they mature, particularly grain sorghum where bird damage and lodging may occur. Under these conditions drying equipment can not only pay for itself but gives the grower flexibility in deciding when the grain should be harvested.

This can be important in areas where the harvest of one crop such as sorghum can clash with the harvest of other crops such as peanuts. With drying equipment, the grain can be harvested allowing these other operations to be carried out.

During the last few years there have been changes in drying techniques. The long established principle was to use fairly low volumes of air per unit volume of grain through a grain depth of 2 to 3 m. This technique was very satisfactory but it took a long time for the grain to dry.

With the demand for quick drying facilities, the trend is now towards units which supply large volumes of air per unit volume of grain and to keep the power required to force this quantity of air through the grain to a practical amount, the grain depths are usually less than 1 m.



View of fast drying front bin showing mesh cylinders used to duct hot air through the grain mass.

Coupled with high output oil burners these new driers are capable of reducing grain from 19% to 13% moisture in two hours. With this type of unit, high temperatures are involved and the heat output needs to be controlled to avoid grain damage. For example, in bin driers, sunflower and soybeans should be dried with air temperatures not exceeding 43°C.

The field bin-drier described in this article was built by Mr. W. J. Dow of Mulgildie in the Monto district. It has been in operation for three harvests. In 1974 it was used on a sorghum harvest of 750 tonnes and later in the year for 400 tonnes of wheat and barley. In 1975 it handled 750 tonnes of sorghum.

The machine took Mr. Dow and one helper four months to build. It was completely built on the farm and where possible parts and equipment from existing machinery were adapted for use on the drier.

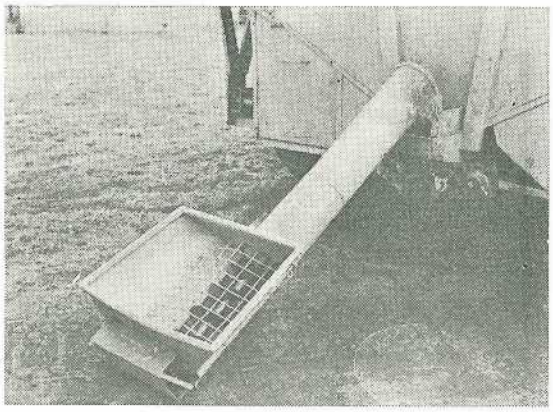
The total cost of parts was $2,500, labour costs were estimated at $4,000, giving a total of $6,500. The machine has now been used for three harvests and no repairs or maintenance have been needed.

It is 3·6 m wide, 12·6 m long and has a capacity of 40 tonnes, with grain depth varying from 1·2 m to 2·4 m. The floors of the bins are made up of 9 mesh 20 gauge wire mesh over weldmesh reinforcing. This allows the

heated air to travel along the length of the bins, as in normal drying units, and up through the mesh floor. The storage area is divided into two compartments each of 20 tonnes. One compartment is fitted out for rapid drying.

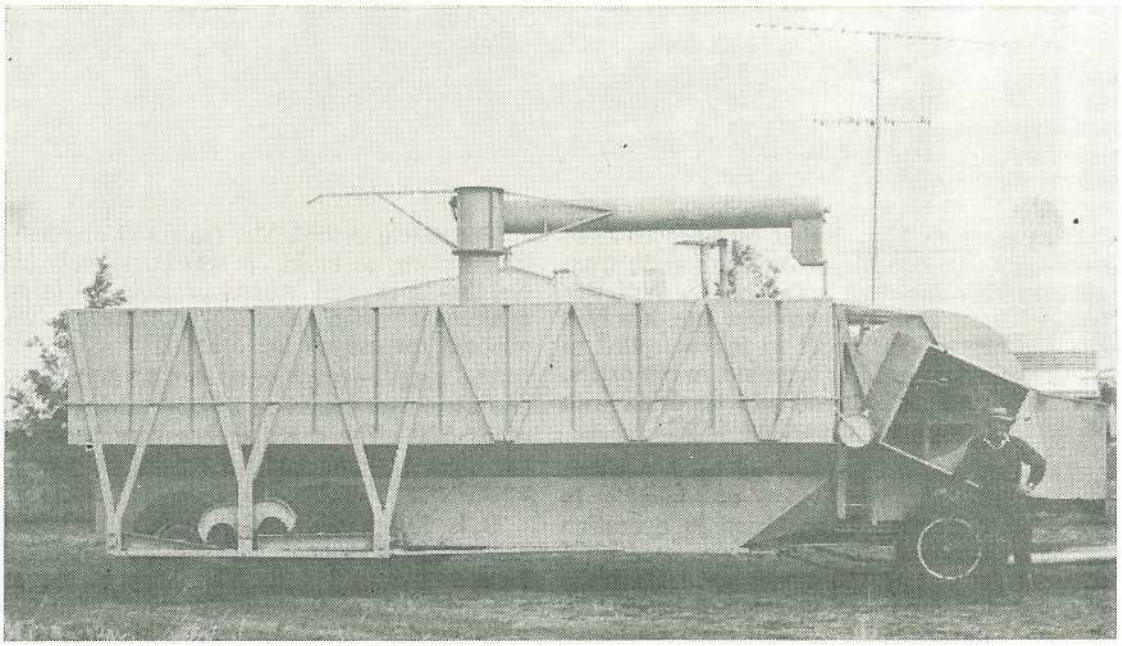
Rising vertically from the floor of this bin at 1 m intervals are a series of wire mesh cylinders. These allow the heated air to rise up into the bulk of the grain. Between these rows of mesh cylinders are identical cylinders which act as exhaust ducts. These exhaust ducts commence about 300 mm. from the floor of the bin. They channel the hot moist air out of the grain mass and out of the bin. The inlet ducts consist of 4 rows of 6 cylinders each. There are 3 rows of exhaust ducts of 7 cylinders each. Each of the individual cylinders varies in height from 1 to 2 m.

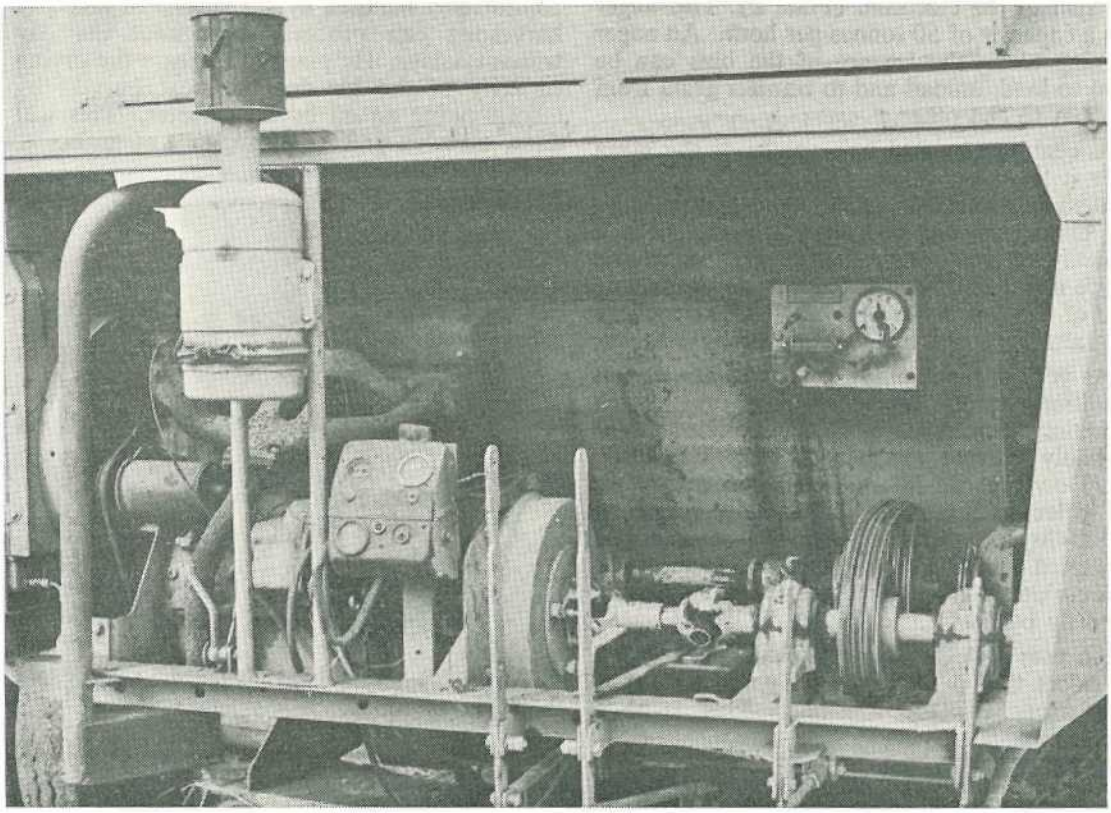
This system of ducting means that heated air travels through no more than about 400 mm. of grain.



Rear loading auger can be used to fill bins if header cannot be emptied directly into bins. Also can be used to transfer grain from trucks or other field bins.

General view of drier showing centrally located unloading auger.





View showing diesel motor used to drive blower and augers and the various controls.

The second bin can also be used for drying but has none of the ducting described above. In this bin the heated air passes through the bin floor and rises through the grain mass in the normal way.

With a gas burner the quick drying front compartment can reduce the moisture content of 20 tonnes of grain from 18% to 12% in 10 hours. The present heat source is not considered adequate and a higher capacity oil burner will be installed to cut down on the drying time.

The draught is supplied by a centrifugal fan. The fan was formerly used as an exhaust fan in the now defunct Mulgildie coal mine. It has inlets on both sides of the fan and has a capacity of 550–750 m^3 per minute.

The fan is V-belt driven by a 37·3 kW diesel motor which is enclosed so that its heat is drawn into the fan inlets. The motor was formerly part of an air compressor unit, and has a "watchdog" device so the drying cycle can be automatically stopped after any given time.

The storage bins are built of 16 gauge sheet steel and the under-carriage is sturdily constructed. There are two dual wheels (225 x 20) at the front, which is provided with a turntable to allow for manoeuvreability. The rear is fitted with two sets of aircraft (1 500 x 20) wheels in tandem.

The bin is normally filled directly from the header but if conditions are too wet it can also be filled from trucks using an auger placed at

the rear of the machine. (Plate 2). This auger has a capacity of 50 tonnes per hour. An auger running along the bottom of the bins can be used to load, unload and to transfer grain from one bin to the other.

A centrally located auger unloads the grain after it has been dried. The auger is 370 mm in diameter and was made from spirals from the combs of old Sunshine headers, with a capacity of 100 tonnes/hour. The auger can rotate a full 360° and trapdoors on the underside of the auger are opened to allow transfer of grain from one bin to the other.

As yet the bin has not been used in wet soil conditions so its manoeuvrability under such conditions is not known. Such conditions would probably prevent the header from operating. Mr. Dow uses an International 766 tractor on the drier and is able to reach a speed of 20 km/hr on gravel or bitumen roads. The estimated weight of the unit is 7·5 tonnes and he considers that it can be handled quite satisfactorily by any tractor above 55 kW.

He uses a 4·7 m New Holland header and considers that a 40 tonne daily throughput is satisfactory for the machine. This is then comfortably handled by the drier. In this way harvesting can proceed throughout the day without delays. He plans to increase the drying capacity of the bin for the next harvest by incorporating an oil burning heater. This will allow an even greater throughput of grain.

Economics

Drying Operation—

		$
Diesel Motor—		
4·5 litres/hour—45 litres @ 7·4c/litre		3.33
Gas—		
36 kg @ 33c/kg	=	11.88
Labour—		
Loading ½ hour		
Unloading ½ hour		
Say 1 hour	=	3.00
		$18.21

For a 20 tonne load this amounts to less than $1 per tonne.

FOURTH EDITION—FARM MANAGEMENT BOOK

The fourth edition of this handbook is aimed at providing a ready reference to technical and financial data which can be used by educational institutions, extension officers, farmers, graziers and others concerned with property planning and development.

The handbook has been completely revised and converted to the metric system. It brings together reference data from numerous sources and presents it, for convenience, in a single publication.

To obtain your copy of the Farm Management Handbook, send $2.50 to: Director of Economic Services, Department of Primary Industries, William St., Brisbane, 4000.

A.B. helps upgrade beef herd

by RON CLARK,
Dairy Cattle Husbandry.

Australia wide interest in the 1969 importation of Charolais semen prompted Mr. Eric Rylands to start a grading-up programme on his Condamine property.

IN 1969 inseminators willing to work in beef herds were not plentiful, so agistment was arranged for 40 Brahman–Shorthorn cows at Mr. Peter Bondfield's Dalveen property.

Here they were close enough for Warwick veterinarian, and long time A.B. enthusiast, Mr. Syd Miller, to provide the insemination service, and the grading-up programme was away to a good start.

Sales of first cross progeny helped. A bull from the first calf drop brought $1,900, while a heifer sold for $1,400. Recently another bull brought $2,400. Cull cattle are also bringing higher prices since A.B. became established in the Ryland herd.

With the successful Charolais programme established, the Poll Hereford section of the herd was bred to Simmental bulls in 1972. The object here was to improve mothering ability of female progeny.

Present programmes involve 260 cows, and by the end of 1975 there will be sufficient Charolais and Simmental cross females available to allow replacement of all base cows. The proportion of semen from Poll Charolais bulls used over cows with a Poll background is providing a significant number of Poll calves in the present drop.

The criteria Mr. Rylands uses for selection of progeny to be maintained for breeding purposes are size, conformation, and docility, with the emphasis on size. Sires are selected first on growth performance but with a strong emphasis on likely calving difficulty. Most bulls from whom semen is available have had this factor catalogued, and Mr. Rylands has found this information to agree closely with results obtained on his property.

"Easy calving" rather than high weight gaining bulls are selected for use on first cross heifers—both in the Charolais and Simmental

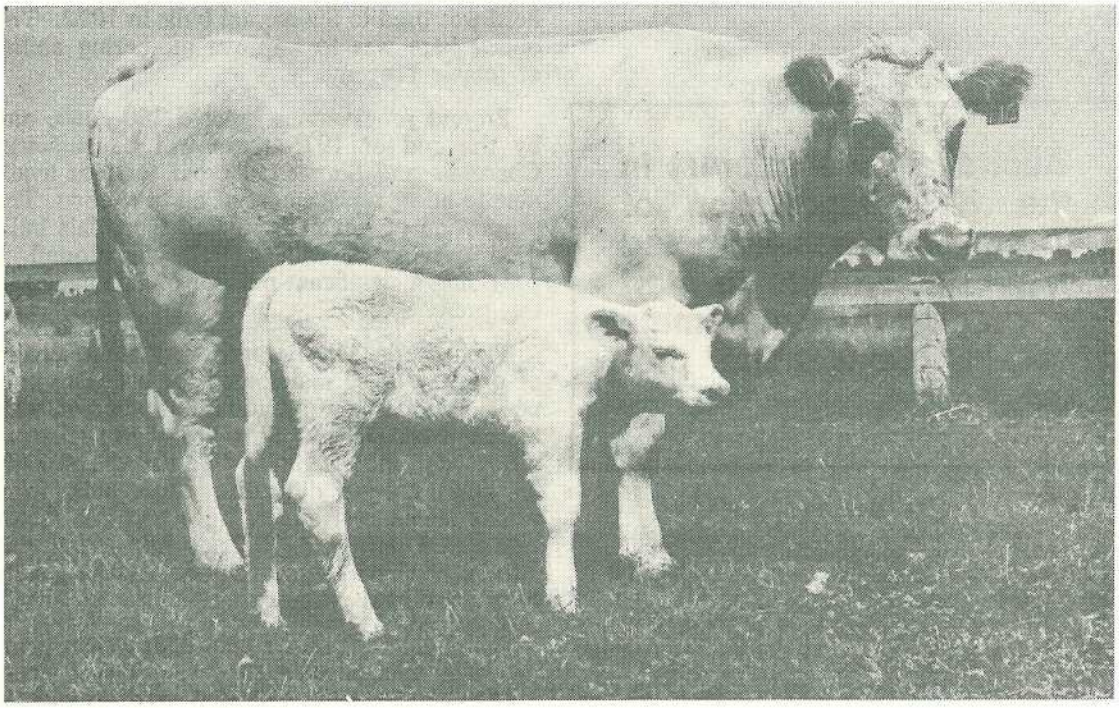
programmes. He considers that breeders can take more liberty with the mating of half-Charolais heifers as he has definitely experienced less calving difficulty with these, than with the original base cows.

With this careful selection of sires, calving difficulty over-all is not a problem. Only 8 of the recent 120 Simmental cross births from Poll Hereford cows could be classed as difficult. Only one cow and two calves were lost.

The success of the Rylands' entry in the 1973 Miles Show Carcass competition is proof of the value of the programme. A pen of three steers were beaten half a point on the hoof, but finished 5 points ahead on the hook. An outright win against four other breeds.

Mr. Rylands believes in careful examination of Sire pedigrees to get out the important pieces of information they contain. Glossy photos only serve to confuse the issue—the facts are all that matter. In 1975, the programme that Syd Miller helped start six years ago has already paid for itself despite depressed beef prices. Now the Rylands daughter Robyn has been trained as an A.B. technician and will carry the programme on to the next stages of the grading-up process—a stage which, on past performance should meet with continued success.

7/8 Charolais Cow with 15/16 Heifer Calf by Carabinier at foot.
Born at Woodlands on 16th January, 1975. Birth weight (unassisted) 56 kg or 124 lbs.



The authors of this article, BOYD PARKINSON, B.V.Sc., M.A.C.V.Sc., Director; and KEVIN BEAUMONT, District Inspector, Division I, are from Slaughtering and Meat Inspection Branch of the Department.

Each has been associated with the Departmental Beef Carcass Competition for over twelve years as a judge or steward.

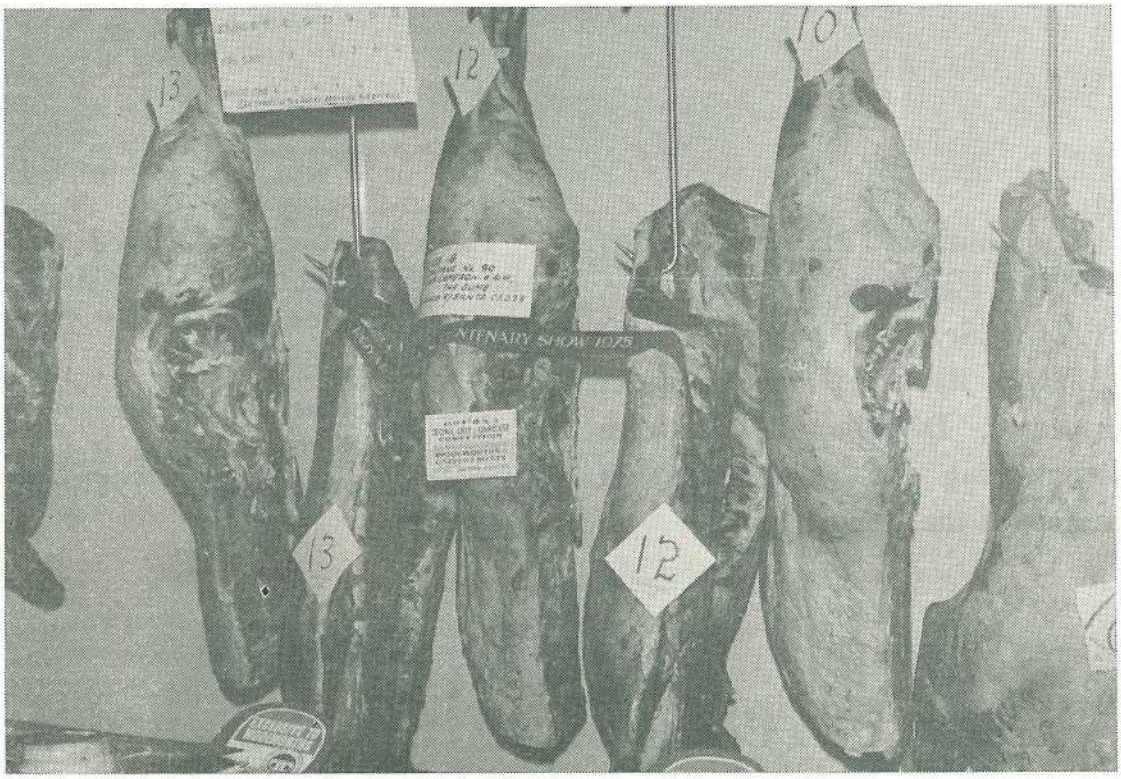
They prepared the specification and Schedule to establish it as a Bone-out Competition in 1968 and they say:

"Beef carcass judging has been approached in an objective way"

FOR ten years before 1968 the Department had sponsored an annual competition for a pen of three steers and or heifers judged to be most suited to the requirements of the local trade. This competition is conducted in conjunction with the Royal National Association, Brisbane Exhibition.

Until 1968 the results were obtained by visual judging, so it depended on the skill, experience and knowledge of the judge to decide the winner. Visual judging is regarded as a subjective method by some people. However it must be recognized that butchers and operators at meat works select carcasses for the butcher's shop trade by their own visual appraisal. They keep in mind the type of carcass that each butcher's shop will need to suit its clients.

They know that different type carcasses may be needed from one shop to another within a suburb or from one suburb to another.



The winning pen in the 1975 competition.

The full muscular development with a light even fat cover make these carcasses ideally suited to the local trade.

LOCAL TRADE

The requirement for this trade is tender young meat with no trimming as excess or unacceptable fat.

Cuts from the smaller, younger type of carcasses (approximately 180 kg) are very much in demand by the housewife. From this carcass, suitably sized steaks can be sliced for grilling, frying or barbecue. Housewives prefer high rolled roasts or brisket for slow cooking because carving is easier and everyone gets an attractive serving.

They will buy meat with a light covering of fat but will completely reject overfat meat. The butcher selects his trade carcasses from his estimate of saleable meat: that is, the amount of meat he can sell over his counter. Saleable meat includes the fat cover acceptable to the consumer. He likes a carcass with the light fat cover to protect the meat, as he may have to hold it in his chiller for four or five days before he sells it. If the carcass has not enough external fat the meat colour will become dark and unattractive and will be harder to sell.

The schedule for the competition sets out the specifications for carcasses entered in the local trade class.

THE SCHEDULE

The schedule for the 1968 and subsequent competitions was changed to bone-out one side of each carcass into standard primal cuts. Each cut was to be trimmed to acceptable trade requirements, weighed and valued on realistic current trade prices.

Animals were allowed no more than two permanent incisor teeth erupted at the time of slaughter. Stewards checked this to make sure this age requirement was met.

The weight range is 181 to 272 kg (400–600 lb.) but within this range some price penalties are imposed to favour the lighter carcass which is more in demand.

The judges take the quality of the carcass or cuts into consideration in arriving at the price allocated per kilogram.

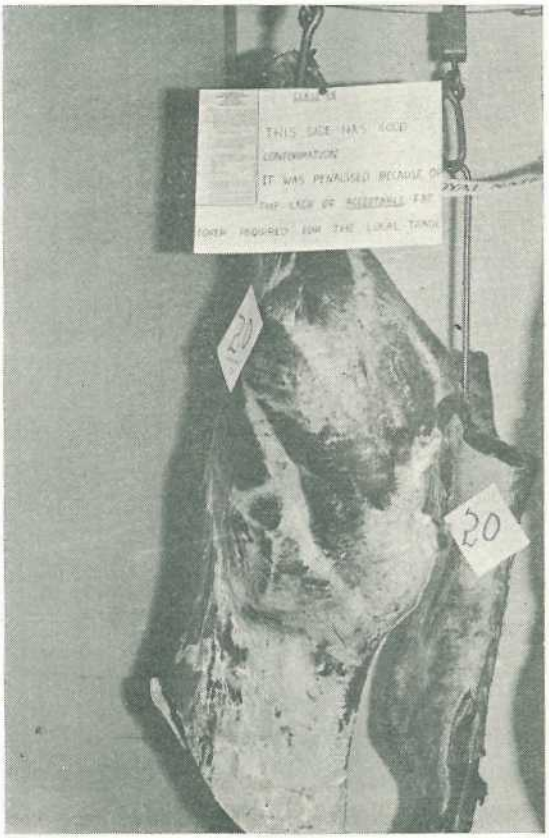
Total carcass meat values are determined and placings are made in order of the highest average price per kilogram obtained for each entry.

The carcasses are judged on the hook after slaughter and ribbons awarded but no cash prizes. The Bone Out prizes are awarded as First prize, $60; Second, $30; Third, $10; donated by the Department with the Champion carcass gaining the R.N.A. sash and card.

Woolworths Qld Ltd and Calvert Meats Pty Ltd buy the meat at ruling prices by private negotiation with the Royal National Association Council stewards.

Special prizes are contributed by some Breeders Associations if a particular breed should win.

The Bone-out Competition was introduced to produce an accurate objective result.



The hindquarter and forequarter (from the same side of beef) have good conformation. The carcass does not have sufficient fat cover to make it completely acceptable to the local trade.

THE BONE-OUT

A standard method for the break-up of the side was drawn up for the 1968 competition. The same standard has been used since so that the yield of primal cuts, fat, bone and meat trimming can be compared each year.

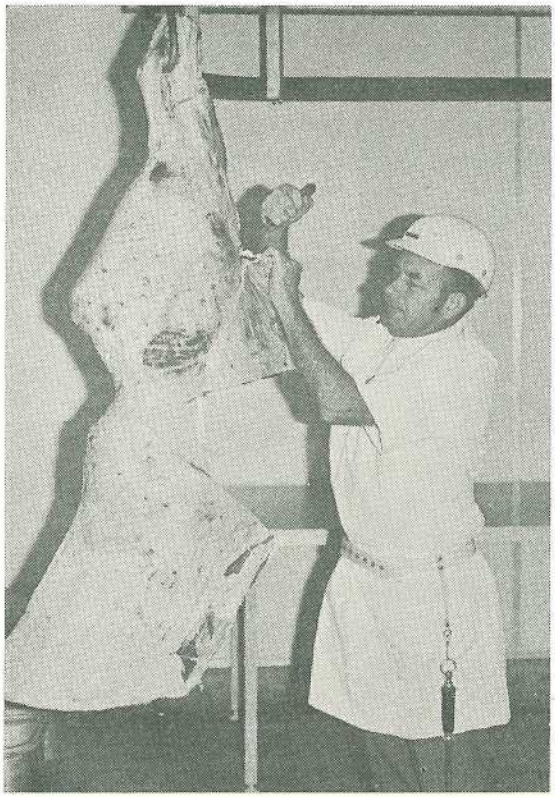
One steward marks the cuts so that the "boners" do not vary the cut by individual methods.

The boners prepare the primal cuts for the "slicers" who trim each cut to a standard prescribed by the judges. All cuts are bone-out except the loin which is left to be sold as T bone steak.

After the cuts are approved by the judges they are passed to two stewards who weigh and record the total weight and value. Even at the boning table the price of any cut may be varied for any defect found by the judges.

A steward, who is an officer of the Economic Services Branch of the Department of Primary Industries, then prepares the figures for a computer programme. In 1975, first and second place was separated by only 0·0278 cents per kilogram.

The judges for 1975 have acted in this capacity on six occasions. They are Barry Daley of Woolworths Qld Ltd representing a commercial meat firm and Kevin Beaumont, the Departmental representative.



ABOVE. The steward here has almost separated the rump and loin from the butt and proceeds to remove the thick flank. His work is a key point for accuracy in the bone-out. Note the smooth even fat finish on this hindquarter.

THE COMPETITION

The bone-out competition has retained its popularity because it is objective and because of its contribution to the meat industry.

Percentage yields based on the local trade standard for each carcass portion are now well known. The figures for these yields have been published.

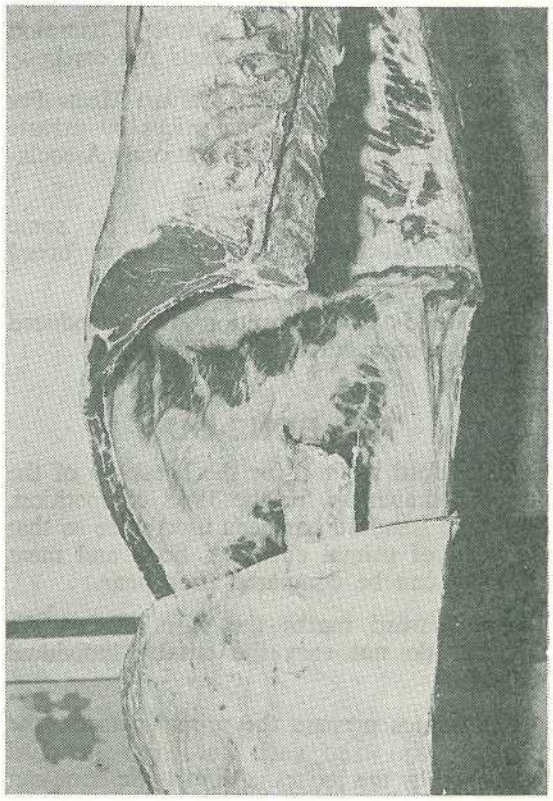
Over the years some authorities have tried to produce an accurate objective beef carcass appraisal system. Each of these systems has been applied to the competition results for comparison. They have all shown some degree of merit with the Australian Beef Carcass Appraisal System (ABCAS) the one showing most potential.

It would be a tremendous advantage if some carcass measurements could be taken and a precise carcass yield predicted. This would eliminate the need to spend the considerable amount of time required to bone out each carcass side in the competition.

Some of these systems are not designed for competition judging but categorize the carcasses for buyer identification. (Charles System.) The Butterfield system is more suited to technical studies of carcass composition rather than competition judging.

No matter what system is applied it can be compared with the objective result of the bone-out. The average price per kilogram includes penalties for carcasses or cuts of a lesser standard and is one method of carcass comparison. The other is on the percentage yield of saleable meat, fat and bones.

The most notable feature of the competition has been the improvement in the type of carcass entered.



RIGHT. The 'eye muscle' in this forequarter is of good size. This muscle is used as one point to assist in estimating the meat yield of the carcass. The extent of the fat cover can be seen at this cut surface.

CARCASS IMPROVEMENT

This improvement is shown in records kept since 1968. In that year the winning pen yielded 69·08% saleable meat, 16·77% of bone and 14·15% of fat trimming. This year the figures were 73·95%, 15·77% of bone and 10·28% of fat trimming. This shows the good results of an extra 4·87% of saleable meat 1% less bone and 3·87% less fat trimming.

The winning carcass this year was a lightly covered steer. It produced the figures of 77·32% saleable meat, 16·17% bone, 6·51% fat trimming.

Table A sets out the percentage yield of each cut, fat and bones, with the total yield of saleable meat for the years 1968–1975. The 1974 competition was not held due to industrial trouble.

TABLE A

	1968	1969	1970	1971	1972	1973	1975
	%	%	%	%	%	%	%
Hindquarter Cuts—							
Sirloin	5·71	5·59	5·98	6·04	5·77	5·97	5·96
Rump	3·93	3·80	3·89	4·08	3·82	4·0	3·96
Fillet	0·80	0·74	0·74	0·77	0·73	0·76	0·77
Silverside	5·43	5·59	5·73	5·54	5·42	5·84	5·85
Topside	5·54	5·63	5·58	5·79	5·60	6·23	6·14
Thick Flank	3·99	3·43	3·65	3·97	3·64	4·09	4·06
Total Hindquarter Cuts	25·40	24·83	25·56	26·19	24·97	26·90	26·74
Forequarter Cuts—							
Blade	6·23	6·26	6·38	6·35	6·25	6·78	6·49
Brisket	6·46	5·59	6·11	6·51	6·35	6·97	6·83
Chuck	6·85	7·38	7·46	7·57	8·02	7·61	7·80
Rib Roast	9·45	9·85	9·89	9·82	9·51	9·44	9·87
Total Forequarter Cuts	28·96	29·08	29·84	30·26	30·12	30·80	30·99
Other Saleable Meat—							
Leg and Shin	5·0	4·99	4·87	5·23	5·07	5·24	5·29
Skirt	1·71	1·61	2·06	1·83	2·23	2·75	2·52
Meat Trimming	8·01	9·34	8·72	8·74	7·85	7·42	8·42
Total Other Saleable Meats	14·72	15·94	15·66	15·80	15·15	15·41	16·22
Fat %	14·15	15·14	13·81	12·57	15·10	10·92	10·28
Bones %	16·77	15·01	15·12	15·18	14·65	15·97	15·77
Total Yield Saleable Meats	69·08	69·85	71·06	72·25	70·25	73·11	73·95

Table B sets out the percentage yield of saleable meat and gives interesting comparisons. These include the number of carcasses entered each year, the average percentage yield, the highest and lowest percentage yield and the range.

TABLE B

PERCENTAGE YIELD OF SALEABLE MEATS

Year	Number of Carcasses	Average Per cent Yield	Highest Per cent Yield	Lowest Per cent Yield	Range Between Highest and Lowest
1968	57	69·08	73·55	64·48	8·87
1969	27	69·85	73·96	65·15	8·81
1970	27	71·06	76·35	66·10	10·25
1971	36	72·25	77·63	66·16	11·47
1972	48	70·25	75·25	65·61	9·64
1973	21	73·11	79·59	69·25	10·34
1975	21	73·95	78·74	70·38	8·36

COMPETITION FUTURE

The Bone-out competition is a popular, well established annual feature. This is endorsed by the number of people who visit the boning room on the day of the carcass break-up. The display at the R.N.A. Meat Hall prompts many probing questions indicating a keen interest by people who want to know more about meat.

One can only wait now to see how high the yield of saleable meat can go. This meat must always have the right amount of fat cover to maintain its flavour and protect the external meat colour.

Carcasses with heavy muscular development and light bones gained by good breeding and feeding and carrying no surplus fat will need the computer to decide the results.

Remember this year first and second places were separated only by 0·0278 cents per kilogram.

Metric Program for AG. and Vet. Chemicals

THE agricultural and veterinary chemicals industry is now planning the final phase of its metric conversion program.

Details of the program were drawn up during discussions by representatives of the Agricultural and Veterinary Chemicals Association of Australia (AVCA) and the Technical Committee on Agricultural Chemicals which involves State and Federal Government authorities concerned with regulation of agricultural and veterinary chemicals.

They agreed that, in line with the decisions of the Standing Committee on Packaging, sole imperial statements of contents will not be acceptable on labelling from 1 January 1976.

They also decided that:

- statements on labels giving directions for use will be in metric terms for the 1976 registration period;
- active constituent statements on labels will be in dual terms until the beginning of the 1979 registration period. That is, metric expressions such as grams/litre (g/l) or grams/kilogram (g/kg) will be used and the expression of percentage weight/volume (w/v) or weight/weight (w/w) will be placed in brackets, e.g. 400 g/l (40% w/v) 2, 4-D present as the amine; and
- stocks with imperial labels remaining on dealers' and resellers' shelves should be cleared by the beginning of the 1979 registration period.

AVCA members plan to distribute advice to dealers and resellers on stock rotation and the clearance of industry products to conform with the agreed program.

Reprinted from M.C.B. News.

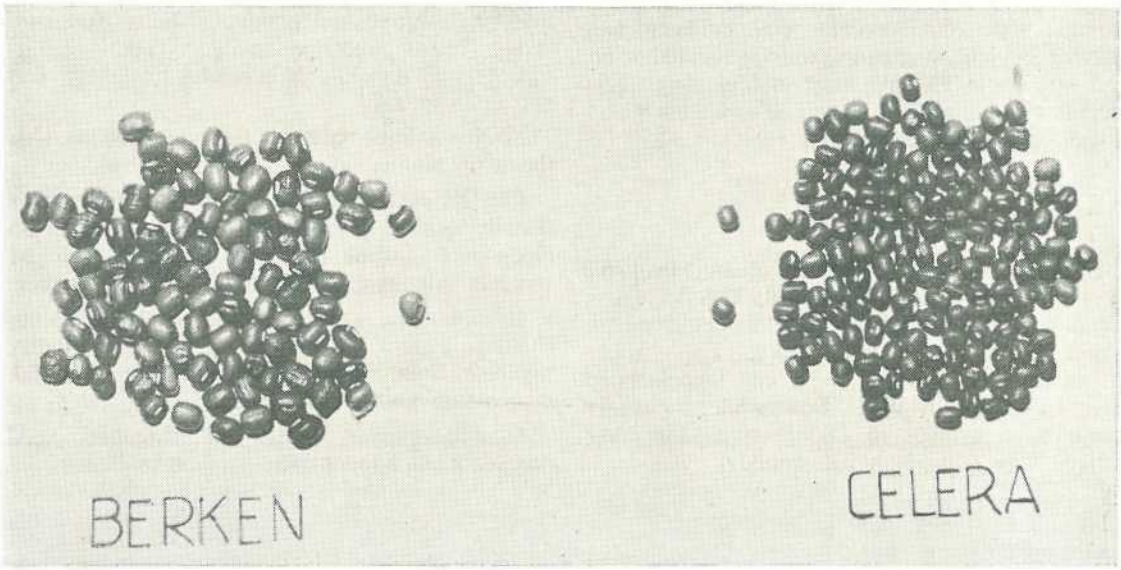
BERKEN

a new mung bean variety

by R. W. KINGSTON,
Agriculture Branch.

Berken, a mung bean *(Vigna radiata)* **variety introduced by the Queensland Department of Primary Industries from Oklahoma, U.S.A., in 1967, has yielded well in trials on the eastern Darling Downs.**

Berken and Celera mung bean seeds showing 70% larger seed size of Berken.



THE main market for mung beans is as seed for the production of bean sprouts (young seedlings) which are used in Oriental dishes.

Sprouting tests, carried out by the D.P.I. Standards Branch show that Celera, an important variety, is defective in size and vigour of its sprouts, mainly because of its small seed size. Seed of Berken is about 70 per cent larger than that of Celera. Celera also tends to have a small percentage of hard seeds which do not germinate readily. Berken does not have this problem.

Trials run by the Department indicate that Berken has similar yielding ability to Celera. The variety also is less prone to lodging and shattering, and ripens more uniformly, than Celera. It shares with Celera the attractive advantage of quick maturity. This makes them valuable for double cropping. Both Berken and Celera flower in 6–7 weeks from sowing, and mature in another 6–7 weeks on the eastern Downs.

Berken and Celera are both markedly superior to the older commercial variety. In the 1972–73 departmental trials on the Darling Downs, this older commercial cultivar was inferior in yield, was prone to lodge and shatter, and was some 15 days later in flowering. The seed is also defectively small, like Celera's and is dull in appearance.

ORIGIN

Berken was developed and released in 1962 by Oklahoma State University, U.S.A., from a quicker maturing single plant selected within a crop of a large-seeded variety. This variety in turn was developed from large-seeded selections made by W. E. Berkenbile, a pioneer mung bean grower in Oklahoma. The new variety was named in his honour.

DESCRIPTION

Berken is erect, branching, up to 35–75 cm in height. Berken's leaves are trifoliate, medium sized, and hairy. The unpaired leaflet is 10–13 cm long and 8–12·5 cm wide and its length averages 1·25 times its width.

The flowers are pale yellow in colour and carried on flowering shoots arising from the leaf axils. These shoots are 8–28 cm long. Under favourable conditions 3–6 pods develop per raceme. The pods are 6–11 cm long, and each pod contains 8–13 seeds. The ripe pods are very dark brown to black in colour, tend to droop, and do not shatter easily. The seeds of Berken are glossy with semi-rounded ends and average 16,500 per kg.

Celera resembles Berken but is not quite so tall, its leaflets are narrower and almost smooth, and are held more erect. The flowers of Celera are deeper yellow in colour than those of Berken. The pods of Celera are lighter in colour, being brown to dark brown, 4–8 cm long, and less drooping than Berken's. Celera is inclined to shatter a little in a warm dry period. Celera's seeds are more spherical than Berken's, very glossy, and average 29,000 per kg. Sowing rate should be higher for Berken than for Celera because of Berken's bigger seed.

PLANTING TIME IS IMPORTANT

The mung bean market requires a high quality, unblemished product. Near maturity, mung beans weather easily. The seed is attacked by mould and becomes unsightly, and germination falls.

So it is important to time sowing so that the crop ripens in a likely dry period.

On the eastern Darling Downs a dry period usually occurs during March and April. To ripen at that time the crop would need to be sown in this region from mid- to late December.

It would be preferable to plant later than this and accept a lower yield, of a high quality product than sow earlier and run the risk of weather and mould damage.

Cowpea–peanut strain of rhizobial seed inoculant is appropriate for mung beans.

TABLE 1

YIELDS OF BERKEN, CELERA, AND "OLD COMMERCIAL" OVER 8 SITES IN 1972–73 (kg/ha)

Variety	Varietal Mean	Sowing Date							
		Yangan 2–1–73	Hermitage 28–11–72	Kingsthorpe 6–12–72	Warwick 29–12–72	Maryvale 18–12–72 (irrig.)	Inglewood N.A. (irrig.)	Allora 18–12–72	Killarney 20–12–72
Berken	1 567	1 285	1 611	1 442	1 019	3 230	1 650	1 360	940
Celera	1 486	1 165	986	1 316	1 120	2 860	1 700	1 550	1 190
Old Commercial	865	473*	550	290*	280*	2 260	1 170	1 000	900
Site Mean	1 306	1 410	1 049	1 016	806	2 783	1 507	1 303	1 010
Berken as % Celera	106	110	163	110	91	113	97	88	80

YIELDS OF BERKEN AND CELERA IN THREE EARLIER TRIALS (kg/ha)
(Old Commercial was not included in these trials)

Variety	Varietal Mean	Sowing Date		
		Emuvale 22–12–70	Hermitage Research Station 24–12–70	20–12–71
Berken	1 250	841	1 469	1 440
Celera	972	863	1 401	650†
Berken as % Celera	129	103	105	220

* This variety (Old Commercial) shattered severely in these trials.
† Celera was severely affected by *Ascochyta* leaf spot disease in this trial.

TABLE 2

COMPARISON OF BERKEN WITH CELERA AND THE OLDER COMMERCIAL CULTIVAR

Variety	Seed Size	Seed Appearance	Sprouts	Maturity (weeks to flowering)	Lodging	Shattering	Recommended Seeding Rate (kg/ha)
Berken	Excellent: 16 500 per kg	Glossy	Large, attractive	6–7	None	None	22–28
Celera	Inferior: 29 000 per kg	Very glossy	Spindly	6–7	May be serious	Occasionally slight to light	14–18
Old Commercial	Inferior: 26 000 per kg	Dull	Spindly	8–9	May be some	Serious	15–20

Of particular interest

Items of news recently released by the Minister for Primary Industries, the Hon. V. B. Sullivan, M.L.A.

Cattle Semen Depots

The Department of Primary Industries has established cattle semen depots at Rockhampton and Mackay in a move to save stockowners the high cost of freight from Brisbane.

The depots, which would be located at D.P.I. offices in these cities, began operating on Monday, October 27.

This extension of the Departments artificial breeding service will enable beef producers and dairymen in Central Queensland to buy only their immediate requirements instead of ordering bulk supplies to minimise freight costs.

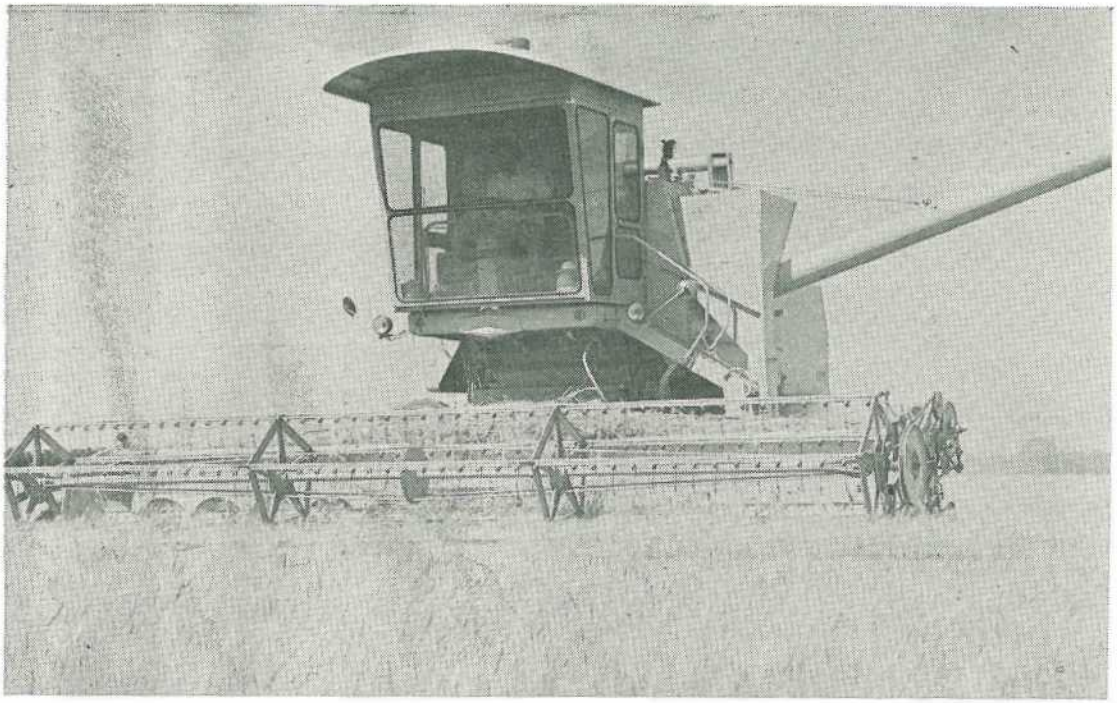
All semen now available from the Wacol A.I. Centre, Brisbane, will be supplied from these depots and the usual trading terms will apply. Four farmer groups and more than 50 private technicians use artificial breeding in these two districts. This number is expected to increase.

My Department is extremely conscious of the problems which rising production costs are creating for stockowners generally.

This new semen service is intended to help reduce the cost factor in one important area—the use of artificial breeding as an aid to herd improvement.

Interested stockowners should contact the Dairy Adviser, or Beef Cattle Husbandry Officer, in Rockhampton or Mackay for details of the new semen service.

Your stock return is due on 31st January. Have you lodged yours?



Harvesting in full swing at "Kindon", in the N.E. of the Shire.

Farming systems in the Waggamba Shire

by J. F. BOURNE,
Extension Officer,
Department of Primary Industries,
Goondiwindi.

The Waggamba Shire is situated along the southern border of the State. Total area is 13 850 square kilometres, of which approximately 20% is devoted to cultivation. The rest apart from reserves and Crown Land, is grazing country. The population of the shire is approximately 6 800 (including the Goondiwindi town area which is separate local authority).

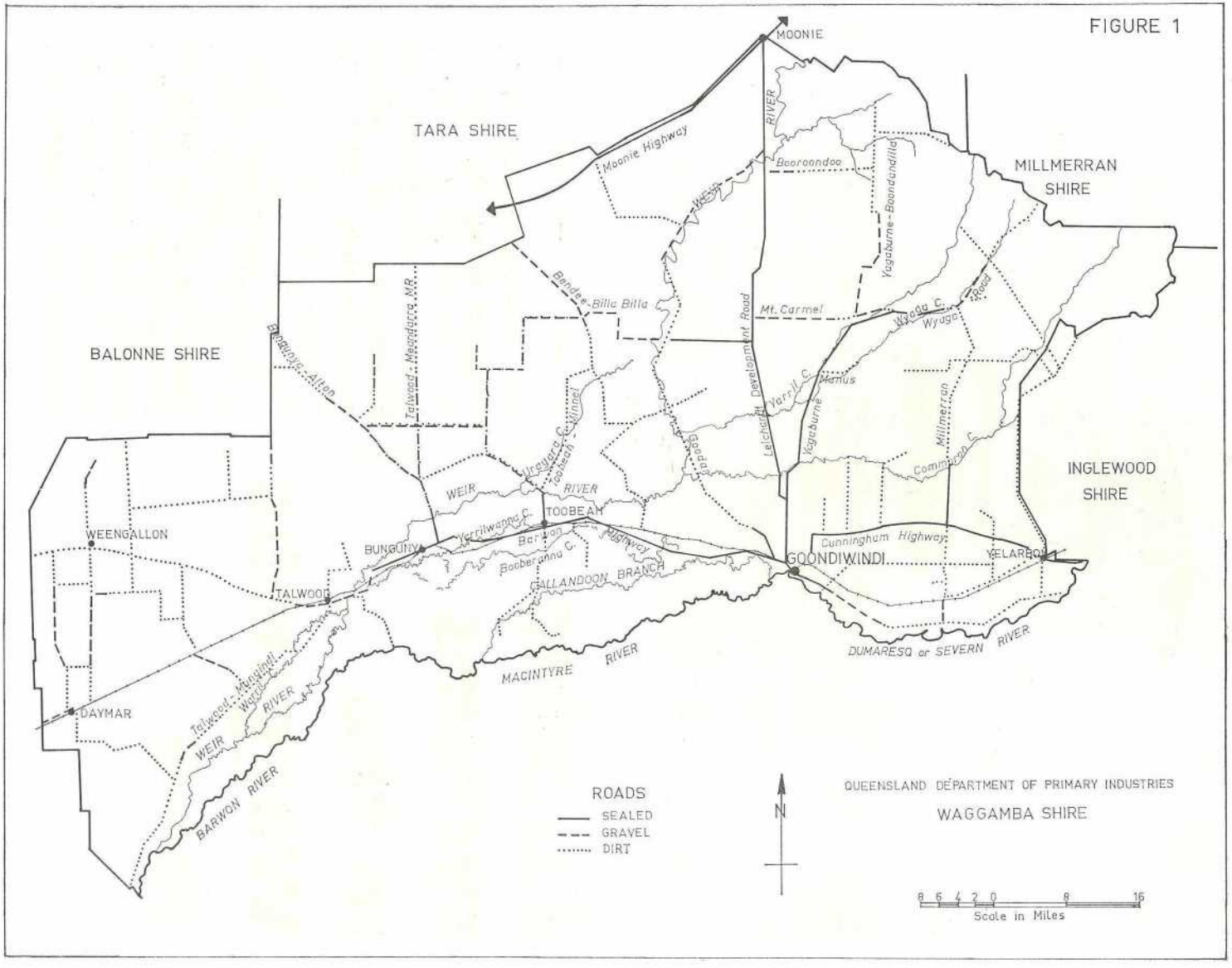


FIGURE 1
MOONIE
TARA SHIRE
Moonie Highway
MOONIE RIVER
Booroondoo
MILLMERRAN SHIRE
Yagaburne-Baandandilla Road
Mt. Carmel
Wyaga C.
Wyaga Road
BALONNE SHIRE
Bandee-Billa Billa
Talwood-Mandamara Rd.
Leichhardt Development Road
Yarril C.
Manus
Yagaburne
Millmerran C.
Commando C.
INGLEWOOD SHIRE
WEIR
RIVER
TOOBEAH
Irregare C.
Toolleen
Tinnel
WEENGALLON
BUNGUNYA
Yerrilwonga C.
Barwon Highway
Boobenjinna C.
GOONDIWINDI
Cunningham Highway
YELARBON
GALLANDOON BRANCH
TALWOOD
DUMARESQ or SEVERN RIVER
MACINTYRE RIVER
DAYMAR
Talwood-Mungindi Road
WEIR
RIVER
BARWON RIVER
ROADS
SEALED
GRAVEL
DIRT
N
QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
WAGGAMBA SHIRE
8 6 4 2 0 8 16
Scale in Miles

THE shire headquarters is at Goondiwindi on the southern boundary, by road some 370 kilometres south-west of Brisbane.

Main net works of communication, townships and river systems are shown in the map.

Tables 1 and 2 give a summary of shire statistics over recent years, including crop areas and production.

SETTLEMENT and DEVELOPMENT

First settlement in the area took place in the 1840s when several large grazing runs were taken up along the southern boundary of the present shire.

During the 1860s Goondiwindi emerged as the administrative and commercial centre of the district, and the first big runs yielded to closer settlement. Further settlement followed the arrival of the railway in 1908, and again in the early 1930s following control of the prickly pear.

Post-war development included the 'wool-boom' in the 1950s, while extensive areas have been brought under cultivation during the past 15 years.

CLIMATE

The shire lies within the 550–650 mm rainfall zone. Approximately two-thirds of the rainfall occurs between the summer months of October-March. However, the reliability of winter rainfall has been an important factor in the expanded winter cereal development.

Summer temperatures are hot, with an average January maximum of 34°C, while the average July minimum is 5°C.

Heatwave conditions can be experienced from October to March, but are most likely to occur during December and January. Frosts can occur from April to October.

The predominantly summer rainfall means that winter cereal production is largely dependant on moisture stored during the summer fallow. The importance of storing moisture over the summer is having a significant effect on fallowing methods used in the cropping areas. Techniques such as contour ploughing and the use of grass buffer strips are being used to slow down the rate of runoff experienced during summer storms. This increases moisture penetration as well as reducing losses from soil erosion.

Summer cropping is more risky, due to high summer temperatures and problems with moisture penetration from summer storms.

TOPOGRAPHY and WATER RESOURCES

The shire is generally flat apart from undulating country in the north, and rises gradually from the flood plains of the Macintyre River towards the north and east. Scattered throughout the central portions of the Shire are low lateritic scarps, known locally as "jump-ups". These are of little significance in total area, and rarely exceed 15 metres in height.

The Macintyre River is the only permanent stream in the district. The other creeks and streams carry mainly run-off and usually disintegrate into a string of unconnected water holes.

Underground Water

The shire is the eastern extremity of the Artesian Basin and although artesian water exists under the whole area, the depth of this water has prevented extensive use of bores. Water can be reached at depths from 120–375 metres in the eastern, to 900–1 200 metres at the western edge of the shire. Tested flows range from 18 000 kl to 2 Ml/day. The water quality is suitable only for stock purposes.

A few sub-artesian aquifers occur in the east of the Shire. However, these bores have generally been abandoned due to salt or failure of supply.

On-farm storage of water is generally in surface dams.

Irrigation

Little irrigation is carried out in the Shire and it is confined to properties with frontages along the Macintyre and Weir Rivers. The most suitable irrigation soils are the alluvial creek flats east of Goondiwindi. Licensed areas are 20–50 hectares, with lucerne and fodder crops being the main crops irrigated.

Cattle grazing on failed grain sorghum crop. "Burradoo", Goondiwindi.

The construction of the Glenlyon Dam in the adjoining Inglewood Shire to boost irrigation supplies to the border rivers system is not expected to increase significantly the area under irrigation. Properties along the Macintyre east of Goodiwindi are mainly grazing properties, where intensive irrigation is not expected to play a big part in the farm enterprises in the near future.

SOILS and VEGETATION

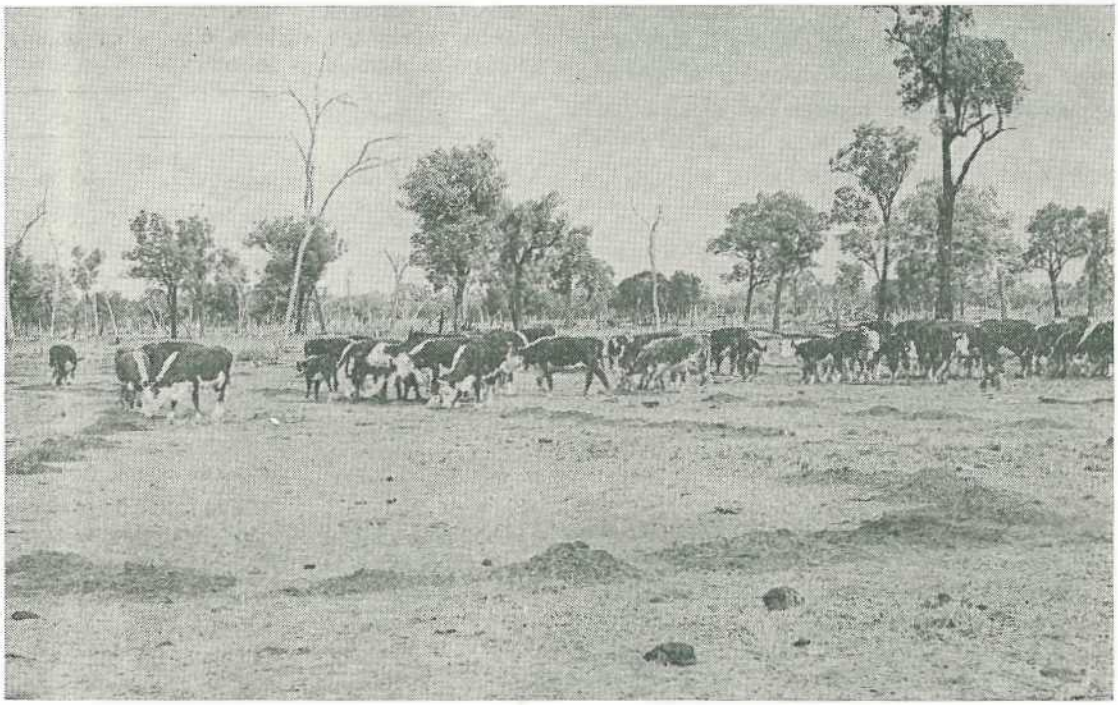
A number of soils and vegetation groups can be identified in the Shire.

ALLUVIAL SOILS. These are mainly found in the thin strip 3–4 kilometres wide, along the Macintyre River between Goondiwindi and Yelarbon. They are the most suitable for irrigation and are subject to occasional flooding.

GREY SOILS OF HEAVY TEXTURE. This group extends over the area between the Weir and Macintyre Rivers to the west of Goondiwindi, and is known locally as the "Flooded Country". Dominant vegetation is the Coolibah (*Eucalyptus microtheca*), with a number of shrub species including the river wattle (*Acacia stenophylla*), and lignum (*Muehlenbeckia cunninghamii*). In some areas of open woodland, myall (*A. pendula*) and boonaree (*Heterodendrum oleifolium*) are the dominant species.

Soils in this group crack extensively on drying, making the preparation of a fine seedbed almost impossible. The large clods which result give poor seed-soil contact, and a poor strike of cereals and pasture species.

GREY and BROWN CLAYS—BROWN CLAY LOAMS. These soil groups make up the bulk of the brigalow-belah belt, which



Drought feeding on silage.

covers the northern and eastern parts of the shire. This is the main grain-growing area.

The grey clays support predominantly brigalow (*A. harpophylla*) stands in the virgin state with numerous gilgais. These gilgais, or local depressions and rises, make cultivation difficult, although continual working will have a levelling effect over a number of years. Locally this soil is known as "melon-hole" soil, with the actual depressions varying in size from several metres to 20 metres across and up to 3–4 metres deep.

Brown clays do not show much gilgai development and so are more suited to cultivation. Brigalow and brigalow-belah stands are most common on this soil type.

The brown clay loams in the east of the shire originally carried belah (*Casuarina cristata*) dominant stands, and are generally classed as the top farming country in the district.

Weekly solodized-solentz soils occur throughout these soil groups, particularly along local creeks and waterways. These lighter soils support box species, sandalwood (*Eremophila mitchellii*) and wilga (*Geijera parviflora*). They are usually not cultivated.

LATERITIC RED EARTHS. These soils, together with a small area of red-brown earths, cover most of the western end of the shire and extend into a large proportion of neighbouring Balonne Shire. Locally this area is known as the "red country". The main vegetation is poplar box (*E. populnea*) and sandalwood, with other small shrub species including Cassia. Some areas, particularly local ridges, support both silver leaf and narrow leaf ironbark (*E. melanophloia* and *E. crebra,* respectively).

This area is basically grazing country and improved perennial grasses, such as buffel grass, have significantly boosted grazing potential. Crusting of the soil surface is a problem in pasture establishment.

DEEP SANDS. These are associated mainly with localized cypress pine-bulloak forests (*Callitris columellaris* and *Casuarina leuhmannii* respectively), in the central and eastern parts of the shire. Much of these areas have been given over to the State Forests.

LAND TENURE. At present approximately 80% of land is held under Perpetual Lease Selection or Freehold tenure, or is in the process of being converted into these categories.

Before 1965 the figure was 30–40%. However, this climbed to the present level in 1970 and has remained static since then.

Other types of tenure in the shire include Settlement Farm Lease, Grazing Homestead, Grazing Farm Pastoral and Stud Holdings.

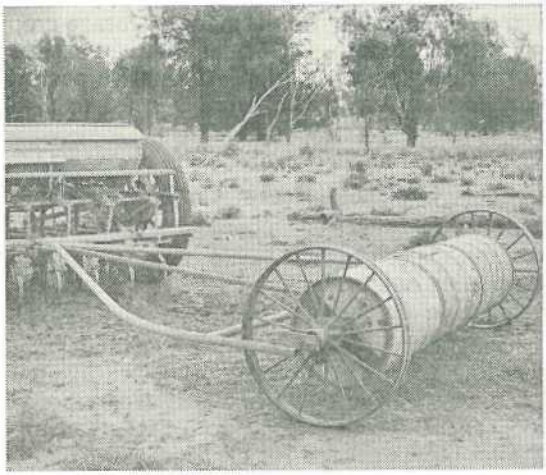
LAND VALUATIONS. A guide to unimproved values for various classes of country within the shire is as follows:—

Description	Value
	$
Arable brigalow-belah	30–60/ha
Flooded heavy grey clay	16–30/ha
Lateritic red earth	5–45/ha
Bulloak–Cypress Pine, together with lighter box soils (partially arable)	12–35/ha

FARMING SYSTEMS

The pattern of land use has become more intensive during the last decade. Before 1960, wool growing was the main enterprise but over recent years the tendency has been to diversify operations. Cattle numbers have increased, as has the area under cultivation. The major agricultural enterprises in the shire now are wool growing, sheep breeding, cattle breeding and fattening, and grain growing.

A crop of late-maturing E57 Grain Sorghum, grown by Mr. A. M. Parker, "Lalaguli", Talwood.



A roller-drum seeder used by Mr. E. P. S. Roberts, "Minnel" Toobeah, for sowing buffel grass.

It is possible to recognize a number of farming systems in the district, incorporating one or more of these enterprises into a whole farm programme.

Sheep Breeding and Wool Production

A small proportion of properties, mainly in the western part of the Shire, are still entirely devoted to this system. Most run merino breeding flocks for wool production, there being only isolated instances of pure wether flocks. Total sheep numbers in the district are about 700,000, including several merino studs.

Rams are purchased from local studs or outside the district. Those brought in from different environments, especially in the southern States, may need twelve months or so to acclimatize. Most breeders purchase a draft of young rams each year, rather than a complete new draft every 4–5 years.

Average number of rams used at mating is 3 per 100 breeding ewes.

A small fluctuating demand exists for British breed rams for fat-lamb enterprises. Seasonal conditions which favour fat-lamb raising in the shire are a mild winter-spring, with above average native pasture growth during this period. These conditions may be expected 3–4 years in every 10.

Joining normally occurs in late summer and autumn, and lambs dropped in the spring. Lamb marking varies from 60–100%, with a ten year average of 66%.

Shearing and crutching are carried out throughout the year, but mainly in autumn and spring.

Wool from the district is of 60–62's quality (22 microns), while the 10 year average for wool cut/head is 4·58 kg.

One annual dipping is normally carried out for ecto-parasite control, shortly after shearing. One or two jettings are needed for blow-fly control, while mulesing is a growing practice at marking.

The average breeding ewe is culled for age at about 5–6 years. Cull ewes are sold at the same time as the weaner portion of the wethers.

Sheep Breeding/Wool Production: Cattle Breeding/Fattening

With the recent swing to cattle, this combination of enterprises is common in the Shire. The sheep enterprise is usually a breeding flock with wool the main source of income. Beef cattle are run as either a breeding herd, or stores are bought and fattened.

Total cattle numbers in the Shire are approximately 162,000.

Approximately 80% of producers carry out at least some degree of controlled mating. Ideally this extends from November to March giving a calving period from August to January. Some herds (in better condition) are joined earlier and for a shorter season. Most calves are dropped in October and November.

To supplement native summer-growing pastures some winter cereal crops, particularly oats, are sown for grazing. Calves remain on the mother during the summer and are weaned onto winter crops.

Yearlings are then usually sold off crop in the spring as fats, at an average of 200 kg dressed weight. Grass fattening still accounts for the bulk of cattle turned off. These are usually carried through and sold off grass in summer and autumn, at 18 months, as fats at approximately 225 kg dressed weight.

Purely fattening enterprises rely on either winter crops or native grass pastures over the summer. Summer forage crops may also be sown although these are generally used simply to hold stock in condition, before fattening on grass or winter crop.

Cattle enterprises vary throughout the district, usually according to the type of country on which they are run.

Crop fattening is more of an opportunist venture on the heavy grey clay soils because of the cultivation difficulties. If available, crops are used to fatten, otherwise the animals may be run purely on native pasture and turned off in good store condition. Beef carrying capacity ranges from a beast to 3·5–6 hectares.

In the brigalow-belah grain growing belt, carrying capacity ranges from a beast to 2–5 hectares.

Further to the west in the "red country" breeding is the main enterprise. Some oats is grown for fattening, while summer forage crops are often used to supplement native pastures during the summer period. On native pasture, carrying capacity varies from a beast to 6–60 hectares.

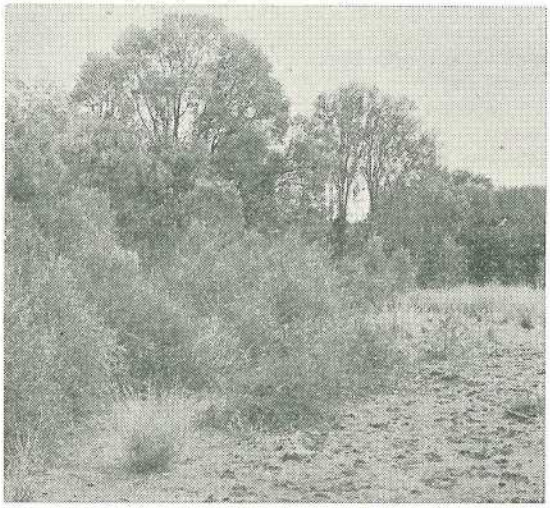
Grain Growing—Beef Cattle Breeding/ Fattening

The majority of owners who drew their properties in land ballots in the last decade are using this system.

Generally grain growing was begun as a side-line within an overall scrub clearing programme. Sowing down of newly cleared areas for several years helped to offset the large capital inputs needed for clearing.

Wheat was the first main crop grown. Over the past 10–15 years high grain prices have encouraged local graziers to continue with this enterprise. More land has been cleared for sowing each year.

Annual medic planted under the final wheat crop in a rotation system.



Heavy limebush regrowth at "Kildonan", Goondiwindi.

An average of 90 000 hectares are sown to wheat each year in the Shire. The main sowing time is May–June, while harvest starts about mid-October and continues through until December.

Grain is delivered to State Wheat Board Depots at Talwood, Bungunya, Toobeah, Goondiwindi and Yelarbon, within the Shire, and to Thallon, Millmerran and The Gums in adjoining shires. The total capacity of State Wheat Board Storages within the Shire is 100,000 tonnes. A small proportion is sold privately to grain merchants in New South Wales. Average yields are of the order of 0·8–1 tonne/ha, and in most seasons over 65% of deliveries qualify for prime hard premiums. Main varieties grown are Gatcher, Timgalen and Gamut. Many growers still retain part of their total sowing under older varieties such as Mendos, which provides excellent grazing if the crop fails. Newer varieties grown include the dual purpose wheat Tarsa, while interest has been shown in Oxley.

Barley is the second most important winter grain crop, with 5 000–10 000 hectares sown annually. If late planting rains are received, barley is a popular alternative to wheat. Yields are generally slightly higher than for wheat, but not all crops are harvested. Up to 50% or more may be grazed as a winter fodder crop.

Oats is the main winter grazing crop. Between 50 000 and 70 000 hectares are sown annually, of which only 2 000 hectares on average would be used for grain production. Yields are up to 1 tonne/ha, but rust reduced crop yields significantly in many seasons.

Main varieties grown are Benton and Minhafer (quick maturing), and Belah or Camellia (mid season to late maturing).

Fertilizers are not generally used on the brigalow-belah soils, although the Queensland Wheat Research Institute is at present looking at the fertilizer requirements for the main arable soils. Definite responses to 50–60 kg/ha superphosphate have been obtained on the lighter box soils and on the lateritic red earths.

Winter weeds such as wild turnip (*Rapistrum rugosum*), New Zealand spinach (*Tetragonia tetragonioides*) and climbing buckwheat, (*Polygonum convolvulus*) are becoming increasingly prevalent in the grain belt and spraying for weed control is now a regular practice with many growers.

Wild oats (*Avena ludoviciana* and *A. fatua*) is another important winter weed. Most growers go into summer crops or temporary pasture to overcome this problem.

Summer cropping in the Shire increased significantly in the period 1969–71, following the partial failure of wheat in these years. Since then an average of 12 000–15 000 hectares has been sown annually, mostly to grain sorghum. As climatic conditions are less suited to summer cropping, most sorghum is grown in the eastern half of the Shire under a slightly higher rainfall, to produce average yields of 1 tonne/hectare.

Two main sowing times are September–October and early January. Heat wave conditions in mid summer can cause significant reduction in yields due to "head blasting". The longer maturing varieties are most popular as they yield better and provide greater amounts of stubble should the crop fail. Many growers

TABLE 1

STATISTICS OF RURAL HOLDINGS—WAGGAMBA SHIRE

Year	Rural Holdings	Area of Holdings	Activities of Rural Holdings						
			Holdings Growing				Holdings Running		Tractors on Rural Holdings
			Any Area of Crop	More than 8 ha of—			Beef	Sheep	
				Wheat	Barley	Sorghum			
	No.	Hectares	No.	No.	No.	No.	No.	No.	No.
1954–55	309	1 374 876	57	11	N.A.	1	264	284	257
1962–63	368	1 380 055	182	82	N.A.	10	322	339	476
1963–64	374	1 358 147	195	75	N.A.	4	339	344	501
1964–65	378	1 350 128	202	93	N.A.	11	329	349	553
1965–66	383	1 364 124	201	98	N.A.	7	327	348	557
1966–67	386	1 347 606	259	182	37	5	322	343	609
1967–68	380	1 266 864	274	203	13	6	327	338	672
1968–69	391	1 313 662	286	225	25	7	311	339	691
1969–70	405	1 356 075	309	250	39	26	333	327	758
1970–71	409	1 334 966	298	213	29	67	353	315	757
1971–72	413	1 355 990	317	255	44	84	365	309	763
1972–73	403	1 365 000	303	221	19	71	370	288	769
1973–74	400	1 355 000	279	198	39	56	368	285	744

N.A.: Not available

Source: Australian Bureau of Statistics

plant grain sorghum purely for feed purposes, and harvest the grain if the season is favourable and other feed plentiful.

Important recent developments include the sowing of grain sorghum in wide rows up to 100 cm combined with inter-row cultivation and band spraying of atrazine, a pre-emergent herbicide, within the crop row. These techniques allow the crop to make much more efficient use of limited soil moisture and provide effective control of the summer weeds, particularly mintweed (*Salvia reflexa*) and summer grasses mainly (*Urocholoa* and *Echinochloa* spp.

Grain drying is also now being considered by the larger growers.

In addition to grain crops, both summer and winter fodder crops are also sown.

Once land has been cleared and cropped, it can be used for further grain growing, fodder cropping or a pasture phase. A grain enterprise fits well with cattle breeding/fattening as it enables winter fodder crops to be sown for fattening and in addition summer forage crops to boost summer growing native pastures. Failed grain crops can also provide bonus feed in poor seasons.

Grain Growing—Sheep Breeding/Wool Production—Cattle Breeding/Fattening

This combination is by far the most common system in the Shire.

Basically it is an extention of the previous system, with sheep generally run as a breeding flock.

In recent years as more land is cleared, the concept of crop rotation is slowly being accepted. The idea of spelling a paddock under a temporary improved legume pasture, was initially used to control the build-up of crop weeds. The aim was to provide a semi-permanent pasture over a period of 2–3 years. The extra carrying capacity on such pastures, particularly lucerne, over a native pasture heavily infested with weeds, was found to be an additional advantage.

TABLE 2

CROP AREAS AND PRODUCTION—WAGGAMBA SHIRE

Year	Total Area Under Crop	Wheat		Barley		Sorghum		Millets and Panicum		Sunflower		Safflower		Hay	
		Area	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
	ha	ha	tonnes	ha	tonnes	ha	tonnes	ha	tonnes	ha	tonnes	ha	tonnes	ha	tonnes
1954–55	3 481	570	384	3	..	11	33	..	..	..	..	..	..	446	1 145
1962–63	22 456	6 960	9 241	61	65	340	666	93	128	..	..	..	..	571	1 551
1963–64	26 866	7 792	9 961	20	27	174	72	28	7	..	..	12	..	405	952
1964–65	31 623	12 251	16 715	148	154	854	2	34	..	..	..	..	..	174	483
1965–66	36 084	16 743	5 233	154	..	603	231	..	..	..	..	9	4	361	454
1966–67	57 334	38 822	61 958	1 759	2 143	397	412	20	9	..	..	81	33	380	1 117
1967–68	77 903	57 157	50 678	501	444	631	629	..	..	..	..	210	15	757	1 378
1968–69	113 082	86 244	113 576	1 760	1 841	1 240	756	368	54	..	..	15	..	646	2 598
1969–70	145 013	103 025	95 683	2 400	2 273	3 033	3 379	437	347	..	..	267	113	1 894	4 010
1970–71	124 471	74 910	36 716	1 615	801	8 232	15 435	1 148	908	626	258	412	16	575	1 995
1971–72	134 522	92 861	85 283	2 724	2 542	12 748	10 811	425	159	4 216	988	431	134	1 127	3 930
1972–73	137 200	87 837	64 412	950	409	11 769	4 942	583	159	2 060	499	283	102	1 066	1 877
1973–74	119 000	67 614	70 094	3 198	1 864	14 620	11 740	782	472	2 357	854	364	132	686	1 450

Source: Australian Bureau of Statistics

One such rotation, which has been developed for the brigalow–belah associations by a local grazier over a number of years, is as follows:—

Year	1	.. Pull scrub, rake and lightstick-pick
Year	2	.. Oats
Year	3–7	.. Wheat
Year	7–11	.. Lucerne
Year	12	.. Oats
Year	13–16	.. Wheat
Year	17–20	.. Lucerne.

Alternatively, after several years of crop following the initial clearing, the area may be sown down to a permanent perennial pasture such as green panic or buffel grass. In this situation, pasture legumes such as lucerne or annual medics may be introduced under the last crop, so that a balanced grass-legume pasture is obtained.

The need for the increased use of improved pastures follows from the dependence of livestock enterprises in the Shire on native pastures, forage crops or failed summer grain crops over the summer period, and winter forage crops for fattening. This means that stock can be subject to feed quality and quantity troughs in autumn and spring. Late autumn and early winter are recognized as an important feed troughs by producers, i.e., after summer feed has been grazed down, and before winter crops have had time to develop to the stage that they can be used.

To minimize the effect of these troughs, areas of improved pasture, particularly perennial grasses such as buffel and green panic, are recommended. Improved pasture species provide higher quality feed for longer into the early winter, and can make use of early spring rains to provide a quicker green pick.

Because of its greater drought tolerance, buffel is recommended for the western areas, while green panic is more popular in the higher rainfall areas to the east of Goondiwindi. Sorghum almum is a popular semi-permanent pasture for cattle as it provides a bulk of feed quickly and is easy to establish.

Pasture legumes are also becoming increasingly important in the district. Annual medics are recommended to be added to perennial grass stands, to replace nitrogen used by grass species. Carrying capacity can be increased up to 2–3 times over that of native pasture, by sowing improved perennial pastures.

TIMBER REGROWTH CONTROL

Following initial clearing and cultivation of many areas over the past 10–20 years, timber regrowth is now an important problem facing graziers who have now reduced their area of cultivation.

Brigalow regrowth can be controlled by 4–5 years of continuous winter cropping. However, this is often not possible due to excessive wear and tear on machinery, particularly in heavy "melon-hole" country. Heavy stocking with sheep has controlled regrowth in the past, and resulted in good stands of native grasses but a common method used today is aerial spraying with 2,4,5–T. A double spraying twelve months apart has given good kills and allowed native grasses to come back successfully.

Chemical control methods for box and sandalwood are also available, however, the cost of labour today makes them prohibitive. Mechanical methods appear to be a better proposition at present.

Limebush (*Eremocitrus glauca*) invasion of old cultivation is recognized as the most difficult regrowth problems in the Shire. Control is a long-term project (4–5 years), involving both mechanical and chemical treatments. Several years of cropping are usually necessary during the programme, to recover some of the high initial chemical costs.

Queensland Wildlife Legislation

by CHARLES ROFF,
formerly of the Fauna Conservation Branch.

INTEREST in native animals and birds is deeply embedded in the emotions of a wide cross-section of the community. It manifests itself in such different individuals as those who enjoy indiscriminate land development and those who are ardent naturalists and desire total protection for all living creatures. A course between these two extremes is often desirable.

Queensland is developing rapidly: Swamps which are the home of waterfowl have been drained and natural haunts of other fauna such as rainforests, eucalypt forests, brigalow, grass lands, wallum and sand dunes have been destroyed. The numbers of land developers, hunters and trappers have increased, faster transport is available to remote areas, and generally there is more leisure time as people strive for greater affluence. All these activities affect our wildlife.

Native Fauna is at all times the property of the State, and the Minister and Conservator are responsible for retaining this fauna in perpetuity. However, the legitimate needs of State development and of groups such as sportsmen must be met, while at the same time longer-term aesthetic and conservation values must not be ignored. Furthermore, some of our wildlife may at times be a nuisance, several are pests in industries, and a few are carriers of diseases of man and domesticated animals.

Obviously, fauna conservation is a complex subject covering inter-dependent aspects such as wildlife studies, education and enforcement. Wildlife law enforcement has necessarily occupied man's attention in varying degrees throughout time; this article deals primarily with the 1974 Queensland legislation, including associated regulations.

FAUNA LEGISLATION

In the first instance in Queensland, the right of man to hunt animals for food, clothing and sport was a natural one wholly unrestrained by law. With increases in human population it became necessary to abridge or restrict this right in order to retain viable populations of animals. This early change in outlook has evolved gradually over the years. Today in Queensland, as in all civilised countries, the taking of wildlife and the destruction of habitat is becoming a controlled privilege. Indiscriminate usage is being increasingly discouraged.

The obligation on the part of the State of Queensland to recognize its responsibilties is exemplified by the following list of enactments over many years; all of these have now been repealed.

The Native Birds Protection Act of 1877.
The Native Birds Protection Amendment Act of 1877.
The Native Birds Amendment Act of 1884.
The Game and Fishes Acclimatisation Act of 1898.
The Native Animals Protection Act of 1906.
The Animals and Birds Acts, 1921 *to* 1924.
The Fauna Protection Act of 1937.
The Fauna Conservation Act of 1952.

Commencement of current Act

On 2nd May, 1974, the *Fauna Conservation Act* 1974 was assented to by the Governor in Council. This Act and "The Fauna Conservation Regulations 1974" were both proclaimed to come into force on 1st September, 1974.

Where to obtain Act

This article is not intended to replace the 1974 Act and Regulations and the interpretations are offered only as a guide; in these

matters, of course, the Court is the final arbiter. Each person concerned with fauna conservation should obtain copies of the Act and Regulations from the Government Printing Office, George Street, Brisbane, at one dollar ($1.00) each. For specific legal advice, a Solicitor should be consulted.

Purpose of Act

As indicated in the preamble to the Act, the main purpose of the Act and Regulations is to consolidate and amend the law relating to the conservation of fauna in its habitats and throughout its distribution in the State of Queensland.

WHAT THE ACT COVERS

The Act and Regulations are directed into Parts which are broadly as follows:

PRELIMINARY

Savings

Here it is provided that all actions, proceedings, orders, directions, licenses, permits, registrations, certificates, delegations, sanctuaries, fauna conservation reserves, appointments of fauna officers and honorary protectors, made under the repealed Fauna Acts are legally continued under and subject to the *Fauna Conservation Act* 1974.

Interpretation

Various terms are defined and it is particularly important to note the following among others:—

"Conservation" means the care and protection of fauna and its habitat in the presence of man and his activities: the term includes research, extension or management to this end.

"Fauna" means a mammal or bird: the term includes also any other animal or group of animals wild by nature declared by Order in Council to be fauna.

"Bird" means a bird wild by nature whether native to a State or Territory of the Commonwealth, migratory or introduced, in captivity, bred in captivity or tamed: the term includes in relation to such a bird—

(a) any species or individual member thereof;

(b) the eggs or young;

(c) the whole or part of the carcass or nest.

"Aviary bird" means a bird that is declared by Order in Council to be an aviary bird, being one bred from birds kept in captivity otherwise than in contravention of this Act or obtained from birds so bred.

"Mammal" means a mammal wild by nature whether native to a State or Territory of the Commonwealth, migratory or introduced, in captivity, bred in captivity, or tamed: the term includes in relation to such a mammal—

(a) any species or individual member thereof;

(b) the eggs or young;

(c) the whole or part of the carcass skin or nest: the term does not include marine mammals save such as are declared by Order in Council to be mammals.

"Crown land" means all land in the State except land that is for the time being—

(a) lawfully granted or contracted to be granted in fee-simple by the Crown;

(b) reserved for or dedicated to public purposes;

(c) subject to a lease or licence lawfully granted by the Crown;

(d) set apart and declared to be a State Forest, National Park or Timber Reserve or deemed so to be.

"Land" includes waters within the territorial jurisdiction of the State, land covered by water, Crown land or a holding.

"Holding" means land held in fee-simple or under any tenure or subject to a trust under any Act relating to the occupation, lease or alienation of Crown land: the term includes land held from the Crown under an occupation licence within the meaning of that term as defined in the *Land Act* 1962–1973.

"Place" includes land, building or other structure, tent, camping area, or other premises of any kind, an aircraft, a vehicle, caravan, trailer, boat or other conveyance.

"Appliance" means a thing of any kind used or capable of being used for the taking of fauna, or for facilitating or assisting in the taking, of fauna and, without limiting the generality of its meaning, the term includes—

(a) any prohibited gun, air-gun, firearm, other gun of any description, catapult, or other weapon from which any shot, bullet, arrow or other missile can be discharged;

(b) any trap, snare, net, mist-net, aircraft, boat, vehicle, caravan, trailer or other conveyance, animal, bird, decoy, poison, bird-lime, explosive, implement, gear or apparatus;

(c) any lamp, flash-light, torch or other artificial light;

(d) any shot, bullet, cartridge or other ammunition: where an appliance is carried or otherwise kept in parts by two or more persons in company each of those persons shall be deemed (for the purpose of this Act) to carry or otherwise keep that appliance.

"Boat" includes a ship, vessel or boat of any kind, raft, punt or hulk.

"Take" includes—

(a) in relation to fauna, hunt, shoot, kill, poison, net, snare, spear, trap, catch, pursue, disturb, stupefy, disable, pluck, injure, destroy or damage or attempt or permit any of those acts;

(b) in relation to flora, collect, pick, pluck, poison, disturb, cut, pull up, destroy, damage, dig up, remove or injure or attempt or permit any of those acts.

"Keep" includes have in possession or under control in any place, whether for the use of or benefit of the person of whom the term is used or of another person, and although another person has the actual possession or custody of the thing in question.

RIGHT OF ENTRY ON LAND

The right of landholders is preserved. Unless expressly provided, open seasons or licences, permits, certificates or general authorities do not give a person the right of entry onto land that is the property of another person. Permission is required to enter any land including any holding for hunting or trapping (that is "taking") fauna.

OTHER ACTS NOT AFFECTED

The *Fauna Conservation Act* 1974 and its Regulations are in addition to and do not substitute or derogate from *The Criminal Code*, the *Animals Protection Act* 1955–1971, the *Forestry Act* 1959–1973 and the *Queensland Museum Act* 1970.

Where fauna conservation offences may constitute breaches under several of these above Acts a person may however, only be proceeded against under one of these Acts. This means that a person cannot be punished twice for one offence.

OWNERSHIP OF FAUNA

The property of fauna is vested in the Crown. The Control and responsibility of the Fauna Authority for fauna in Queensland is firmly established in the new Act. The Fauna Authority has control over all fauna on all representative lands.

The interests of other government departments are served, as required, under the Regulations.

ADMINISTRATION

The Act provides for a Fauna Authority and this means the Minister for Lands, Forestry, National Parks and Wildlife Service and, subject to him, the Conservator of Fauna. The Conservator of Fauna is responsible for the working administration of the legislation.

Fauna Officers

For the day to day enforcement of the Act, the Fauna Authority is dependent upon fauna officers. In this regard, it is essential that all fauna rangers and police officers serve continuously, effectively and efficiently in the role, particularly in an area of law enforcement where firearms are often involved. There are permanent fauna rangers in Brisbane, Rockhampton, Cairns and Charleville and they are responsible for fauna ranger districts which roughly divide the State into four sections. A description of these districts is available.

The following persons are fauna officers by virtue of their Offices, without further or other appointment—

(a) all members of the Police Force of the State;

(b) officers of the Department of Primary Industries holding any of the following Offices—chief veterinary officer, divisional veterinary officer, regional extension officer, extension officer,

chief adviser, district adviser, adviser, senior inspector, district inspector, inspector, special stock officer;

(c) officers of the Department of Lands holding any of the following Offices —land commissioner, assistant land commissioner, land inspector;

(d) forest officers of the Department of Forestry;

(e) boating patrol officers of the Department of Harbours and Marine.

Powers of fauna officers

(1) A fauna officer at any time—

(a) may enter any place;

(b) may make with respect to any place such investigation and enquiry as is necessary to ascertain whether the provisions of this Act are being complied with;

(c) may examine an appliance or other thing of any kind used, apparently used or capable of being used for the taking of fauna or for facilitating or assisting in the taking of fauna, found by him in any place, and may seize and detain an appliance so found that is being used or has been used or that he suspects on reasonable grounds is being used or has been used for the taking of fauna in contravention of this Act, or that he reasonably believes will afford evidence as to that contravention;

(d) may interrogate, for the purposes of this Act, a person found by him in any place or found by him in possession of any appliance to ascertain whether this Act is being complied with, and require a person so found to answer the questions put;

(e) may require a person found by him committing an offence against this Act or who he believes on reasonable grounds has committed an offence against this Act, or whose name and address are in his opinion reasonably required for the purposes of this Act to state his full name and the address of his usual place of residence and if he suspects on reasonable grounds that a name or address so stated is false, may require evidence of the correctness thereof;

(f) may search any place if he suspects on reasonable grounds that an offence against this Act has been or is being committed and that there is or likely to be in that place any fauna, appliance or other thing of any kind with respect to which that offence was or is being committed or that will afford evidence as to the commission of that offence, and may break open and search every box, basket, receptacle or package of any kind in that place;

(g) may seize and detain fauna in respect of which an offence against this Act has been or is being committed or in respect of which he suspects on reasonable grounds that such an offence has been or is being committed, or that he believes will afford evidence as to the commission of that offence, or an appliance or other thing of any kind that has been or is being used or that he suspects on reasonable grounds has been or is being used in contravention of this Act or that he believes on reasonable grounds will afford evidence as to that contravention;

(h) may remove fauna or an appliance or other thing seized by him under this Act from the place where it was seized to such place as he determines, or may allow that fauna, appliance or other thing to remain at the place of seizure and in the latter case make such arrangements as he considers necessary to protect it;

(i) may require a person to produce to him a licence, permit, certificate or other authority under this Act granted and issued to that person or alleged by that person to have been granted and issued to him, and may inspect, examine and make copies of or extracts from a licence, permit, certificate or other authority so produced;

(j) may call to his aid—

(i) another officer in a case where he is obstructed or has reasonable grounds to believe that he will be

obstructed in the exercise of his powers or the discharge of his functions and duties;

(ii) a person who he thinks is competent to assist him in the exercise of his powers or the discharge of his functions and duties;

(k) may use such force as is reasonably necessary in the exercise of the powers or the performance of the functions and duties conferred or imposed by this section;

(l) where and only where he is a member of the Police Force of the State, may arrest a person found committing an offence against this Act;

(m) may, for the purposes of this Act, stop any aircraft (whilst on the ground or the water), any vehicle, caravan, trailer, boat or other conveyance;

(n) may, by order in writing, require a person who has failed to comply with this Act to take such steps as are specified and within such time as is specified to remedy those matters in respect of which the non-compliance has occurred;

(o) may exercise such other powers and perform such other functions and duties as are prescribed.

(2) An order pursuant to subparagraph (n) of subsection (1)—

(a) shall be in the prescribed form;

(b) shall not prejudice or affect in any way a proceeding or action that has been or may be taken for the failure to comply that resulted in the order, save that the person to whom the order is given is not liable for a continuance of the failure to comply during the time specified therein.

(3)—

(a) Before a fauna officer enters any part of premises which part is being used exclusively as a dwelling-house he shall, save where he has the permission of the occupier of that part to his entry, obtain from a justice a warrant to enter.

(b) A justice who is satisfied upon the complaint of a fauna officer that there is reasonable cause to suspect—

(i) that there is in any place fauna, a carcass of fauna, or an appliance or other thing of any kind used, apparently used or capable of being used for the taking of fauna; and

(ii) that in respect of that fauna, carcass, appliance or other thing an offence against this Act has been committed, is being committed or is likely to be committed,

may issue his warrant directed to the fauna officer to enter the place specified in the warrant for the purpose of exercising therein the powers conferred on a fauna officer under this Act.

(c) A warrant shall be for the period of one month from the date of its issue sufficient authority for the fauna officer and all persons acting in aid of him—

(i) to enter the place specified in the warrant; and

(ii) to exercise therein the powers conferred on a fauna officer by this Act.

(d) In this subsection premises that are used as a dwelling-house do not include the curtilage of those premises.

(4) For the purposes of gaining entry to any place a fauna officer may call to his aid such persons as he thinks necessary and those persons, while acting in aid of a fauna officer in the lawful exercise by him of his power of entry, shall have a like power of entry.

Honorary Protectors

The success of any fauna legislation is dependent upon the co-operation of the public. Consequently, the opportunity is provided in the Act for reputable citizens interested in fauna conservation to be appointed as honorary protectors.

The appointment of all existing honorary protectors is confirmed in the new Act. The appointment is for the whole State, but, of

course, common sense dictates that an honorary officer is mostly active in the district where he resides.

New applicants are required to complete a prescribed application form. This allows a check of the credentials of each applicant, so that suitability can be determined; references that must be supplied are taken into account. Finally before appointment, the applicant is interviewed by a Government officer nominated for this purpose.

Appointment as an honorary protector is thus treated seriously.

Incidentally, when drafting the new Act provision of wider powers for honorary protectors was considered. The consensus of State Government administrative and legal opinion was that the following powers were as much as could be given to a private person; clearly official power not subject to the disciplinary control as of a Government official is unwise.

Powers of Honorary Protectors

Subject to terms, conditions or restrictions that may be imposed on his appointment by the State Government, an honorary protector:—

(1) may ask an offender to state his full name and address and to verify the correctness of that information;

(2) may ask an offender to deliver up fauna or appliances involved in the commission of an offence (your attention is directed to the definition of "appliance" defined earlier in this article);

(3) may remove any fauna or appliance so handed up to him;

(4) may require an offender to produce a licence, permit, certificate or other authority for viewing and copying or extracting if necessary;

(5) may call to his aid a fauna officer and this includes all ex officio fauna officers, such as policemen, fauna rangers;

(6) may require a person to quit a sanctuary, refuge or reserve.

Restrictions on Honorary Protectors

An honorary protector cannot hold a licence authorising dealing in fauna. However an honorary protector may be specially authorised to have an aviary.

Offences

It is an offence for any person:—

(1) to assault or obstruct an honorary protector in the execution of his duties;

(2) to give a false or misleading answer to an honorary protector;

(3) to fail to comply with a lawful order of an honorary protector;

(4) to fail to deliver up fauna, appliances when requested by an honorary protector;

(5) to interfere with fauna or appliances taken into possession;

(6) to fail to produce a licence, permit, certificate or other authority when so requested;

(7) to interfere with the interrogation of another person.

Training Courses

The Fauna Authority is unable to provide fauna officers and honorary protectors with all the immediate help they may require. They therefore need to act by themselves on most occasions. To assist these officers, seminars and workshops are being conducted as follows:

(a) *For Police Officers*

Fauna Rangers attend the Queensland Police Academy and lecture on fauna and flora conservation to each new police cadet cadre.

(b) *For Honorary Protectors*

In the past two years Fauna Rangers have organized seminars and meetings at Lawes, Boonah, Mackay, Mount Isa, Cairns, Ingham, Caloundra, Maryborough, Townsville and Dalby and others are planned so that a broad coverage will be achieved.

(c) *For ex officio Fauna Officers*

In the Departments of Primary Industries, Forestry, Lands and Harbours and Marine, in-service extension workshops are being organized by Regional Extension Leaders and Fauna Rangers and the first have already been held at Gympie, Townsville, Cairns and Toowoomba. These are to be continued throughout the State.

Next Issue: Classification of Fauna

Part 2

A guide to soils and plant nutrition

In this, the second part of Mr. Cassidy's guide, he looks at clay minerals; water, air and the soil; and irrigation and drainage.

by N. G. Cassidy.

Terms in block capitals are covered in the glossary at the end of the article.

Clay Minerals

IN the previous chapters it was shown that soil clays are actually microscopic crystals. The pure clay minerals may have great differences between themselves.

Platy-type minerals are represented by two common types. Both of these have a layer of aluminium atoms associated with oxygen and hydrogen atoms. In Kaolinite each aluminium layer is united with a silica layer, but in Montmorillonite the aluminium layer has a silica layer on each side of it. These are distinguished as 1:1 and 2:1 layer minerals (Fig. 2); they tend to have opposite characteristics.

Montmorillonite (2 :1)	Kaolinite (1 :1)
Expanding lattice.	Little swelling and shrinking.
Unit spacing 9·6–21·4 A°.	Unit spacing 7·2 A°.
Water and cations between layers.	Only edges of layers are active.
Total cation capacity 100 m.e. %	Total cation capacity 5–10 m.e. %
Potassium " fixation " when very dry.	No potassium fixation.
Holds divalent cations strongly.	Holds monovalent cations strongly.

Other 2:1 layer minerals are Illites, Hydrous micas and Vermiculites. Halloysite is a 1:1 layer mineral.

Some clay minerals are not alumino-silicates at all, but are simply oxides of iron or of aluminium. The iron oxide minerals especially may differ from each other in the amount of water of constitution which they contain (HYDRATION). Minerals of this group represent the final stages possible in soil weathering:—Lepidocrocite, Haematite, Magnetite, Gibbsite, Goethite.

For example soils formed on basalt on the Atherton Tableland in North Queensland differ in their clay minerals in accordance with the amount of annual rainfall.

Annual Rainfall	Minerals present in (0–76) cm. layer
90 cm	Kaolinite 77%. Iron and aluminium oxides 16%
370 cm	Kaolinite 56%. Iron and aluminium oxides 36%

It will be noticed that Montmorillonite is not mentioned in these tropical soils formed under medium to heavy rainfall. It is in fact one of the first minerals to be formed in rock weathering. If conditions for continued leaching are present montmorillonite does not survive.

Kaolinite and montmorillonite differ from each other in the intensity with which they hold monovalent and divalent ions.

Montmorillonite holds the divalent cations calcium and magnesium more firmly than it holds the monovalent cations potassium and sodium. Kaolinite has exactly the opposite properties.

This means that montmorillonite needs to be about 80% saturated with calcium to allow maximum uptake by plants, whereas kaolinite needs only about half this saturation percentage. For this reason workers accustomed to temperate-climate soils are surprised to find so little response to liming with tropical soils of low pH value.

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Although the clay minerals certainly dominate the properties of a soil it is to be remembered that the sand fractions also contain minerals. In general, however, sand particles consist of rock fragments that are only partly decomposed, and of pieces of quartz that are quite inert.

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It is important to realize that these clay minerals are COLLOIDS and that they carry electric charges on the surface. This is nearly always negative charge, and it therefore provides the force which attracts and holds CATIONS such as potassium and calcium, which carry positive charges.

Water, Air and the Soil

IT is important to know the maximum amount of water a soil will hold. In common practice the soil is sampled shortly after it has been wetted to saturation by rain or by irrigation. The intervening time is allowed so any further drainage taking place will be insignificant. A period of one day is sometimes selected as the drainage time.

It is essential to realize the fallacy in a statement such as "after the light rain that has fallen the soil is still only half-wet". In fact, soil becomes wet in a similar manner to absorbent paper. When the lower edge of a strip of such paper is dipping into water, a portion will become saturated but the rest will remain dry. So soil becomes thoroughly wet by rain to a certain depth, say 8 cm, but the soil underneath will be as dry as immediately before the rain.

The amount of water held in the wetted layer immediately after gentle rain has ceased, represents the "maximum water-holding capacity" of the soil. After drainage has ceased the soil is said to be at field capacity, and the percentage of moisture by weight is commonly known as the field capacity of the soil.

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In laboratory estimates of the water capacity of a given sample of soil, the amount of water held against a suction force of known value is adopted. The trouble with this method is that a certain standard of suction has to be set for each kind of soil. For a sandy soil one-tenth BAR and for a soil of medium texture one-third bar are sometimes selected. Checking against results in the field is desirable.

Water capacity can also be expressed as cm of water (or rainfall) contained in 10 cm depth of soil. A heavy clay soil may hold 5 cm water per 10 cm depth. If a farmer knows this figure for the full depth of the root zone, he knows if it is safe to plant a crop for "dry farming".

In this form of agriculture practically all the water needed by the future crop must be already present in the soil profile before planting. (A bonus resulting from the practice of conserving moisture in this way is the production and storage of nitrate during the fallow period, ready for the subsequent crop.)

At one time Field Capacity was regarded as a fixed quantity for each soil. One authority wrote "each soil has a definite capacity for moisture . . . which does not change". This has been shown to be false, but the fact is often not sufficiently appreciated. Very significant changes can occur in the amount of water a soil will hold at saturation, depending on the kind of prior treatment given to the soil.

Dry-grinding treatments generally reduce the water capacity, and wet-working tends to increase it. The severity of the treatment and the moisture content at which it is applied, vastly affects the result. For example a red volcanic soil (krasnozem) had a value of 44·7% after dry-grinding but 64·7% after wet-working. The difference for significance at $P = 0{\cdot}05$ was less than 3·3%. This is however an unusually large change in water capacity.

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When a soil has just reached Field Capacity, not all the water in the soil mass is available to plants. As the plant roots gradually draw water out of the soil, the water that remains eventually becomes more difficult to extract. Finally the pull exerted by the roots is equalled by the opposite tension existing in the soil. This is the WILTING POINT. At this stage plants which wilt during the day now fail to recover during the overnight rest period.

Measurements of wilting point are carried out with a standard plant (often sunflower) grown in pots having an impermeable cover over the soil-surface to prevent water-loss by evaporation.

The per cent. moisture remaining in the soil is itself usually known as the Wilting Point.

Often it is desired to prevent loss of moisture, by evaporation, from the soil surface. At one time a "dust mulch" was considered necessary. This is now discredited. Surface losses are almost inevitable; deep losses can and should be prevented by destroying all weeds.

It will be seen that Field Capacity — Wilting Point equals Water Available to the plant.

Soil	Field Capacity	Wilting Point	Available Water	
	%	%	%	cm/10cm
Sand	6·2	2·4	3·8	0·57
Sandy Loam	17·6	8·4	9·2	1·33
Krasnozem	45·4	33·3	12·1	1·10
Clay	39·4	18·5	20·9	2·43

The clay has most available water. Although the krasnozem has a high total capacity its wilting percentage is also very high. Clays are usually the most drought-resistant soils and are essential for "dry-faming" operations: but sands respond quickest to light rain.

Organic matter helps to raise the water capacity of a soil: but advice "to build up the organic matter", except in a garden situation, is usually impracticable. It fails to acknowledge the resulting accelerated activity of micro-organisms and the rapid destruction of organic matter (especially in warm climates). Simultaneous additions of nitrogen fertilizer are necessary if any permanent gain is sought and these might be used more judiciously on a growing crop.

pF Scale

The force with which soil attracts and retains moisture varies widely with the nature of the soil and the amount of water present. This makes it necessary to use a measuring scale that progresses in multiples of ten just as in the pH scale of acidity-alkalinity. The units are cm length of a water column that would exert the same suction force.

Status of Water in Soil

	pF.
Gravitational water (fast moving)	0·2–1·8
(slow moving)	1·8–2·5
Water at Field Capacity	3·0
Water at Wilting Point	4·2

At Field Cacapity the soil holds water against the force of gravity. The suction (pF = 4·2) exerted by all soils at wilting point is the same. What does vary is the amount of moisture in each soil at that time.

Soil Air

The air which is present in soil, normally contains about the same amount of oxygen (20%) as atmospheric air. An important difference is that soil air contains about ten times as much carbon dioxide as ordinary air, because of respiration from roots and the continual decay of organic matter in the soil.

The total air space in a sandy loam will usually be adequate at any depth, both in the wet or the dry state. A silty clay soil may have inadequate air space below a depth of about 30 cm especially when wet.

Under such conditions the air in the silty clay may occupy less than 5% of the total void volume, which is only about a third of what is available in the sandy loam.

The effect of small air space is aggravated by the fact that oxygen decreases and carbon dioxide increases when free movement between soil and atmosphere ceases. It has been postulated that in normal aeration the soil air is renewed hourly to a depth of 20 cm.

It should be noted that liquid water will move through the soil only when the pore spaces are sufficiently large; air will diffuse satisfactorily provided there is sufficient total space. A clay soil is therefore not necessarily poorly aerated.

It has been found that apple roots will continue to subsist at 5% of oxygen in soil air; but more than twice this value is needed for roots to absorb water and to make new growth.

The solubility of oxygen in water decreases from 3·8% by volume at 10°C to 2·6% at 30°C. This is a reason for the aggravated effect of water-logging when it takes place at high temperatures. It is common knowledge that flooding at high temperatures proves more lethal to plant life than flooding at lower temperature.

An examination of the soil profile will reveal cases of long-standing deprivation of oxygen.

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The slow intake of water by clay soils is very important in low-rainfall zones. The result is that heavy clays are seldom saturated by rain to a greater depth than a metre. (At Gilruth Plains in Queensland 20 cm rain within a week only penetrated two-thirds of a metre.) This fact is not always appreciated.

Irrigation and Drainage

PROPER irrigation requires a wetting of the soil to the appropriate depth, followed by removal of excess water by drainage. Where there is a danger of salt (SALTING), some of the waterings may need to be made heavier than usual, in order to keep the salt down to the bottom of the soil profile.

The depth to which water has penetrated is a fact of fundamental importance to plant growth under any form of watering. A simple and effective tool for testing this, whether for farm or garden, is the probe. This is an iron rod about 1 cm in diameter and a metre long. (One end should be bent to provide a handle.) The probe will easily penetrate newly-wet soil but not the drier soil underneath. Watering is complete when the full depth of the root zone is wet.

Persistent **shallow-watering** can cause plant roots to become concentrated in the top layer of soil. This restricts the size of the root zone, so water must be applied more often. (It also restricts plant-foods available to the crop.) The natural droughtiness of the situation is then aggravated, and the frequency and cost of irrigation is increased. Where trees or perennial pasture are concerned, the effect can be cumulative, year by year.

Nevertheless, **over-watering** is the most common mistake in irrigation. It can lead to accumulation of salt derived from either the water itself or from the sub-soil. If there is salt deep down, water-logging could bring it towards the surface, by a capillary rise when the surface soil dried out.

This situation of dry soil at the surface, and saturation with water at a lower level (i.e. the presence of a WATER-TABLE) leads to an upward movement of water in the very fine crevices, bringing dissolved salt with it.

The control in the first instance will depend on prevention of water-logging. This can be achieved by adequate drainage, if necessary through the use of tile drains.

These are porous clay-pipes 30 cm long which are butted end to end, with tarred paper and a layer of coarse gravel to cover the joints: this prevents soil from washing down into the pipes. The use of plastic tubing having narrow slot-holes to admit the drainage water, is also feasible, as this tubing can now be laid mechanically.

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Irrigation water in the soil soon becomes more concentrated through evaporation and through transpiration.

The latter is the movement of water through plants from the roots to the leaves. The combined process (evapo-transpiration) leads to the soil solution having several times the concentration of the original irrigation water. This cannot be prevented. The only control for this kind of salting is to use occasional heavy waterings (with adequate drainage) in order to keep the salt well down in the profile.

The gradual removal of sodium chloride that had been applied experimentally to the surface of a red brown earth of the Murrumbidgee Irrigation Areas is shown in the following records.

SALT IN SOIL (%CHLORIDE IN 0–60 CM LAYER)

Salt Treatment	Heavy	Medium	Light	Nil
Original soil	0·012	0·010	0·014	0·013
Treated soil (calculated)	0·32	0·09	0·03	0·01
Sampled at 3 months	0·329	0·103	0·041	0·016
Sampled at 6 months	0·238	0·080	0·052	0·018
Sampled at 17 months	0·220	0·066	0·034	0·014
Sampled at 30 months	0·092	0·073	0·035	0·018
Sampled at 40 months	0·048	0·038	0·020	0·008

Irrigation plus rainfall during the whole period would have been about 300 cm.

After more than three years the salt in the Heavy treatment plots had been reduced to one-sixth of its original value. Nevertheless the level of salting was still high enough to injure plants.

This shows how land can become damaged **beyond economic recovery,** if conditions for salting are present.

Over-watering is bad even when there is no salt risk. Unless there is very good drainage through the subsoil, a water-table may be set up. The root zone is then restricted and aeration may also become minimal. This can happen temporarily if a hardpan or a heavy clay horizon is present. It was a recurring problem in many irrigated orchards in Australia until tile drainage was installed to cope with it.

The effect of a water-table on plant health (in the absence of salting) will depend on a number of factors, but species is probably the dominant one. The following minimum depths to the water-table will provide guide lines.

Minimum Depth to Water-table for Good Growth	
Pastures	40 cm.
Arable land	60 cm.
Bananas	100 cm.

Citrus and avocado require at least as much depth as bananas.

Fluctuations in the level of the water-table can be recognised by colours in the soil profile. This can prevent wrong conclusions, if examination of the water-table happens to be made during a dry season, when the water level will naturally be very low.

For example, in humid Fiji the Veimama variety of banana was shown to need at least one metre of unmottled soil in order to remain healthy and produce well.

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Correct timing of irrigations can be based on the daily rate of evaporation. It has been shown that when a crop completely covers the land surface the daily amount of evapo-transpiration is substantially equal to the amount of the daily evaporation from a free water-surface, as measured by an evaporimeter.

The root-zone will have been filled to Field Capacity at the last irrigation. It is only necessary to sum the daily amounts of evaporation in order to know how many days the crop can go before it needs water again.

In semi-arid regions rain is light and infrequent. When heavier rain occurs it is usually unwelcome because it upsets the sequence of watering. All paddocks then become ready for their next irrigation at the same time, instead of in rotation.

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A special form of drainage that applies to some irrigation areas may be mentioned here. In flat, riverine country there are often buried sand beds of former geological times, underlying the present landscape. These dry beds can become saturated with water from excessive irrigation. The result may be high water-tables that are a menace to all crops.

To cope with this situation, tube-wells may be put down to tap the water in the beds. By continual pumping of the water into drains at the surface, the level of the water can be controlled. Whether this system is economic will depend on the cost of alternative systems.

Another, semi-permanent system of drainage is by "mole drains". This is a very old method, now of doubtful validity. A tractor pulls a torpedo-shaped object through the subsoil at the required depth. Tube-shaped drains are thus formed down the slope of the land. These mole-drains lead into an open-cut, main drain, at the bottom of the slope.

The mole-drains will collapse in soil that is too sandy. In any case the system needs renewal when water is no longer removed effectively.

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When drainage is not effective and water-logging takes place, lack of oxygen at the plant roots is not the only result. There are considerable changes in the availability of plant nutrients. Phosphate, nitrogen and iron become more soluble—all of these changes are usually favourable to plants. At the same time manganese in solution is increased largely, possibly up to a toxic level. In the special case of rice culture the over-all result is, in general, very favourable, because rice is unaffected by the lack of oxygen in solution.

Even temporary water-logging can bring an increase in available phosphate, and soils analysed soon afterwards may show increased

values. In special circumstances this can give misleading results for the phosphate status of a soil.

Some common systems of irrigation are given in the following table with notes on their characteristics.

System	Notes on Characteristics
Spray	Especially good for sandy soils: saves water: avoids over-watering. Needs least land-preparation. Involves expensive equipment.
Furrow	Good for fairly heavy soils. Furrows are cheap and easy to construct. Initial levelling and smoothing may be expensive if slope is uneven. Needs skill to avoid over-watering when infiltration rate is high.
Contour bays	Notably useful for flooded rice, where the water controls weeds. A rapid supply of water is needed especially for the first flooding. Gently sloping land, i.e. little side slope, is necessary.
Border check (" straight bays ") ..	Reduces labour requirements and machinery operations are easier. Requires large grading implements. Improves crops. More flexible, e.g. for vegetables.
Drip	New system. At fixed points, e.g. each tree in an orchard. Needs valves capable of good adjustment and no clogging. Economical of water: fairly saline water has been used. By continual slow downward movement of the drip system, salt can be controlled: (for how long?).

GLOSSARY

CATION: An ion carrying a positive charge; e.g. hydrogen, sodium, potassium, calcium, magnesium, zinc, copper. Combined with hydroxyl ion they form hydroxides ("alkalis" or "bases").

COLLOID: In solution, such a substance is dispersed as particles which are larger than molecules, but too small to settle out. They carry electric charges.

HYDRATION: A union between water molecules and some other substance.

SALTING: Any increase in the soil-salt that is likely to depress plant growth. It may refer to total salt throughout the profile or to a damaging concentration of salt near the soil surface.

WATER TABLE: The upper level in the soil zone at which there is saturation with water.

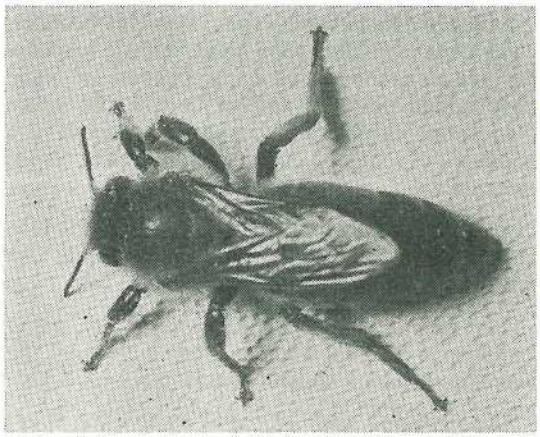
WILTING POINT: The soil moisture content at which a plant wilts, but recovers quickly when watered.

Looking back—

SOME interesting items that appeared in issues of the Q.A.J. 75 years ago, in November and December, 1900.

- The Queensland Agricultural College held a livestock sale giving an opportunity to *farmers and others engaged in stock raising to purchase well-bred bulls and pigs at reasonable prices; prices for which have been fixed at Ten Guineas for bulls, Two guineas for boar pigs and One Guinea each for sows.*
- Poultry farmers were given the following advice under the headline: *"A few things you can't do." You can't expect your hens to give good profit unless you feed and care for them properly. You can't expect to feed a hen properly for one year under 4s. 6d.*
- In these days of rising telephone installation costs, maybe Telecom Australia could take a tip from this item reprinted from an American journal of the time: *A cheap and novel telephone system is in every-day use among the farmers in Indiana. The top wire of a barbed wire fence is given a good coat of india-rubber paint and is used as the conductor. Where roads or railways are crossed an ordinary galvanised wire is laid in an inverted trough underground, or raised up on poles. The line is many miles long.*
- An American nurseryman had been sued for selling trees untrue to name, and the jury had awarded damages against him. An editorial comment which followed the report stated ruefully: *We do not know how the Law of the Colony would deal with a dishonest nurseryman, but we do know from sad experience that we have purchased trees, especially citrus trees, by the hundred from travelling agents, and have had ample reason to regret having done so.*
- The fourth annual ploughing match of the Lockyer Agricultural and Industrial Society was held in October, and the report of the event stated that the land was very hard and difficult. The Champion Match attracted eight entrants and was won by James Taylor of Pittsworth, with 87 points. Second prize went to David Cooper of Oakey with 84 points.

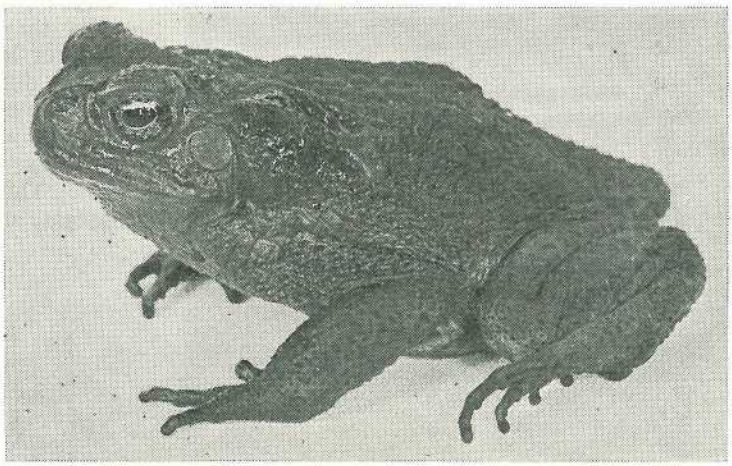
Laidley Ploughing Match—James Taylor, Champion Ploughman.

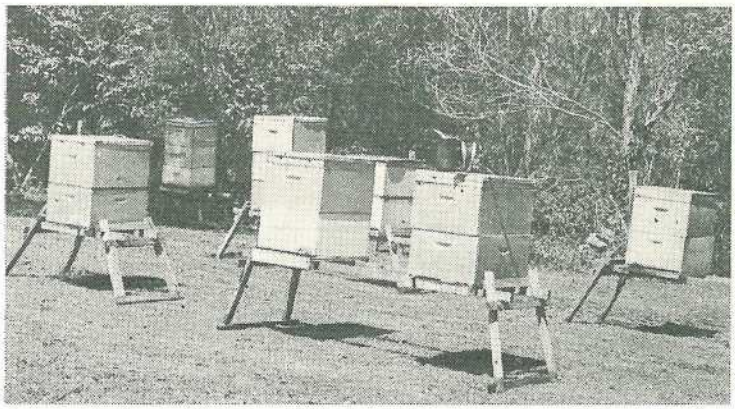


Honeybees

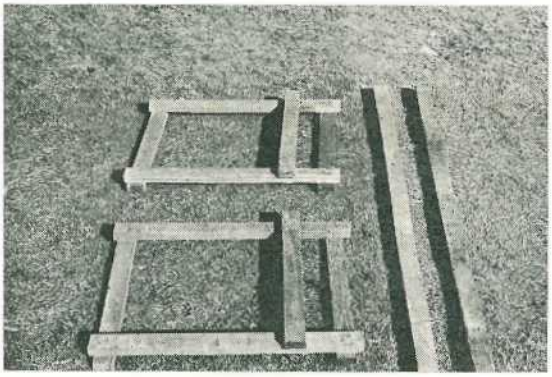
by C. ROFF, Chief Adviser in Apiculture.

Giant Toads

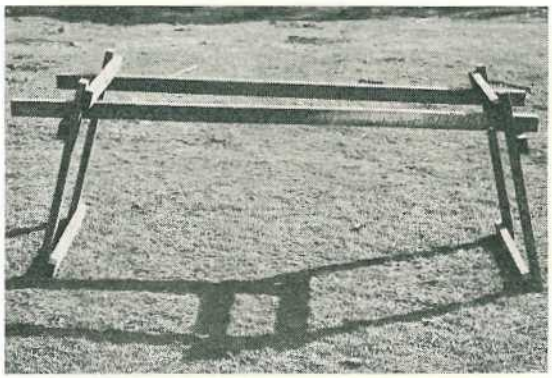




and Hive Stands



The two supports and two runners of the collapsible hive stand assembled.



THE introduced giant toad *(Bufo marinus* L.) is now recognized by beekeepers as a persistent and voracious feeder on workers, queens and drones.

It is a native of tropical America extending from Mexico to Argentina. From French Guiana it was introduced into Barbados about 1850, to assist in the control of rodents attacking sugar cane. From there they were introduced to most West Indian Islands including Puerto Rico in 1920. Later they were taken to Honolulu where they increased rapidly and have since been established in the Phillipine Islands.

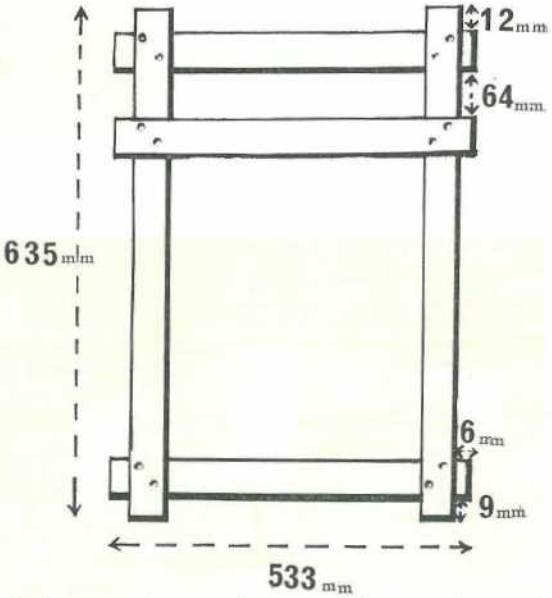
In Puerto Rico where they were introduced, it was observed that they were eating successfully large numbers of cane beetles in their newly added country and of course the value of such an important predator attracted the attention of sugar cane technologists from Queensland.

Following this they were introduced into Gordonvale, Queensland, from Honolulu on 22nd June, 1935.

The animal is now widespread in many localities in coastal Queensland including the lower foothills of some coastal ranges.

Honeybee colonies are weakened when these pests congregate near apiaries snapping up the honey bees at the entrance to hives.

Most of the feeding is at night and during the day they are found hiding in small holes and under logs. They grow very rapidly and consume different kinds of insects and there is evidence to show that they regularly visit the same spot where they have been in the habit of making easy kills of large numbers of insects. This is noticeable by the way they congregate near street lights at night.



Each support is made up of five wooden parts assembed as shown in this plan.

They were primarily imported for the purpose of attacking the greyback cane beetle, a major pest of sugar cane in Queensland. The toad's diet, however, has proved to be varied and extensive, and it has an enormous capacity for food. Examination of toads showed that 51% of their food contained species of insects harmful to sugar cane.

Since their introduction stomach contents have been found to contain ants, leafhoppers, grasshoppers, mole-crickets, a range of beetles, including the greyback beetle, cynid bugs, dipterous bugs, white grubs, flying ants, termites, moths and of course honey bees.

In the honey producing industry control measures are an added cost in materials and labour.

Placing the hives on stands about 609 mm (2 ft.) high considerably reduces losses. Migratory beekeepers have found the collapsible hive stand illustrated most suitable for the purpose.

It can be easily assembled and dismantled in the field, and the components can be packed readily for transport.

A complete stand to carry two hives is constructed of grey ironbark timber. The five parts of each support are nailed together with 60 mm x 2·8 (2¼ in. x 12) galvanised flat-headed nails through drilled holes with the nail ends clinched. (See the diagram.)

The timber required is as follows:—

RUNNERS: 2 pieces each 1 534 mm x 50 mm x 38 mm (60 in. x 2 in. x 1½ in.).

SUPPORTS: 4 pieces each 635 mm x 50 mm x 25 mm (25 in. x 2 in. x 1 in.) 6 pieces each 533 mm x 50 mm x 25 mm (21 in. x 2 in. x 1 in.).

As the supports are slanted outwards, stability of the stand is assured by the weight of the hives locking the runners in the opening formed by the top crosspieces. The bottom crosspieces help to prevent the stand from sinking into the ground.

Tuberculosis-Free Cattle Herds (As at 21 February, 1975)

ANGUS

Corden, E. B., Netherby, Warwick
Crothers, H. J. "Mooreenbah", Dirranbandi
Mayne, W. H. C. & Sons, "Gibraltar", Texas

A.I.S.

Cox, T. L. & L. M. J., Seafield Farm, Wallumbilla
Evans, E. G., Lauraven A.I.S. Stud, Maleny
Henry, Mrs. K. & Sons, "Tara", P.O. Box 4, Cambooya
H. M. State Prison Farm, Numinbah
Klein Bros., Kapleton A.I.S. Stud, Ma Ma Creek, via Grantham
Lawley, E. D. & Sons, Arley A.I.S. Stud, Maleny
Marquardt, C. R. & J. L., Cedar Valley A.I.S. Stud, Wondai
Martin, J. P. & R. J., Kentville, via Forest Hill
Middleton, C. W., Airton Vale, Cambooya
Mitchell and Mulcahy, Rosenthal
O'Sullivan, P. W., "Navleigh", M.S. 371, Greenmount
Pagel, E. E., and Hayes, E. M., Trafalgar Stud, Tarampa, via Lowood
Queensland Agricultural College, Lawes
Ross, W. & Co., M.S. 23, Rosewood
Schelbach, N. N. & Co., Allanview Stud, Warwick
Siebenhausen, J. & S. C., "Meniton", M.S. 195, Pittsworth
Thompson, W. H., "Alfa Vale", Nanango
Vohland, A. R., Bevallan, Stoneleigh, M.S. 150, Pittsworth
Weier, L. G., Prairie Plain A.I.S. Stud, M.S. 765, Allora

AYRSHIRE

Goddard, B., Inverell, Mt. Tyson, via Oakey
Scott, J. N. & Son, "Auchen Eden", Camp Mountain

BRAFORD

Bowden, W. H., "Brendale", South Pine Road, Strathpine
Thompson, M. A. K., "Glen Kyle", Buderim

FRIESIAN

Behrendorff, E. C. & N. G., Inavale Friesian Stud, M.S. 786, Boonah
Evans, P. J., M.S. 28, Dragon St., Warwick
Guppy, N. J. & H. M., Bli Bli Road, Nambour
Hickey, K. A. & M. R., Bunya
Lobley, N. E., "Neloby", Mt. Pleasant, via Dayboro
McWilliam, A. A., Oatlands Stud, M.S. 918, Toowoomba
Martin, R. J. and E. L., Kentville, via Forest Hill
Panzram, J. & K., Blenheim, via Laidley
Queensland Agricultural College, Lawes
Stumer, A. O., Brigalow, Boonah
Vonhoff, A. R. & D. G., M.S. 918, Toowoomba

GUERNSEY

Dionysius, R. L. & L., Warana Stud, M. S. 1796, Proston
Erbacher, J. P. & M. M., "Leafmore", Hodgsonvale
Hopper, G. T. & H. W., Ellendean Guernsey Stud, Maleny
Wilson, R. A. and M. R., "Okeden", Proston

HEREFORD

Hill, W. W. & P. C., "Mathalla", Dirranbandi
Panorama Stud Pty. Ltd., M.S. 765, Allora

JERSEY

Conochie, I. S., Brookland Jersey Stud, M.S. 461, Kalbar
H. M. Prison Farm, Capricornia Stud, P.M.B. 11, Rockhampton
H. M. State Farm, Palen Creek
Lau, J. F., "Rossallen", Goombungee, Toowoomba
McDonald, R. G., "Buffelvale", M.S. 807, Mundubbera
Paulger, S. & S. M., "Advale", Kenilworth
Postle, R. S. & G. C., "Yarallaside", Pittsworth
Queensland Agricultural College, Lawes
Snare, A. E. & Son, Laidley Park Stud, Laidley, 4341
Spressor, O. W., Carnation Jersey Stud, Mt. Walker Rd., Rosewood
Todd, J. R., Aberfoyle, Laravale, via Beaudesert
Vohland, A. R., Bevallan, Stoneleigh, M.S. 150, Pittsworth
Waite, H. M., M.S. 182, Laidley
Westbrook Training Centre, Westbrook

POLL HEREFORD

Anderson, J. H. & Sons, "Inverary", Yandilla
Christensen, B. L. & M. O., "Elavesor", Rosevale
Morris, H. J. & D. I., Gaiview Stud, Clifton
Nee Nee Pastoral Co., Dirranbandi, 4392
Stiller, N. L., "Vine Veil", Guluguba

POLL SHORTHORN

Leonard, W. & Sons, "Welltown", Goondiwindi
Pointon, R. B. & S. C., "Wywurri", M.S. 780, Kingaroy

BRAHMAN

Queensland Agricultural College, Lawes
The Cherokee Group Brahman Cattle Co., Tanby

SANTA GERTRUDIS

Barbara Plains Grazing Co., Barbara Plains, Wyandra
Central Estates, Comet Downs, Comet

SHORTHORN

Pointon, R. B. & S. C., "Wywurri", M.S. 780, Kingaroy

DROUGHTMASTER

University of Queensland, Veterinary School, St. Lucia

CONTROL OF TOBACCO PESTS IN THE FIELD

by R. H. BROADLEY,
Entomology Branch

A considerable proportion of the total Australian tobacco production is Queensland grown. In 1973, for example slightly more than half of the 15.3 million kilograms was produced in the State.

This was made possible, in part, by the development of successful insect control programmes, designed specifically to protect tobacco plants in the seedbed and in the field from both introduced and local pest species. Most of these pests are distributed along the eastern Australian coast, and consequently similar problems are experienced in the widely separated tobacco growing districts.

It should be noted, however, that each area has, in addition, its own peculiar problems. The following account of field pest control relies heavily on information obtained from the Mareeba–Dimbulah district which grows approximately eighty per cent of Queensland's quota.

There are several reasons for this. Firstly, the district is compact and the largest of its kind in Australia. Secondly, the warmer conditions result in accelerated insect development times and a compounded pest problem. So higher pest activity in the North has occasioned a more intensive study of the insects and their control.

Tobacco looper

This native species is one of the primary field pests in the Mareeba–Dimbulah district of North Queensland. One of the main reasons for this is that individual female moths can lay up to 2,200 eggs, giving this pest a tremendous capacity for increase. The flattened, elliptical eggs are laid singly on the undersurfaces of leaves situated in the lower three-fifths of the plant.

The larvae (grubs) which subsequently hatch from these eggs begin feeding in the vicinity of the empty eggshell. During the first week of their existence they eat an area from the leaf surface equivalent to that of a ten cent piece. This early damage, caused by feeding only on the lower tissues of the leaf, has the appearance of small transparent "windows", whereas older larvae devour the entire leaf tissue in irregular areas between the veins. It is obvious that the most appropriate time to control larvae is during the first week after they hatch, before they cause any significant damage to the leaves.

A marked build-up in numbers from August to December is characteristic of the species.

Control

The high populations of looper which may seriously damage a growing crop in November and December can be avoided by planting early. Harvesting is then largely completed by the most troublesome time of the insect year. Incidentally, harvesting can act as a form of pest control as larvae are removed with the leaves they are feeding on.

Spraying in accordance with the Insect Activity Prediction Service recommendations (see page should ensure that application coincides with the appearance of young larvae on the plants. The service operates in North Queensland only.

Insecticide sprays should be directed towards the *undersurface* of the *lower* leaves where larvae are most likely to be found. Chemicals which have been proven to give good looper control include 0·025% a.c. Methomyl, 0·025% a.c. Phosfolan, 0·05% a.c. Aminocarb and 0·05% a.c. Monocrotophos.

Breeding sites such as unwanted tobacco plants in the field and abandoned seed beds should be destroyed.

Tobacco budworms

Two species of budworms are serious pests of tobacco wherever it is grown in Queensland. It is virtually impossible to distinguish the larvae of one from the other as they are similar in behaviour and appearance.

Like the tobacco looper, the adult female lays eggs singly on selected plant parts. If the plant is budding or flowering the upright, pearly white eggs are laid preferentially on the buds or flowers. Before budding however, and contrary to popular belief, the eggs are laid on the middle to upper leaves of the plants, and are found in approximately equal numbers on the upper and lower leaf surfaces. Few are found on the tip leaves. After an incubation period of three to five days larvae hatch and begin feeding, moving to the tip of the plant in another four to six days.

As budworms are cannibalistic it is usual to find only one grub in the heart of each plant. Severe damage to the growing tips is common and the whole apical meristem can be destroyed. Apart from the subsequent loss of leaves, extensive suckering of the plant can occur, and control of these suckers is a costly operation.

The green forms of budworm larvae are easily confused with the larvae of the tobacco looper. There is a basic difference in the style of movement employed by each species—looper larvae loop along, whilst budworm larvae move in an undulating fashion. Larger larvae of the looper have on their backs two distinctive white stripes which are not found in budworms. It is important to recognize the difference between the species as this influences the choice of insecticide.

Budworms are present in moderate numbers at any time of the year, and this may be due to their wide range of hosts. Consequently

periods of distinctive and obvious population increase are not as apparent as with the tobacco looper.

Control

Effective budworm control really begins in the preceding tobacco season. It has already been noted that budworms have a preference for feeding on the buds and flower heads, and up to thirty large larvae have been recorded from one flower head. Therefore the destruction of residues or neglected flowerheads after the crop has been harvested deprives budworms of breeding sites. Abandoned tobacco seedbeds, which are usually left unsprayed, come into this category and should also be eliminated.

Young larvae before they have moved to the plant tips are more vulnerable to insecticide sprays, because of their exposed positions on the middle to upper leaves of the plant. Thus timing of spray application is critical, and the Insect Prediction Service can be of some help to growers in this respect. Regular inspections of plants for young budworm larvae also can be a valuable aid in control. A 0·025% a.c. Methomyl or a 0·05% a.c. Monocrotophos spray will control budworm larvae, provided sufficient attention has been paid to placement of insecticide. Sprays should cover both surfaces of leaves on the upper three-fifths of the plant.

Experience has shown that once budding or flowering has occurred in the growing crop significant budworm damage seldom occurs. This follows from the undoubted preference among budworm larvae for feeding on buds and flowers rather than on leaf tissues.

Cluster caterpillar

This insect is usually of less importance than either budworms or looper but can cause occasional problems, especially in late summer and winter. The situation may be aggravated where alternate hosts of cluster caterpillar, particularly legumes, are grown adjacent to the tobacco crop.

Eggs are laid in clusters of more than one hundred and covered with fluffy brown scales from the abdomen of the female. Most larvae hatch almost simultaneously from the egg mass, and commence feeding near the egg laying site. Little movement occurs in the first few days of larval life and consequently only a few leaves are attacked, but these are severly damaged. From this focus of infestation larvae move to adjacent plants, chiefly those in the same row. Movement may be facilitated by wind action—larvae suspended on silken threads are blown to other plants. Dispersal by crawling from leaf to leaf is also important.

Large larvae are voracious feeders and consume large amounts of leaf tissue. They may be found anywhere on the plant, but prefer the undersurfaces of leaves. Because of their distinctive colouration and large size (they are the largest caterpillars of all tobacco pests), the mature larvae can be easily recognized. Their usual pattern is an overall grey-brown, with conspicuous triangular black marks in a line along each side of the top of the body. In the smaller stages they are broadest at the front of the body and narrowed behind. If disturbed the larvae react by curling and falling to the ground.

Control

Cluster caterpillar is easily recognized and no confusion should exist in the identification of this species, as might occur between budworm and looper.

Cluster caterpillar attack is quite characteristic. It is important to remember, however, that although damage to a few plants might be quite severe, overall damage to the whole paddock may be slight. In these circumstances, the costs of control must be weighed critically against likely losses.

Seldom is cluster caterpillar the only pest species found in a crop as it is usual for other species such as budworm and looper to be present simultaneously. Chemicals which are effective against cluster caterpillar include 0·025% a.c. Methomyl, 0·025% a.c. Phosfolan, 0·05% a.c. Aminocarb, or 0·05% a.c. Monocrotophos.

Tobacco leaf miner

This pest occurs sporadically throughout the district during the tobacco season and its occurrence is usually associated with the presence of other plant hosts in the vicinity of the crop.

Female moths lie motionless in the crop or in nearby woodland during the day. At dusk they become active and commence laying eggs, which are deposited on the ground at the base of the stem or on the lower leaves. Larvae begin mining almost immediately after hatching and as a result the lower leaves are the first to be infested but in severe attacks the upper leaves of the plant may also be damaged. Occasionally leaf miner larvae are found in the plant stem where they damage supporting tissues, and in such cases the plants are blown over even in moderate winds.

Control

Leaf miner can develop on a number of alternative hosts, both weeds and cultivated species. Vegetable plants such as tomatoes and potatoes should be sprayed at the first signs of infestation. It might pay to remove weeds such as wild gooseberry, deadly night-shade and thornapple if these are growing close to the transplants.

Old abandoned seedbeds can be an important source of the adult moths which will move readily to the young transplanted crops in the field. These seedlings should be either destroyed or sprayed in the normal routine manner.

An 0·05% a.c. Azinphos-ethyl, 0·025% a.c. Methomyl or a 0·05% a.c. Monocrotophos spray can be used to control leaf miner. Azinphos-ethyl can cause phytotoxicity if applied regularly, so it should only be applied as a spot treatment. If sprays cover both surfaces of the lower leaves of the plant few problems with leaf miner should be encountered.

Tobacco stemborer

Stemborer is primarily a pest of seedlings, but has the ability to attack plants in the field. Of these it is the younger plants, especially transplants which are most sensitive to damage, whilst older plants are better able to tolerate infestations. Larvae may be found in the leaf midribs, leaf stalks, suckers or stems of mature plants. In one instance, twenty larvae were taken from a flowering plant approximately 160 cm high. Fortunately, such occurrences are relatively uncommon in North Queensland, in contrast to India for example, where this pest has been shown to cause serious problems in the growing crop.

Eggs are principally found cemented to the leaves but can also be found on the plant stems. On hatching, larvae burrow almost immediately into the plant tissues and proceed to form feeding tunnels. Therefore stemborer larvae, unlike looper and budworm larvae, spend only a small part of their lives on the leaf surface.

Control

At the present time stemborer cannot be controlled once the larva is concealed in the plant tissues. Regular protective insecticide sprays would prevent the pest establishing itself in the plant, but are economically unsound. Therefore, strict attention must be paid to crop hygiene.

Stemborer can only breed and develop on members of the plant genus *Nicotiana* (cultivated and wild tobaccos) and the egg plant. Obviously elimination of these hosts will result in a reduction in stemborer numbers. To achieve this, all tobacco, whether residues, regrowth or volunteer plants, should be destroyed in the off season. Abandoned seedbeds, unless sprayed regularly, should also be destroyed.

Mature tobacco plants are fairly resistant to and tolerant of stemborer attacks occurring in

the field. Most damage is caused when the pest is already present in the transplanted seedlings. Therefore, it is imperative that the tobacco seedbeds be kept free of stemborer, firstly by adopting a schedule of spraying with Methomyl every six days, and secondly by rejecting any infested seedlings as transplant material. This can be done by avoiding the edges of the beds, the favoured oviposition site of stemborer, and by recognising the symptoms of stemborer infestation, particularly the stem gall they cause.

Minor pests

GREEN LOOPER

Although closely allied to the tobacco looper, and virtually indistinguishable from it, this pest causes few problems in tobacco and attains only minor pest status. This may be attributed to the fact that it is most numerous in autumn and winter, when there is very little tobacco in the field in north Queensland. The green looper is capable of breeding on a wide range of cultivated and wild hosts.

Control

Recommendations for tobacco looper control are applicable to this species.

WIREWORMS

Wireworm is the name given to the soil dwelling larva of a beetle commonly known as the "click beetle". As the name suggests the wireworm has an elongate, thin wire like body. Whilst they normally prefer to feed on the roots of native plant species, wireworms which survive the preparation of a tobacco paddock will readily feed on young transplants. They are capable of destroying the whole root system, and boring into the stem. Plants affected suffer from a lack of water, and usually die.

Control

Because they live their whole immature life in the soil, wireworms are difficult to control. Fortunately they occur only occasionally in tobacco paddocks and few problems can be expected after thorough pre-planting cultivations. This pest is more likely to occur in a weedy, inadequately prepared area.

Where treatment becomes necessary drenching the bases of the plants with 0·025% a.c. Methomyl offers some degree of control.

FALSE WIREWORMS

More than one species of false wireworms have been recorded attacking young transplants in the field. Both adult beetles and larvae can cause problems by nibbling at the stem, at or below ground level. An infestation is more likely where tobacco follows a weed fallow.

In appearance, the false wireworm larva resembles a true wireworm, except that the last segment of the body is always bluntly rounded. When fully grown it is less than 3 cm long and can be found in the soil in the vicinity of the plant. The adult beetles are about 10 mm long, with a dirty soiled appearance. Often they are found clustered together underneath debris.

Control

The ground where it is intended to grow tobacco should be subjected to thorough cultivation. It is important to destroy any weeds on which the false wireworm larvae can feed and survive.

Chemical control may be attempted by drenching the plants bases with 0·025% a.c. Methomyl.

GRASSHOPPERS AND LOCUSTS

Many species of grasshoppers have the ability to damage tobacco plants, their damage being easily recognized as irregularly shaped areas eaten from the leaves. As they move onto crops from the surrounding grassland, the peripheral plants are usually the worst affected. Under certain conditions, large numbers of some species aggregate into a migrating swarm and can devastate most crops, including tobacco, in their path.

Control

There is little the individual grower can do to protect himself against migrating swarms of locusts.

It is uneconomic to attempt the control of low populations of grasshoppers, because of their mobility, but in special instances, where intensive damage is likely, a 0·025% a.c. Methomyl spray is adequate. An 0·05% a.c. Monocrotophos spray is recommended if the spur-throated locust or related species are present.

GREEN VEGETABLE BUG

The adult bug is triangular shaped and predominately green in colour, although fawn coloured forms can occur, especially in winter. Because this species has developed glands which are capable of giving off a pungent, irritating odour, they are often referred to as stink bugs.

Green vegetable bugs normally feed on weeds and legume crops such as soybeans. Damage to tobacco crops usually only occurs when the adults fly into the paddock from some other area of vegetation. The green colouration of the adults makes them difficult to find in the crop. The first sign of their presence may be wilting of plant terminals or individual leaves around the point of attack. This dehydration is the result of insertion of a set of tube-like mouth parts into the tissues to suck the plant juices. Damage is more evident during hot weather.

Control

The migratory habits of green vegetable bugs make their control uneconomic unless they are present in large numbers. Some damage can be tolerated and the plant will often recover.

When spraying is thought necessary, 0·025% a.c. Methomyl can be used. However, it is important that thorough coverage be achieved for adequate control.

JASSIDS

These small, green leaf-hoppers suck tobacco plant sap, causing localized white flecking, mainly on the upper leaf surfaces. This damage is usually insignificant because of the small size of the insects. Of much more importance is their role in disease transmission. Yellow Dwarf, a virus disease which is prevalent in Victoria is spread by the common brown jassid.

Control

An 0·025% a.c. Methomyl spray should give adequate control of leaf hoppers.

APHIDS

These small plant sucking bugs, sometimes referred to as plant lice, occur in low numbers on tobacco plants. The suggested reason for this is the presence of nicotine, believed to be toxic to aphids. Those that survive on the plant are thought to feed in tissues which do not contain nicotine.

The importance of aphids stems from the fact that the flying forms of some species are capable of transmitting a disease called Potato Virus Y. They alight repeatedly on plants, and probe with their mouth parts. Infected aphids take only ten seconds to transmit the virus during feeding, thus making control of the disease by attack on the aphids very difficult.

Control

Frequency of outbreaks of Potato Virus Y can be reduced by the elimination of volunteer tobacco plants and weed hosts, and by not growing tobacco in the vicinity of vegetable crops such as potatoes, tomatoes and capsicums, which act as hosts for the disease.

TOBACCO THRIPS

The tobacco thrips is a minor pest of the tobacco in the southern border districts of Queensland and its feeding results in a silvery blemish on the upper leaf surface in the vicinity of the veins. The adults are small inconspicuous brown insects approximately 2 mm long, while immature stages are creamy white in colour.

Control

A 0·025% a.c. Methomyl spray will control thrips.

MITES

Two types of mites have been recorded as tobacco pests.

The two spotted mite is very small and can just be seen with the naked eye. Its name is derived from the form that has two red spots on its back. These marks are often more noticeable in the early stages of its life cycle. A webbing on the leaf undersurface is characteristic of its presence, and leaves may also have a stippled or yellowed appearance.

The tomato mite, as its name suggests, commonly attacks tomatoes but occassionally is found in tobacco, especially in the southern border districts of Queensland. Because it is so minute, it can only be seen under magnification with a microscope. Leaves affected by these mites become bronzed and hardened.

Damage in both cases arises from the sucking activites of the adults and juveniles.

Control

Control of these two species of mites can be obtained by using a 0·05% a.c. Dicofol spray.

TERMITES

Tobacco is infrequently attacked by the largest termite species in Australia. Typically only plants on the periphery of a paddock are affected, and these are first noticed because of their proneness to wilting. Crops with bushland close by are more likely to have a termite infestation, as the termites move from their natural habitat to the crop to feed. Damaged plants when sectioned revealed the active workers, which are blind and sensitive to light.

Control

Infested plants should be destroyed, along with the termites which they contain.

The source of the infestation, the nest, should be located and destroyed. An 0·05% a.c. Dieldrin spray is an effective method of control. No spray should be allowed to contact the tobacco plants as residues and tainting may follow.

Insect control procedures

There are a number of methods of insect pest control in tobacco, and they should all be considered as being complementary to each other. Selection of planting material plays a role in stemborer control in the field. Alternative host destruction may be warranted in leaf miner control. Thorough cultivation is useful in avoiding problems with wireworms and false wireworms. The importance of destroying tobacco crop residues and regrowth, in accordance with the Tobacco Industry Protection Act, cannot be overemphasised. This practice deprives tobacco pests of breeding and development sites during the off season. Scarcity of hosts, combined with cooler conditions, is very effective in reducing insect numbers below noxious levels for the succeeding tobacco crops. In addition, blue mould incidence could well be minimized. Consequently if each grower carries out these tasks conscientiously the whole district ultimately benefits.

Rotary hoeing is the most effective way of dealing with crop residues, and ploughing is the second most effective. Strip rotary hoeing is preferable to complete rotary hoeing, because it gives much better protection from soil erosion. Discing is not generally recommended but can be effective on some soils if done thoroughly. Slashing is ineffective, especially if done with knives rather than chains, because it does not destroy the plants root system, which under the appropriate conditions will provide the basis for plant regrowth. The method employed in residue destruction will naturally depend on the type of machinery available to the grower.

Insecticides are indispensible in tobacco pest control because they have the advantages of fast action, availability, relative cheapness and a high level of effectiveness, However, there are always dangers of insecticide resistance development and the broad sprectrum insecticides presentlv required can result in the destruction of beneficial insects, such as wasps and parasitic flies. In the long run it is to the growers advantage to use only the chemicals as required, and at the concentrations that are recommended.

Insect prediction service

The goal of effective insect control with minimum useage of chemicals would be much easier to achieve if growers knew of insect outbreaks in advance. This information is made available to growers of the Mareeba–Dimbulah district of North Queensland by the Department of Primary Industries in the form of the Insect Activity Prediction Service. This service enables growers to spray when the young larvae first appear on the leaves, before they have caused significant damage, and while they are easy to kill. It is mainly concerned with budworms and looper, and occasionally with cluster caterpillar, because their outbreaks occur simultaneously throughout the district. The other pests, in contrast, occur sporadically and locally, and are not suited for incorporation into the service.

The procedures involved are outlined below to improve grower understanding of the scheme and so increase confidence in following the recommendations which flow from it.

Natural infestations of budworm and looper are allowed to develop on unsprayed 0·1 hectare (0·25 acre) blocks of mould resistant tobacco (variety C.S.I.R.O. 40T). Insecticide is applied only during the initial three weeks after transplanting into the field. All normal cultural and irrigation procedures are carried out during crop growth.

Thirty plants selected at random from each unsprayed block are marked and the number of eggs, larvae and pupae per plant counted twice weekly. For the earlier (July) plantings, four sites—two in the Mareeba District and two in the Dimbulah District—ensure adequate insect monitoring. This allows comparisons to be made within a district and between districts. Another four sites are used for the later (September) plantings.

Infestation patterns for both districts are essentially similar, with little difference in absolute insect numbers and this makes the operation of the service simpler. New infestations, detected by a sharp peak in egg laying, are followed (after hatching) by an increase in the numbers of young larvae. The best opportunity for insect control is offered at this stage.

In conjunction with actual assessment of insect incidence in the field, light traps are employed to attract and catch adult moths which are active at night. Unfortunately, adult behaviour is influenced by meteorological conditions such as wind and rain and therefore light traps alone are not sufficiently accurate to determine insect build up.

Each prediction involves a sequence of events:

(i) A peak of egg laying by budworm or looper moths, or both, is detected. On the average these peaks occur every two weeks.

(ii) The entomologist decides if the damage the outbreak is expected to cause exceeds the cost of control.

(iii) Growers are notified of the outbreak by advertisements on the local commercial radio station. They are also told which pest is involved, the chemicals recommended for its control, and the date by which the crop should be sprayed.

Although the scheme is designed to cover the major pest problems which may be encountered growers are urged to inspect their own paddocks and to make independent assessments of pests activity. This will ensure that pests not fully covered by the Prediction Service are adequately monitored and that minor field to field differences are considered when decisions on insecticide treatments are necessary.

Where to spray

The major pests in north Queensland display consistent distribution patterns of eggs and young larvae on tobacco plants, and these are briefly listed below.

TOBACCO LOOPER

The eggs and young larvae of this species are located on the undersurface of leaves in the lower three-fifths of the plant. Older larvae may be found in the upper region of the plant, mostly on the leaf undersurface.

TOBACCO BUDWORMS

Eggs and young larvae are found on both surfaces of leaves in the upper $\frac{3}{5}$ of the plant. After several days feeding in these positions, the larvae move to the plant's apical region.

CLUSTER CATERPILLAR

Eggs are laid in clusters of several hundred on the undersurface of the middle and lower leaves. Newly hatched larvae spend some time feeding in the vicinity of the egg mass before moving to other leaf positions and nearby plants.

LEAF MINER

The larvae feed within the leaf tissue of the lower leaves of the plant. In severe infestations leaves in upper plant positions can be affected but this is uncommon.

A summary of this information indicates that coverage of BOTH surfaces of ALL leaves on the plant is necessary for effective insect control. Anything less than this will mean that problems are certain to ensue. Even the best chemical is doomed to failure if it is not deposited on the parts of the plants where insects are found.

Spraying

EQUIPMENT

SPRAYING machinery must be capable of achieving the desired coverage (i.e. both surfaces of all leaves), and to this end there has been a marked change in equipment used in insecticide sprays in north Queensland in recent years. Several years ago aeroplanes and low volume misting machines were widely used. Today 70 to 80% of the tobacco growing area is sprayed with a tri-crop machine (rear mounted, high clearance boom sprayer) while most of the remainder is treated with off-set booms. In the early stages of field establishment tractor sprayers are commonly used, and a change to one of the above types of sprayers is made for later growth stages.

The tri-crop machine is the most effective of available sprayers because it offers the greatest potential for precision treatment. This is a necessary prerequisite for the successful utilization of the Insect Prediction Service.

However, the ability of this machine to place insecticide on the undersurface of all leaves is dependent on the proper placement and number of dropper nozzles. Hollow cone nozzles are recommended as they need less output for successful operation. The bottom nozzle should be placed as close to the ground as possible, to ensure coverage of the undersurface of the lower leaves. This is especially important in looper control. After hilling it should be located below the lowest leaf of the plant. An increase in the number of nozzles on the droppers will be necessary with increase in plant size.

Three properly positioned spray nozzles directed towards each side of the plant and one or two directed into the plant heart have

been found to give consistently good coverage (and hence acceptable control) of both leaf surfaces at the flowering stage of plant growth. Many growers at the present time use only two spray nozzles per side and an increase in the number of nozzles on the droppers should be implemented by such producers during the later stages of their crops growth.

There are deficiencies which become obvious when spraying with the off-set boom. Very little spray is deposited on the under surface of the leaves, where it is most required. Because of this chaacteristic it is inefficient in obtaining kills of young larvae and is wasteful in terms of labour, and insecticide. As it is more suited for preventative spraying, it is incompatible with the Insect Prediction Service.

TECHNIQUE

SPRAYING under adverse conditions can negate the use of both correct chemicals and correct equipment. The small droplets containing insecticide are considerably influenced by meteorological conditions. Wind is a common cause of poor insect control as minute droplets can be caried several kilometres from the site of application. In addition, wind can make effective spraying of certain parts of the plant difficult or impossible. Growers should ensure that spraying is done in cool, calm conditions where best use of insecticide and equipment is obtained. Insecticide treatment in hot conditions can also influence the degree of control achieved. The leaves (especially the tips) may wilt making deposition of insecticide on the undersurfaces impracticable.

Perhaps the importance of good spraying techniques can best be demonstrated by problems in the control of budworms. Mature budworm larvae exhibit a preference for feeding in the growing tip of the plant. When a strong breeze is blowing, the apical leaves are bent over the tip in such a manner as to prevent any spray droplets reaching the heart of the plant. Similarly, in the heat of the day, the apical leaves of the plant will wilt to form a protective cocoon, which shelters the budworm larvae from insecticides. It is important to realize that no spray machinery is good enough to effect control of budworms in these circumstances. Inadequate control arising from these or other reasons may lead a grower to double the strength of the chemical spray on the assumption that twice the pest kill will be achieved. This is a fallacy, especially where short lived insecticides are being used. In reality, it means that twice as much chemical will be falling on the same plant parts as before. If these are not where the target insect is to be found, no advantage is gained, and spraying will still be ineffective.

VOLUME

NATURALLY the volume of application will vary with the type of equipment being used. Suggested rates for use with the tri-crop machine at selected growth stages are:

Hilling	..	340 litres/hectare	(30 galls. per acre)
Budding	..	560 litres/hectare	(50 galls. per acre)
Flowering	..	900 litres/hectare	(80 galls. per acre)

It should be noted however that the number of spray nozzles and their placement can be more important than the actual quantity of spray applied.

SUMMARY OF RECOMMENDATIONS

(i) Young plants should be sprayed weekly with 0.025% a.i. Methomyl for the first three weeks after their transplanting into the field.

(ii) Thereafter, spray according to Prediction Service recommendations, which are made approximately every fourteen days. The chemicals to be used for particular pest species have been given in the relevant sections, and Table 1 summarises this information and gives the appropriate dilution rates.

In areas where the prediction service does not operate growers should inspect their crops regularly to ensure that their insecticide applications coincide with the build-up of young larvae on the plants.

(iii) Growers should be aware of the consequences of spraying under adverse conditions, and of the short-comings of their spraying equipment. These factors are as important as the type of chemical used.

Scientific Names of Pests Mentioned

Tobacco looper	*Plusia argentifera* Guen.
Tobacco budworms	*Heliothis armigera* (Hubner.) and *H. punctigera* Wall.
Tobacco leaf miner	*Phthorimaea operculella* (Zell.)
Tobacco stemborer	*Scrobipalpa heliopa* (Low.)
Cluster caterpillar	*Spodoptera litura* (Fab.)
Green looper	*Plusia chalcites* (Esper)
Wireworm	Family Elateridae
False wireworm	*Gonocephalum* spp.
Grasshoppers and Locusts	Families Pyrgomorphidae and Acrididae
Spur-throated locust	*Austracris guttulosa* (Walk.)
Australian plague locust	*Chortoicetes terminifera* (Walk.)
Green vegetable bug	*Nezara viridula* (L.)
Jassids	Family Cicadellidae
Common brown jassid	*Orosius argentatus* (Evans)
Green peach aphid	*Myzus persicae* (Sulzer)
Tobacco thrips	*Hemianaphothrips concinnus* Morison
Two-spotted mite	*Tetranychus urticae* Koch
Tomato mite	*Aculops lycopersici* (Massee)
Giant termite	*Mastotermes darwiniensis* Frogg.

TABLE 1

MATERIALS AND DILUTION RATES

Chemical Common Name	Chemical Trade Name	Percentage Active Ingredient in Formulation	Recommended Spray Concentration	Amount of Commercial Product to use in 455 litre (100 Gallon) Spray Tank	Pests Controlled
aminocarb	Matacol ..	22%	0·05%	1 030 mls	looper cluster caterpillar
azinphos-ethyl ..	Asphos ..	40%	0·05%	570 mls	leaf miner
	Benthion Chemothion Co-Thion E Guasthion Milathion Thionex	44%		520 mls	
dicofol	Kelthane ..	25%	0·05%	900 mls	mites
dieldrin	Dieldrin .. Apply to Termites nests only	30%	0·05%	760 mls	termites
methomyl	Lannate ..	90% wettable powder	0·025%	125 grams	looper budworm leaf miner cluster caterpillar stemborer
		22·5% liquid		500 mls	grasshoppers* green vegetable bug* jassids* tobacco thrips*
monocrotophos ..	Nuvacron ..	40%	0·05%	570 mls	looper budworm leaf miner
	Azodrin ..	60%		380 mls	cluster caterpillar spur throated locust and related species
phosfolan	Cyolane ..	25%	0·025%	450 mls	looper cluster caterpillar

* Applications of this chemical for control of major pest species should give adequate control of these minor pests.

Castrate calves successfully

by M.A. Burns
Beef Cattle Husbandry Branch.

Open castration

Restrain the calf then make sure both testes are down in the purse. Sometimes one testis is retained in the abdomen, so if only one testis is accessible it is best to wait in the hope that the retained testis will descend as the calf gets older.

If the accessible testis is removed, one has to guess which side of the purse the other lies in when the calf is caught later on to see if the second one has come down.

By feeling the testis along its length and up the cord, you can feel the cord come out of a canal. This connects the inside of the purse with the abdominal cavity. Down these canals (one each side) the testes descend as the calf grows. Sometimes an experienced operator can feel the retained testis lying in the canal and can manipulate it down into the purse.

Next take hold of one of the testes firmly between the thumb and forefingers. With the scalpel in the other hand, hold the testis firmly. so the skin of the purse is stretched over it. Take care to push the testis towards the tip of the purse so it won't go into the canal. This also allows for good drainage. This step is shown in picture 1.

Hold the scalpel short, and make a firm cut through the skin, long enough to let the testis burst through the cut. The cut must be made through the membrane forming the inside of the purse. It is quite in order to cut into the testis, as the cut is then deep enough to allow the testis to be forced through it. This is shown in picture 2.

The pressure of the forefingers and thumb causes the testis to burst out of the purse. The extruded testis is held between the forefinger and thumb, while the second finger is placed between the cord and white membrane which is the inner lining of the purse and which is attached to the end of the testis. See picture 3.

Sever this attachment by placing the scalpel blade between the cord and the membrane below the second finger and cut at the point of attachment as shown in picture 4.

The testis is pulled out from the purse while the scalpel blade is scraped along the cord towards the calf's body to help part the surrounding tissue from the cord. The cutting edge of the blade should be held on a slight angle to stop the cord from being severed – see picture 5.

The cord of the testicle is now fully extended. With a scraping action of the scalpel blade the cord is severed close to the calf's body where the blood vessels are fewer. This is shown in picture 6.

Pulling the testis out of the purse stretches the blood vessels so when they are severed the inner linings tend to twist. This seals the vessels and reduces bleeding. This is also helped by scraping rather than cutting the cord.

This procedure is repeated to remove the second testis.

Lastly the purse is pulled out firmly from the body so the cut ends of the cords move up into the canals and are less likely to become infected.

Release the calf so it can move away quietly.

Elastration

This method uses the principle of cutting off the blood supply to the purse and testis causing them to slough off. It is done by putting a small strong rubber ring around the neck of the purse, close to the calf's body.

The advantage of elastration is that the operation can be performed quickly and simply and doesn't need the same skill as for open castration. It is therefore very suitable for the less experienced operator.

The method of carrying out elastration is as follows:

Check that both testes have descended, as for open castration.

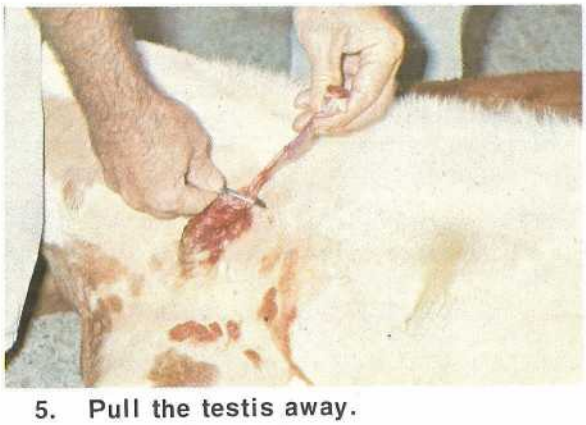
castration step-by-step

3. Force out the testis.

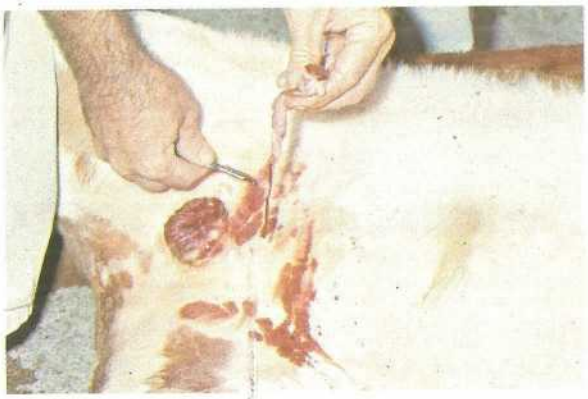
1. Hold testes firmly.

4. Sever the attachment.

2. Make a firm cut.



5. Pull the testis away.



6. Sever the cord.

9. Detach the ring.

7. Placing the ring.

10. Placing 'Burdizzo' pinchers.

8. Testes forced through ring.

11. Closing 'Burdizzo' pinchers.

Now place a rubber elastrator ring on the four points of the 'elastrator' pliers facing the operator. The ring is expanded by pressure on the handles with the right hand, as far as is needed, according to the size of the calf.

Now place the expanded rubber ring over the purse. The tip of the purse is seized between the thumb and forefinger of the left hand, and the skin is pulled through until the rubber ring is at the base of the purse next to the calf's body, but not enclosing the teats or the skin of the abdomen (See picture 7.)

With the rubber ring still expanded, the thumb and fingers of the left hand are placed at the base of the purse. The testes are forced through the expanded ring by gentle pressure, as in picture 8.

Make sure both testes are held in the purse, then release pressure on the handles of the pliers so the rubber ring tightens round the neck of the purse at at its base. Hold the purse lightly with the left hand and detach the points of the pliers from the rubber ring. (Picture 9).

Release the calf quietly.

Bloodless castration

This method relies on cutting off the blood supply to the testes by a pair of sturdy clamps called 'Burdizzo' pinchers. These will sever the testicular cord without injuring the purse. The principle is based on the difference in resistance to pressure between the skin of the purse and the testicular cord.

The procedure for 'Burdizzo' castration is as follows:

First, open the jaws of the pliers which are held in the right hand with the jaw carrying a hook-like lug at each end and furthest from the operator. Then with the left hand, seize the neck of the purse above the testes with the fingers on the underside and the thumb on the upperside placed in the division between the two testicular cords, pushing the cord of one of the testes against the side wall of the purse.

Now place the jaws of the pinchers over the cord, make sure only that portion of the purse surrounding the cord is enclosed in the jaws. This is easy to check as the 'hooklike' lug on one end of the lower jaw on the pinchers, if located in the groove made by the pressure of the thumb against the cord and outer wall of the purse, will make sure too much of the purse is not enclosed in the jaws of the pinchers.

The lug also prevents the cord from escaping when the jaws of the pinchers are closed. It is important to avoid clamping the whole neck of the purse in the pinchers as this would cut off the blood supply to the purse causing it to eventually slough off. This is why a section of the skin of the purse down its midline should be left intact so the blood supply is maintained.

Still holding the purse and cord with the left hand, the pinchers are now closed until the cord is compressed enough to be held in place between the jaws (see picture 10). Now transfer the left hand to the lower handle of the pinchers and with both hands on the handles press firmly until the pinchers are clamped completely closed as shown in picture 11. This crushes the cord and so cuts off the blood supply.

The pinchers are now opened and removed from the purse. The same procedure is followed for the other testis. This completes the operation.

With the blood supply to both testes now stopped they will begin to atrophy and disappear over a period of about six weeks.

Both elastration equipment and 'Burdizzo' pinchers may be obtained through veterinary supply firms, complete with instructions for their use.

Zinc foliar sprays increase yields of navy beans

by H. M. BROUWER; G. R. STEVENS and J. G. FLETCHER,
Agriculture Branch.

Zinc sprays give yield increases of up to 73%

THE application of zinc to prevent zinc deficiency in navy beans is not a routine operation on the southern Darling Downs. In fact, zinc deficiency is not recognized as being a problem by most navy bean growers. Yet, in dryland field trials conducted during 1973–74 and 1974–75 at Emu Vale on the southern Downs, foliar applications of zinc sulphate heptahydrate gave yield increases of up to 73%.

Ratings of zinc deficiency symptoms were taken in the early stages of plant growth. Treatments with severest symptoms—without zinc applied—gave the lowest yields.

Symptoms

The trace element zinc, when deficient in navy beans, initially shows a distinct interveinal chlorosis of the leaves. These leaf areas later turn brown and fall out. Prolonged flowering can also occur, resulting in poor pod and bean setting. (See colour plates on the back cover of this issue.)

Trial Treatments

The trials were planted in both years on the same site. Previous crop history was maize 1971–72 and navy beans 1972–73. The land was fallowed between crops. The soil type is a typical creek alluvial derived mainly from Walloon sandstone. It is a free working, freely drained, clay loam, well suited for agricultural use.

Five navy bean varieties were planted in both years: Selection 51; Selection 46; Selection 39; Gallaroy and Kerman. The treated plots were sprayed with zinc sulphate heptahydrate at the rate of 1 kg in 100 *l* of water per hectare at each application, twice in 1973–74 and three times in 1974–75. A wetting agent (Agral 60) was added at the rate of 100 ml per 450 *l* of water.

Times of application of the zinc in the first year were 14 and 28 days after emergence and in the second year, 10, 24 and 38 days after emergence.

Significantly, soil analyses taken before planting in both years indicated—on present knowledge—that zinc levels could be regarded as being adequate to high. Yet, untreated plots showed severe zinc deficiency symptoms in both years.

Results

TABLE 1

YIELDS IN KG/HA

Variety	1973–74		1974–75		Average both years	
	Control	Zinc Spray	Control	Zinc Spray	Control	Zinc Spray
Selection 51	2 259	2 437 (+8%)	2 805	2 969 (+6%)	2 532	2 703 (+7%)
Selection 46	2 260	2 240 (−1%)	2 754	2 906 (+6%)	2 507	2 573 (+3%)
Selection 39	1 491	2 066 (+39%)	2 457	2 735 (+11%)	1 974	2 401 (+22%)
Gallaroy	975	1 377 (+37%)	2 138	2 573 (+20%)	1 557	1 975 (+27%)
Kerman	1 049	1 955 (+86%)	1 326	2 146 (+62%)	1 188	2 051 (+73%)
Average	1 607	2 015 (25·4%)	2 296	2 665 (16·1%)	1 952	2 341 (19·9%)

Note.—The figures in brackets are the percentage increase in yields as a result of zinc applications.

Zinc sprays applied in the early stages of crop growth gave increased yields in both seasons in which the trials were conducted. Yields from the zinc sprayed treatments were 20% above those for the unsprayed treatments.

The trial results do indicate, however, that the varieties tested varied in their response to zinc applications. The commercial varieties, Gallaroy and Kerman showed the greatest response to zinc sprays with Kerman giving a 73% increase in yield in the two seasons and Gallaroy a 27% yield increase.

Selection 39 also responded significantly to zinc. Should this variety become available commercially, growers will have to ensure that its zinc requirements are met. Selection 46 and Selection 51 responded only marginally to zinc applications.

Selection 51 and Selection 46 are not commercially available at present. Should seed of these selections become available, commercial crops on the southern Darling Downs should not require applications of zinc.

Past experience on the Downs has indicated that zinc deficiency is more likely to appear

in long fallow than short fallow situations. Navy beans grown following wheat or barley on this soil type will often outyield navy beans grown following a summer crop. This could well be tied up with zinc nutrition. It is anticipated that navy bean yield responses to zinc following a short fallow may not be as great as indicated in these trials.

There has not been sufficient evidence, however, to indicate that zinc is unnecessary in short fallow situations.

Increased Returns

The average yields of the commercial varieties Kerman and Gallaroy were used in both years of the trial to calculate the increased financial returns of navy beans due to the application of zinc. The yields in the above table have been reduced by 20% to obtain a clean seed yield.

The price received by the grower from the Navy Bean Marketing Board was 39·6 cents per kg clean seed delivered Toowoomba.

	Kerman		Gallaroy	
	Control	Zinc Spray	Control	Zinc Spray
	$	$	$	$
Gross returns/ha	376.20	649.83	493.42	625.68
Cost of applying the zinc spray (boom sprayer)—Zinc sulphate 34c/kg x 3 applications	..	1.02	..	1.02
Agral 60 R @ 15 ml/ha x 3 applications	..	0.12	..	0.12
Variable costs of plant (tractor and boom spray) 62c/ha x 3 applications	..	1.86	..	1.86
Total costs	..	3.00	..	3.00
Net Return	376.20	646.83	493.42	622.68
Increased return/ha due to zinc sprays	$270.63		$129.26	

Conclusions

The application of zinc sprays to the commercial navy bean varieties, Kerman and Gallaroy, on the southern Darling Downs is a very attractive financial proposition. Spectacular increases in yield and financial returns are possible through the application of zinc sprays in the early stages of crop growth.

Until the seed of varieties such as Selection 51 becomes available commercially from the Navy Bean Marketing Board, varieties such as Gallaroy and Kerman will be the main commercial varieties. On the southern Downs zinc sulphate heptahydrate applications in the early stages of crop growth must become standard crop management.

In the past, zinc applied to the soil both in trials and commercial crops has given inconsistent results. This aspect will be further investigated in the 1975–76 season. Navy bean growers should use foliar applications of zinc until further evidence is obtained.

SILAGE IN QUEENSLAND

by P. B. WYLIE,
Extension Officer, Agriculture Branch

More than 300 000 tonnes of hay are produced each year in Queensland. On an equivalent dry matter basis the amount of silage produced is less than one tenth of this figure.

WHY is silage unpopular with many farmers when claims are made by others that it is a superior and more economical form of conserved fodder than hay?

This article looks at modern silage making techniques and the methods used to overcome many of the drawbacks which the practice has had in the past. It will be seen that provided care is taken to exclude air, silage making is neither a complicated nor risky operation. Besides this, silage can be cheaper and better than hay.

QUALITY COSTS MONEY

Good silage depends on starting with a good product and minimising the losses in quality during storage. A compromise between quality and quantity usually arises when deciding what material to conserve and at what stage to cut it. Two points to consider are:—

- Low yielding crops such as lucerne will provide high quality feed but cost more to produce and conserve per tonne of silage than crops such as fodder sorghum or maize.
- Cutting forage crops early will produce higher quality silage but yields will be lower than those from a later cut and the cost per tonne will be higher.

QUALITY OF SILAGE— HOW LOW?

The crude protein content of fodder provides a useful indication of its quality. Protein content is usually expressed on an air-dry (10% moisture) basis.

If quality costs money, then what is the lower limit for silage to be a useful fodder?

For survival in a drought or dry spell beef cattle need an economical feed with a crude protein content of at least 7%. If the protein level of silage is below this level then supplements such as urea will be needed to utilize it effectively.

Dairy cattle require feed of much higher quality if milk production is to be maintained on silage alone during a dry spell or a period of low feed quality. A crude protein level of at least 12% would be needed for this purpose.

Conserving silage with a protein level of 12% is possible but it is often more difficult and expensive to make than silage of lower quality. Consequently, with dairy animals a careful comparison of other feed sources such as winter pastures or fodder crops, or irrigation and grain supplements, should be made before attempting to conserve a high quality silage for production feeding. On the other hand, a palatable silage of a lower quality can provide a cheap source of roughage for dairy cattle fed a protein rich concentrate.

CROPS FOR SILAGE

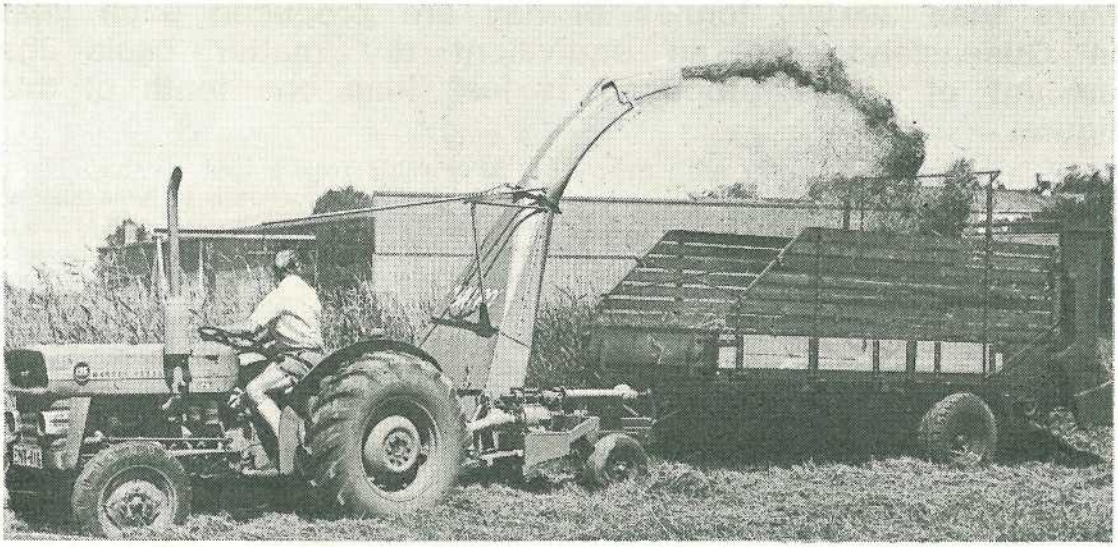
A wide range of crops and pastures can be cut for silage. Differences in levels of protein and water content between crops give some an advantage over others.

Tropical pasture grasses have been successfully used for silage in coastal areas. In inland areas they often have too low a moisture content at the optimum yield stage. If cut earlier, when moisture content is adequate, yields are low.

Forage crops such as sorghum and maize are popular for silage making because the protein and moisture levels usually present no problems at harvest.

Sugardrip sorghum is well suited because of its long flowering period and high sugar content.

Hybrid forage sorghum varieties give good yields but have two features which should be considered. Firstly, because of their faster maturity they need to be harvested a week earlier than ordinary varieties to achieve a similar quality. This removes most of their yield advantage. The other feature is that hybrid varieties can mature too rapidly to allow silage to be made at the optimum quality stage. If the silage making is held up in any way then the quality could drop sharply.



A single chop (flail) harvester. The need for fine chopping of silage material has caused this basic type to be superseded by double chop machines which incorporate a cylindrical chopper.

A precision chop harvester at work in a maize crop. This machine can make chopped hay as well as silage.

CUTTING AND FILLING

Silage making depends upon the fermentation of the plant material producing sufficient desirable acids to preserve the silage. It is important to prevent air entering silage because this always causes heavy losses due to mould growth. An air-tight silo together with fine chopping and good compaction during filling will ensure that air is kept out.

The length of cut needed depends on the material and its moisture content. If good compaction is provided a chopping length of 15 cm is adequate. If the material is drier than 70% moisture, finer chopping is needed.

Crops which have a low sugar content (such as legumes) should be wilted and chopped even finer. The length of cutting should decrease from 5 cm at 65% moisture to 1 cm at 50% moisture.

Compaction of silage is best achieved by rolling with a wheel tractor. Crawler tractors are not suitable as their weight is distributed over too large an area. Rolling is carried out while silage is being placed in the pit or stack and should be continued for half an hour after the day's harvest has been completed. Rolling is made easier by some form of spreading device on the tractor linkage. Two or three prongs built on a carry-all or post hole digger boom have been used successfully for this purpose.

Techniques used in the past to control the temperature of silage are now considered obsolete. One practice was to delay rolling and allow the temperature within the silage stack to build up to achieve faster acid production. However, it is now known that the higher the rise in temperature the greater is the loss of nutrients.

Rapid filling of the stack, effective compaction and sealing as soon as possible, are now the accepted stages in making high quality silage.

MOISTURE CONTENT

If silage is cut from suitable crops and pastures at the early flowering stage the moisture content will normally be satisfactory between 70 and 80%. If the moisture content is higher than 80% water will drain from the silage. This effluent will wash nutrients out with it, decreasing the feeding value. If the effluent cannot drain away, the silage in contact with it may spoil.

At the other end of the range, poorly preserved silage may result from material with less than 70% moisture unless precautions are taken. Poor compaction will result from the springiness of such material and mould will develop as a result of air entering the silage. With such material the length of chop should be reduced and rolling increased.

An approximate guide to moisture content is as follows:—

If a handful of chopped material is squeezed and moisture drips freely, the moisture content is in excess of 80%. If the material is dry and springs apart when released, it has less than 65% moisture.

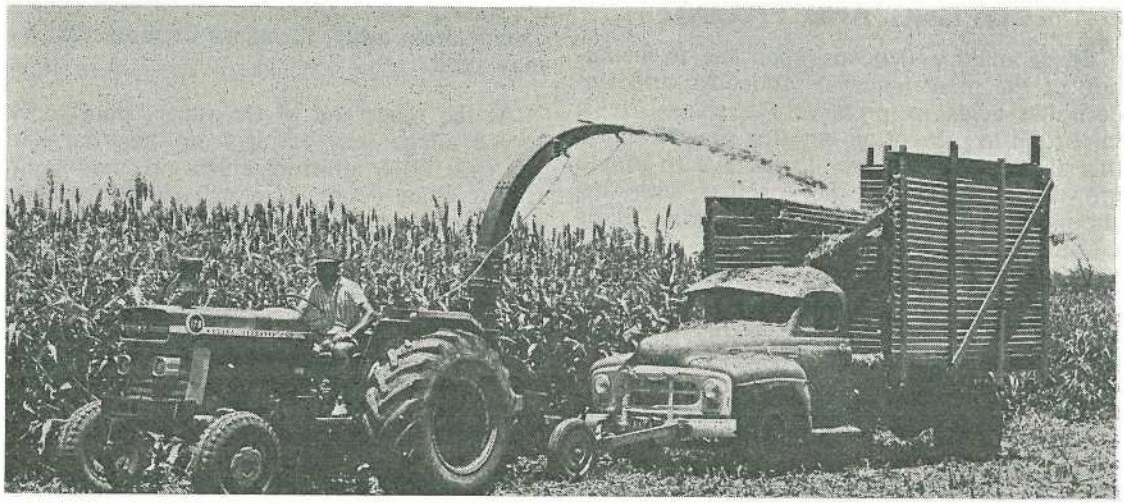
If crops are cut early to provide high quality silage for special purposes the moisture content may be above 80% and wilting is required. Wilting involves cutting the material and leaving it to dry in the field to around 70% moisture. With high protein crops such as lucerne and other legumes the optimum moisture content is lower. Provided they can be finely chopped these crops should be dried to 60% moisture content.

Wilting usually takes 2 to 6 hours in the field. High yielding crops cut with a mower-windrower will require much longer to wilt than short crops mown in swards. Although wilting adds an extra action to silage making, it is possible to complete mowing and gathering in little more than the time needed to cut directly with the forage harvester. This is because wilted forage can be handled much faster by the harvester, particularly if it is windrowed.

TIME OF CUTTING

Time of cutting is the most important factor influencing the quality and moisture content of silage.

Table 1 gives experimental results of the effects of age of cutting on the protein and moisture contents of silage made from a forage sorghum.



Harvesting a crop of Sugardrip sweet sorghum in the Roma district.

A silage pit of some 2 000 tonnes capacity.

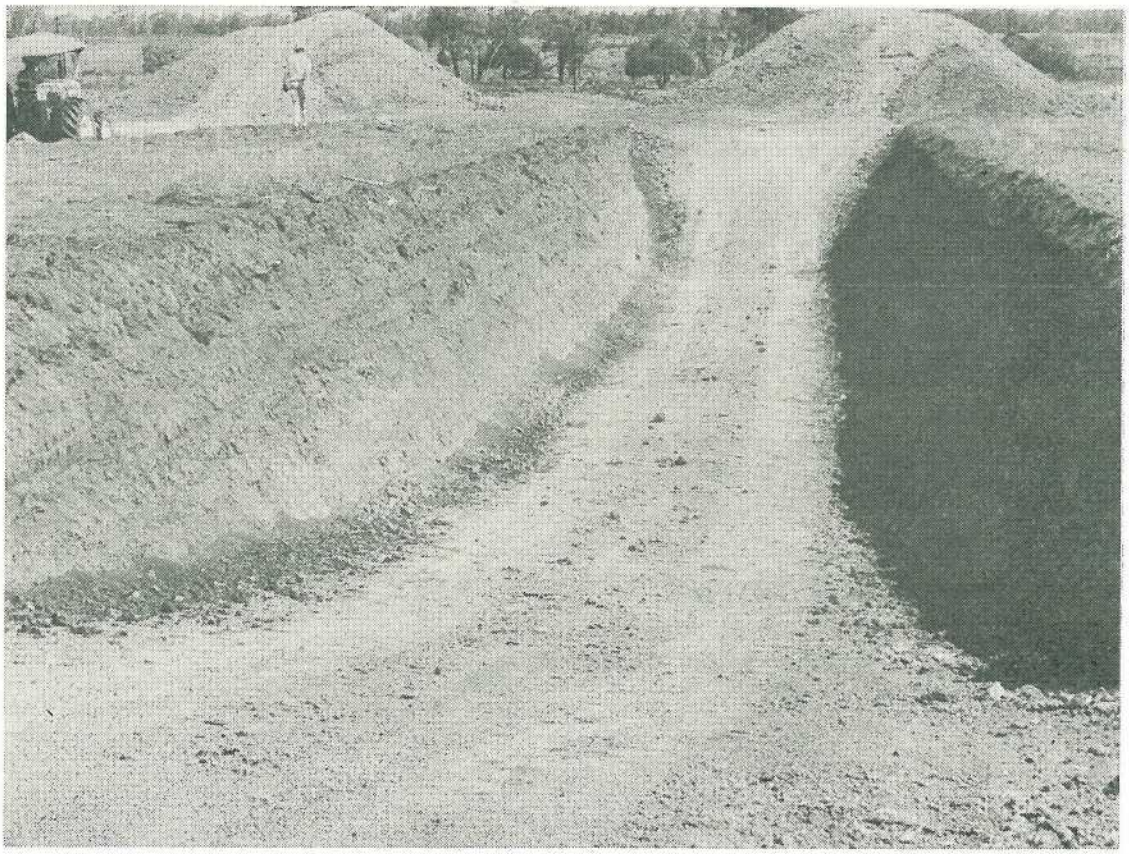


TABLE 1*

MOISTURE AND PROTEIN CONTENTS AND RELATIVE YIELDS OF SILAGE MADE FROM FORAGE SORGHUM CUT AT DIFFERENT AGES

Age of Crop at Cutting (weeks)	Moisture %	Crude Protein %	Percentage of Max Yield
6	83	12·6	39
8	83	9·1	62
10	80	6·7	95
12	78	4·8	100
14	73	5·4	85

* From " The ensilage of sorghum at a range of crop maturities " by V. R. Catchpoole. *Australian Journal of Experimental Agriculture and Animal Husbandry*, Volume 2, May 1962.

With forage sorghums, cutting at the early flowering stage (8–10 weeks) gives the best compromise between yield and quality. If cut at this stage, well made sorghum silage will be around the 8–10% crude protein level. Several weeks before this stage (at head emergence) the protein content will be higher but yields will be lower. The maximum yield of the crop is usually reached at the early dough stage but the protein will have dropped.

If a crude protein content of 7% or better is required, then silage making should be planned to finish before the crop has finished flowering. This needs careful preparation before harvesting and allowance should be made for delays due to breakdowns or bad weather.

ADDITIVES

Additives are usually considered only where high protein—low sugar crops such as lucerne are to be ensiled. Provided these crops are chopped finely (less than 2 cm) and wilted to a moisture content of 60–65%, good silage can be made without additives.

Formic acid has been used on a trial basis in Queensland to preserve lucerne silage where wilting and chopping have not been carried out. A good fermentation was achieved and the resultant silage was very palatable. This additive should be applied at the rate of 2·25 litres per tonne of green material. The approximate cost of the formic acid is 50 cents per litre or $1 to treat a tonne of silage. The most convenient way to apply it is to fit a gravity feed applicator to the forage harvester dripping an 85% solution of acid into the material as it is conveyed into the blower. The applicator costs approximately $60.

Molasses has been used as an additive to make silage from crops with a low sugar content. However, molasses is now fairly expensive and the mess involved in such a process tends to discourage its use.

SILAGE CONTAINERS

Silage containers vary in cost and the amount of wastage which occurs during storage. Cheaply constructed stacks of silage placed on top of the ground may have up to 50% wastage of material during storage and feeding. Storing silage in underground pits or hillside trenches and covering with soil is the cheapest and most effective method of storage. Losses of silage with these containers may be as low as 5%.

Excavation costs are approximately 30 cents per cubic metre or a cost of 50 cents per tonne. As a pit can be used more than once these costs may be quite small over a number of years.

For pits on flat ground, one or both ends should have a gentle slope of one in four to allow a tractor to unload without difficulty. Sealing of the silage is easily provided by covering with 60 to 90 cm of soil. The wastage of silage in contact with the soil is usually restricted to a thickness of 2 to 4 cm and plastic covers are an unwarranted expense.

Table 2 shows the capacity of trench silos of varying sizes.

TABLE 2

CAPACITY OF TRENCH SILOS

Width at Bottom	Width at Top	Depth of Filling	Length (Less Sloping Ends)		
Metres	Metres	Metres	Metres		
			10	20	30
			Approximate Tonnage*		
4	5	2	100	154	210
4	5·5	3	157	244	332
5	6	2	121	188	256
5	6·5	3	190	296	402
6	7	2	143	223	303
6	7·5	3	224	348	472

* These calculations are based on 1·63 tonnes o silage per cubic metre.

Various other more expensive silage containers have been used in special circumstances.

Clamp Silos

Above-ground stacks have been made using walls of concrete or timber to form the sides. These containers cost much more than the pit or trench and sealing problems are greater.

Where problems are encountered in excavating silos, or if self-feeding of silage is envisaged, these silos may have a place.

Tower Silos

There are many old concrete tower silos now unused on Queensland farms due to the large amounts of time and labour needed to fill and empty them. A comparison of these silos with other containers leaves little in their favour.

Vacuum Silage

The use of plastic vacuum tents for silage is also too expensive for normal fodder conservation. The capital cost for the plastic tent would be in the vicinity of $2 per tonne. Unless used carefully the plastic becomes holed during use and it is good for only one or two coverings. Storing vacuum silage for several years is impracticable because of holes which develop in the plastic cover resulting in spoilage. The labour involved in filling a vacuum silage stack would far exceed that required by other methods.

Harvestores

Large glass lined steel tower silos or harvestores have been constructed by some large scale operators. Material stored under air-tight conditions such as this is referred to as haylage.

These storage units are usually fully mechanised with self unloading devices. An analysis of the cost requires a detailed study to determine whether it is likely to be profitable on a property. These containers have immense capital costs and only when used regularly (filled 2 or 3 times a year) will the cost of fodder storage be low enough to compare with other methods. This would preclude their use for long-term storage.

MACHINERY

Three types of forage harvester are used for silage making: Flail harvester, double chop and precision chop machines.

Flail Harvesters

These have been the type most commonly used for silage making until recent years. Their main attraction is the low cost which ranges between $1,400 and $2,000. Unfortunately these machines are poorly suited to silage making as the crop material cannot be chopped finely. The minimum length of cut for most is 25 cm. This not only makes compaction difficult but also makes removal of silage from a stack a difficult operation.

The single chop flail machine can be used both to mow standing crops and to retrieve wilted material from the ground. However, the suction effect of the flails can lead to dust being mixed with the silage.

Double chop harvesters

These cut with flails and then chop the forage with a cylindrical chopper. The length of cut can be adjusted on most makes. This machine is much more satisfactory for silage making than flail harvesters and has been used successfully by many operators. The cost ranges from $2,500 to $3,000. A problem with this type of harvester is that it is usually unsatisfactory for retrieving wilted material from the ground.

Precision chop forage harvesters

This is the most expensive of the three types. It has a sickle bar mower to cut the crop and a cylindrical chopper to chop the material. Because of the method of cutting, the power requirement for a given length of cut is lower than with other machines. Precision chop machines, as their name implies, will chop material very finely if required. Interchangeable fronts can be bought for these machines to change to a finger tine pick up for retrieving wilted material or hay for chopping.

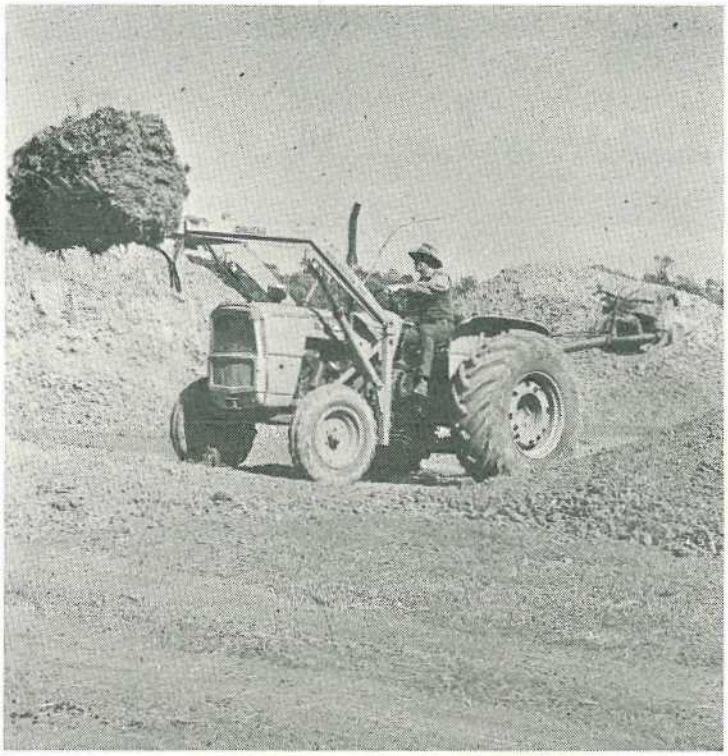
A precision chop harvester costs around $5,000, which at first sight is prohibitive. However, if crops such as lucerne are to be ensiled, when both wilting and fine chopping are required, then such a harvester is almost a necessity. Being able to make chopped hay can also be a considerable advantage and in fact we have here a machine which can make either silage or hay yet costs little more than a baling plant. Enormous labour savings can be made by using silage and chopped hay compared with baled hay, and for many fodder conservation applications this versatility is worth careful consideration.

TRANSPORT

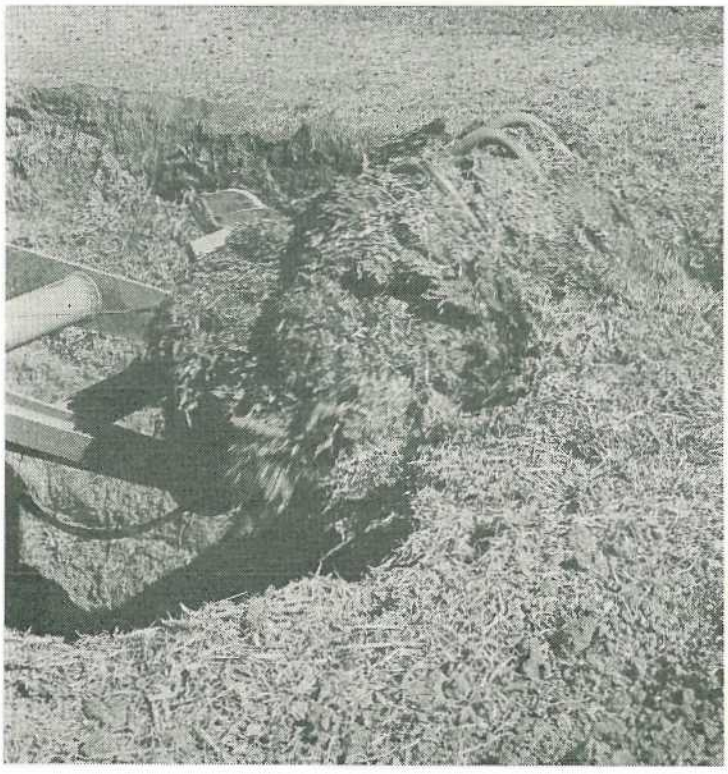
Either forage trailers or trucks can be used to transport material from the crop to the silage pit. Box type trailers which use a chain belt unloading mechanism are generally too slow to unload. If two such trailers are available then silage making can proceed efficiently with one being filled and towed by the forage harvester while one is being emptied.

Filling a pit is made easier if the truck can drive through.

Unloading chopped sorghum material into a pit.



A tractor and silage grab can unload a tonne of silage from a pit in less than 10 minutes. Note counterweight at rear.



Close-up of grab at work.

Trucks with tipping bodies are more commonly used for silage making. If a tipping body is not available it is possible to devise a false floor which can be towed out by the tractor used for rolling.

FEEDING OUT

Mechanical handling of the feed-out process is one of the major attractions of silage. A silage grab can be attached to a front end loader. Such a grab can remove silage from a pit at the rate of 1 tonne in less than 10 minutes.

A counterweight on the rear end of the tractor using a carryall or silage grab can ensure sufficient traction for the machine to reverse out of the silage pit. The cost of a silage grab would be in the vicinity of $500 while a complete front end loader may cost up to $2,000.

SUMMARY OF TECHNIQUES

Successful silage making requires the use of a fine chop harvester. Double chop machines are usually adequate. Where high quality silage making is envisaged or the versatility of making both silage and hay is required then precision-chop harvestors are needed.

Once material of an adequate water content is finely chopped, good compaction is the only other requirement to make good silage.

Cheap handling of silage in bulk and storing in low cost underground containers are the major attractions of silage and are likely to make it the cheapest fodder storage method.

COSTS OF SILAGE

The harvesting, storage and feeding out costs of silage are likely to vary considerably with the type of machines used and the method of storage.

Table 3 shows an example of one system of silage making and some of the costs involved. Three men, one truck and two tractors are used in making the silage for the purpose of this example.

TABLE 3

COST OF STORING 400 TONNES OF SILAGE PER YEAR (as at November 1975)

	$	$
Fixed Costs—		
Interest and depreciation on—		
1. Forage harvester (20% of $2,800)	560	
2. Silage Grab (15% of $2,000) ..	300	
Total		860
Variable Costs—		
(assuming owning one tractor and hiring another)		
Tractor running—30 hours @ $1.50 ..	45	
Hired tractor—4 days @ $15 + 30 hours @ $1.00	90	
Labour—(3 men) total 90 man-hours @ $2.50	225	
Truck costs—30 hours @ $1.00 ..	30	
⅓ cost of pit + interest over 4 years ..	104	
Total		494
Total of fixed + variable costs ..		1,354
Cost per tonne: $3.39		

SILAGE v. HAY

Stored fodder of similar quality can be made either by silage or haymaking techniques. In practice hay is subject to losses in quality by rain damage. Silage is likely to have a more consistent quality than hay.

Hay can be made in a day but the harvesting and drying machinery necessary to make this possible will increase the cost of hay to far in excess of the cost of silage.

Hay has two advantages over silage. Firstly, it can be sold readily. Secondly, it can be used more easily to feed small quantities at regular intervals.

The feasibility of using silage making machinery to make chopped hay adds flexibility to the practice of fodder conservation. The hay can be used for special purpose small-scale feeding while the silage provides the main fodder reserve.

The relative costs of hay and silage making will vary according to the size of operations and the methods used. In general the cost of machinery needed for silage making is usually lower than that for hay. Table 4 shows comparative costs of new harvesting machines.

Silage usually requires fewer man-hours of for hay. Where underground pits are used the costs are considerably cheaper than for haysheds.

Silage usually requires fewer manhours of labour per ton to make than hay. Because silage is mechanically handled when feeding back, considerable savings in labour also occur at this stage.

Comparisons between hay and silage are difficult; however, it can be seen that with modern silage making methods and the cost savings which are possible, silage has much to recommend it.

TABLE 4

COST OF HARVESTING MACHINES FOR HAY AND SILAGE
(as at November 1975)

		$
Haymaking Plant—		
2 m haymaking slasher		2,500
or		
3 m mower conditioner windrower		4 700
Baler, p.t.o. driven		5 200
Loader and elevator		1 500
		9,200
	or	11,400
Silage Plant for Normal Operations—		
1·8 m double chop harvester		2,800
Front end loader grab		2,000
		4,800
Silage Plant for Wilting Operations—		
2 m mower		1,100
3 m rake		1,000
1·8 m precision chop harvester with pick-up attachment		5,400
Front end loader-grab		2,000
		9,500

MORE THAN YOU NEED?

IF you find yourself with unwanted pesticide, either in the original container or in a spray vat, you should try to offer this material to a responsible person who may have need of it.

If this is not practicable, dilute the pesticide to spraying strength. Select a disposal pit at least 18 inches deep and spread a bag of lime over the bottom. Pour the diluted pesticide into the pit and allow it to soak in. Then cover with several inches of soil.

Do not take unwanted pesticide to an incinerator.

BEFORE disposing of any empty pesticide containers, ensure that they are rinsed at least twice with water, and that the rinsing water is preferably added to the spray tank to avoid waste of pesticide and money.

Double rinsing will remove the greatest portion of the container's contents.

By courtesy Agricultural and Veterinary Chemicals Association.

A mobile shearing-shed solved his problem

FOR West Australian sheepman, Tim Blakeway, the job of developing two separate farms 24 km apart brought the problem of finding some way of avoiding the expense of two permanent shearing sheds, each with its costly equipment.

HE found the answer in an unusual design of a steel frame building.

In use it is open down one side, which is intended to front on to an existing building. Its design includes mesh-floored pens to hold up to 160 fully grown sheep, or 200 by using internal races.

When shearing ends on a property the four hinged stands fold up to the roof, the side roof sections are folded down over them and in less than one man/hour the shed is converted into a 14 m by 3·6 m "shearing machine" as the road transport permit describes it. Total weight is less than nine tonnes.

The generator set and demountable external pens form a separate tow to complete a unit which has handled 7,000 sheep without any hitches in its first season of operation.

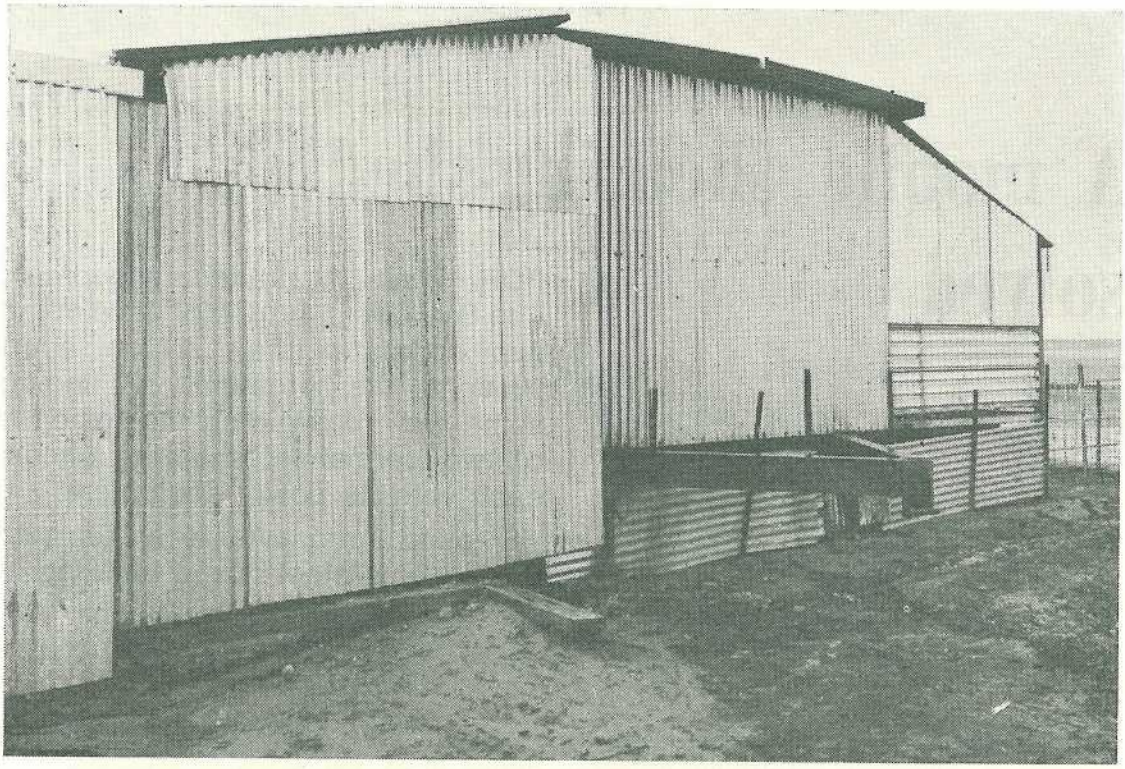
The shed is made on a steel floor frame with the main chassis a 304 mm RSJ bearer mounted directly on to the heavy duty axle with its twin dual wheels.

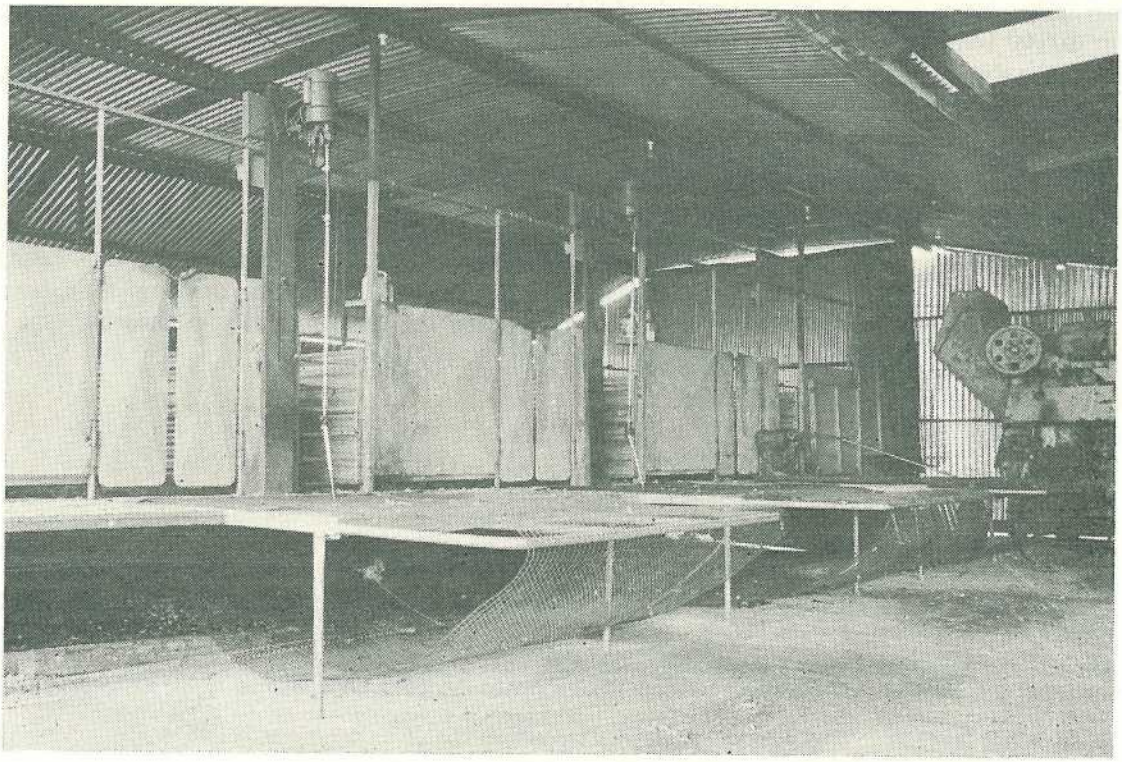
"It isn't intended to develop it commercially," said Mr. Blakeway. "It cost me about $8,000 excluding the generator and actual shearing units but has saved me duplicating two standing sheds, or drafting my sheep between the two properties at shearing time".

Pictures next page:

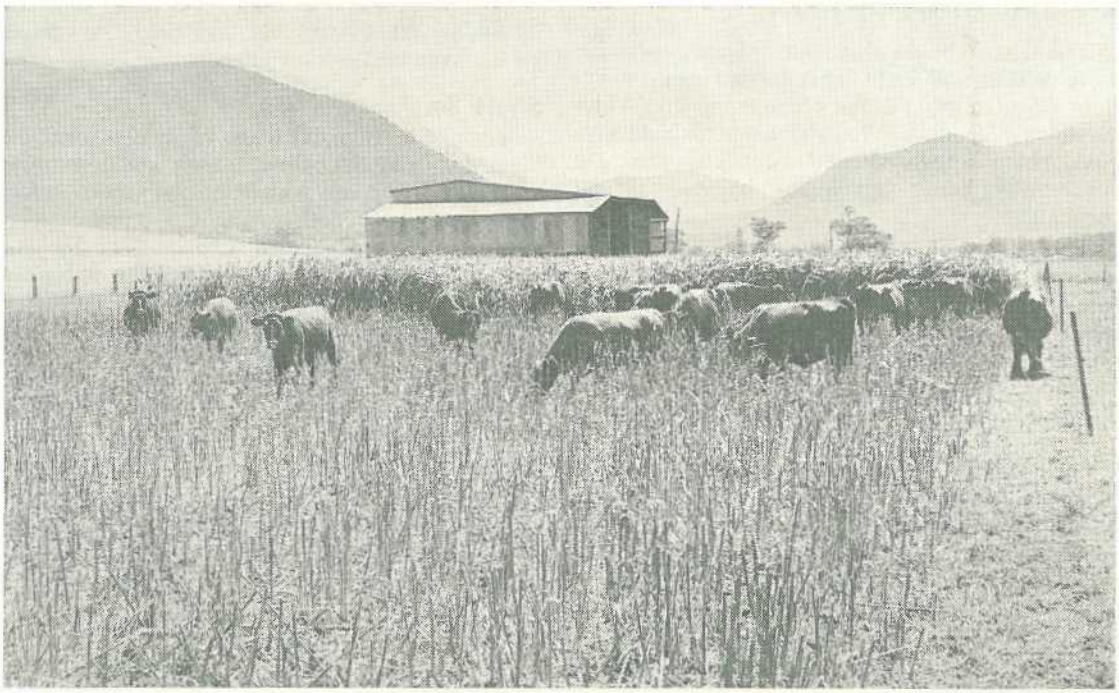
Above: Externally, the shearing shed looks like a conventional permanent building, perhaps prefabricated, but the towbar projecting from the end of the shed indicates its towing potential.

Below: On even more than casual inspection this appears to be an orthodox four stand shearing shed, but the sight of a tyred wheel beneath the centre of the shed gives a clue to its difference.





Forage Sorghums



Wastage can be considerable if the crop is not grazed early. Strip grazing improves utilization.

on the Darling Downs

A feature which gives a comprehensive cover of all the forage sorghums available, and detailed notes on their cultivation.

by G. R. STEVENS, Adviser in Agriculture

BEFORE 1964 only three types of forage sorghum were available in Queensland—the Sudan grasses, the sweet sorghums and *Sorghum almum*. This number has been increased to six by the development of Sudan grass hybrids, sweet sorghum hybrids and grain sorghum x Sudan grass hybrids.

The first hybrid cultivars to become popular were Sudax and Zulu, two similar grain sorghum x Sudan grass types which came into widespread use from 1964–1965 onwards. Others have since appeared and new cultivars are continually being developed by commercial companies.

The release of these hybrid types has resulted in a large increase in the area planted to forage sorghums, although the open pollinated types have retained their popularity in specific areas. Sudan grasses, for example are still very popular on some areas of the Darling Downs.

TYPES

Sudan Grass

Sudan grasses are tufted grasses which stool freely and when in head may reach 2 to 3 m high. The stems and leaves are finer than those of grain or sweet sorghums. In widely-spaced rows the stems may reach 6 mm in diameter, but under normal conditions of heavy plant populations they seldom exceed 3 mm. The root system is completely fibrous with no development of the long, white underground rhizomes which characterize Johnson grass. Sudan grasses are sometimes treated as biennials and have been known to persist into a third season. However, because of frosting and weeds they are normally only an annual crop on the Downs.

Common Sudan Grass

Common Sudan grass was introduced from the U.S.A. in the early 1900s. It is a tall, tufted, heavy tillering summer growing annual or biennial which is very drought resistant and is sensitive to frost. It cures easily and makes excellent hay.

Sweet Sudan

Sweet Sudan was developed in the U.S.A. from a cross between a standard Sudan grass strain and a sweet sorghum, Leoti. This selection is not as tall as common Sudan when grown under similar conditions, but has a similar appearance. The plants stool heavily, and are very leafy, sweet and palatable. Sweet Sudan is still widely grown but it has been largely replaced by the hybrid forage sorghums.

Greenleaf and Piper are two other cultivars of Sudan grass available and they are similar to the common Sudan grass.

Sweet Sorghum

There are two cultivars of sweet sorghum, Sugardrip and Saccaline, which are commonly planted. They are widely grown where standover feed is needed during the early part of winter. Their stems are very juicy and sweet, and even after frosting are readily eaten by stock. Considerable wastage can occur in other varieties of forage sorghums if their stems are too thick or if they are frosted. A standover crop of sweet sorghum can be very useful to combine with lush oats, thus checking scours and allowing greater stock numbers to be carried.

Both Sugardrip and Saccaline are tall, late-maturing cultivars. The foliage of Sugardrip is usually more abundant than that of Saccaline. It is also less prone to leaf diseases. On the Darling Downs, Sugardrip is the more widely grown cultivar.

Grain Sorghum x Sudan Grass Hybrids

This group contains the largest proportion of the forage sorghums grown at present. They are popular because of their high yield potential. The first growth is also more rapid but they must be grazed heavily to obtain high production.

Two cultivars, Zulu and Bantu, have been bred and tested at the Department of Primary Industries Hermitage Research Station near Warwick. Certified seed of both is available.

At present there are more than ten cultivars of the grain sorghum x Sudan grass hybrids commercially available. Forage yields of all are comparable under a wide range of soil and climatic conditions. Selection of the variety to plant in a particular situation could depend in part on a seed price advantage.

Zulu, typical of the group, is a cross between male sterile Redlan grain sorghum and Greenleaf Sudan grass. It is much more like Greenleaf than Redlan in appearance. It stools well and has a coarser stem than Greenleaf. The leaves are usually free of disease. When young, stems are soft, sweet and juicy.

Under good conditions the plants grow quickly and appear to be generally suited to grazing at similar growth stages to those used for Sudan grass.

Sudan Grass Hybrids

At present Trudan 2 is the only hybrid Sudan grass commercially available. It is produced by the crossing of two Sudan grass cultivars and is similar in appearance to common Sudan grass, having fine, leafy stems. It tillers profusely and recovers quickly from grazing or mowing.

As the seed of hybrid Sudan is about half the size of the Sudan grass x grain sorghum types, the stands produced are twice as thick when sown at the same rate. This results in finer stems, a desirable feature in forages grown for grazing or hay making.

Sweet Sorghum Hybrids

These hybrids are the result of a cross between a grain sorghum and a sweet sorghum. Special features are their quick growth, large numbers of stems, excellent regrowth after the first cut, and high yields. They may be used for grazing, silage, a standover crop for winter feed, or combinations of these practices.

Two cultivars are now marketed, F.S. 1a and F.S. 26, the latter being the more popular. The main difference between the two is the percentage of sugar, with F.S. 26 having a much higher sugar content, up to 20%, similar to the sweet sorghums. F.S. 26 is a tall, free tillering plant, reaching a height of around 3 m under favourable conditions. The stems are sweet and juicy and provide excellent standover feed. Being a hybrid, its growth rate is superior to that of the other sweet sorghums.

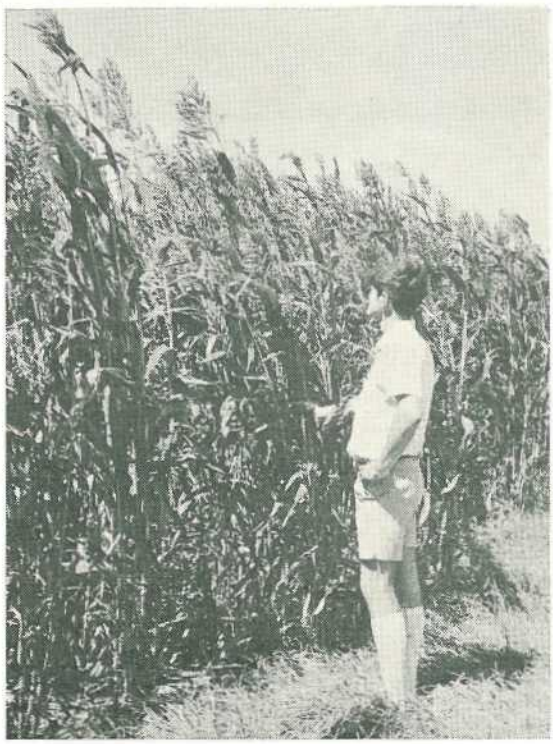
Sorghum Almum (Columbus Grass)

Sorghum almum was introduced into Australia about 25 years ago. This species arose in the Argentine as a natural cross between Johnson grass and an annual sorghum. It is a perennial with underground rootstocks, but these are much shorter than those of Johnson grass and normally turn upward to provide new shoots. On this account it was claimed to be much easier than Johnson grass to eradicate. However, experience has shown that it can be difficult to eradicate, particularly in irrigated grain and fodder cropping situations.

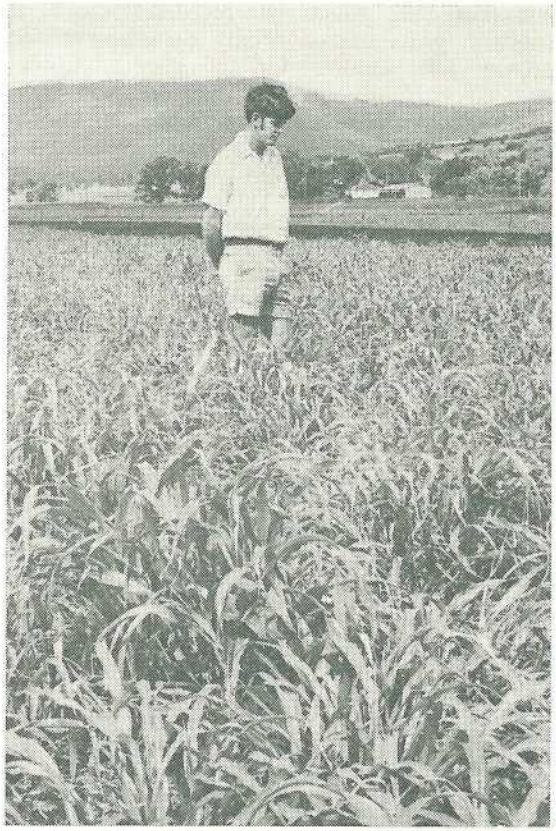
Sorghum almum is tall, with a head similar to that of Johnson grass. Since the seed of these two sorghums cannot be distinguished easily, growers must be cautious when buying seed.

The main cultivar is Crooble, from which subsequent certified and uncertified seed has arisen.

As it is quick and easy to establish, *Sorghum almum* could have a place where pasture establishment is a problem, such as on erodible hillsides. However, in these situations soil fertility could be very low and nitrogen requirements would be high.



A crop of Zulu ready for silage making.



Slashing after grazing results in even regrowth.

CLIMATE AND SOILS

A warm summer growing period of 3 to 5 months, with ample rainfall interspersed with sunny periods, is required. Sorghum plants are drought tolerant, but they are susceptible to frosts and may be killed completely if temperatures are sufficiently low.

Forage sorghums tolerate a wide range of soil types and can be grown on soil varying in texture from light loams to heavy clays, with pH ranging from 5·0 to 8·5. They will also tolerate some salinity. Best results are normally expected from deep loamy soils but useful returns can be obtained from poorer soils if moisture and nitrogen fertility are adequate.

PLANTING

A fine, firm seedbed is important to ensure good contact of seed with moist soil, hasten germination and emergence, and produce a uniform stand. If the final seedbed is too cloddy, it is liable to dry out to planting depth before germination has occurred. A good initial stand is necessary to suppress weed growth.

With early plantings there is the risk of low soil temperatures causing poor germination and emergence. Sowing should not begin until the minimum soil temperature is above 15°C at the planting depth of 2·5 to 5 cm, or until after the expected last frost.

Tests with Piper Sudan in the U.S.A. have shown the following germination response to temperature at a sowing depth of 2·5 to 5 cm:—

A Constant Temperature of	Resulted in Germination of	Number of Days
10°C	27%	24
15°C	57%	14
20°C	95%	6
30°C	96%	4
40°C	54%	7

PLANTING TIMES

Grain sorghum x Sudan grass hybrids	October–November.
Sweet Sudan, Sudan grass, sweet sorghum, hybrid sweet sorghum, hybrid Sudan	September–December.
Sweet sorghum as standover crops	December–January.

Planting within these periods will depend on rainfall and temperature patterns, grazing and conservation requirements and the incidence of pests, diseases and weeds. The earlier plantings produce higher forage yields than later sowings as the latter run quickly to head.

Variable spring rainfall is a problem with early sowings. If sown too shallow, ($< 2 \cdot 5$ mm) the soil surface may dry out before germination is complete and a weak stand can result. If sown too deeply, emergence will be delayed, and those seedlings that do come through are weak plants and grow slowly at first. Dry sowing is not recommended as this may cause poor emergence. If the moisture is marginal a tyre roller could be used to firm the soil around the seed to improve the seed-soil contact and hence establishment.

SOWING RATES

Recommended sowing rates for raingrown stands in 35-cm rows are as follows:

Grain sorghum x Sudan grass hybrids	5–8 kg per ha.
Sudan grass and hybrid Sudan ..	8–11 kg per ha.
Sweet sorghums—forage harvested ..	3–5 kg per ha.
Sweet sorghums—grazed	8–11 kg per ha.
Hybrid sweet sorghums	4–11 kg per ha.

The lower rates are suggested for the drier areas. With irrigation, double the higher rates should be used.

The low sowing rate for forage-harvested sweet sorghums results in tall, stout stalks. These will resist wind damage and the action of the harvester much better than the thinner stalks produced at the higher planting rates recommended for grazing or mowing.

Broadcast sowings require higher seeding rates (about 30%).

Wherever possible, certified seed should be sown. By using this seed the farmer protects himself against introducing Johnson grass to clean land, always a possibility with common Sudan grass and *Sorghum almum*.

FERTILIZERS

Nitrogen

Forage sorghums need abundant nitrogen if they are to yield well, and this type of fertilizer should always be considered. Generally, a good response to nitrogen can be expected if the crop is grown after a short fallow or if it follows grain sorghum. The responses to applied nitrogen include an improvement in colour and tillering, earlier maturity and a significant increase in both yield and protein content.

The rate of application of nitrogen will depend on many factors, including soil type, moisture content, previous crop and long or short fallow. Economic factors to consider are the cost of the fertilizer and the price of the product. On the clay loams rates of up to 50 kg of nitrogen per hectare (110 kg urea) may be required, 30 kg should be adequate on the lighter soils. If soil moisture is adequate an application of nitrogen following each grazing may be beneficial.

A crop of Sugardrip ready for silage making.

For irrigated crops the recommendation is 40 to 50 kg of nitrogen per hectare at planting, and a similar amount following each grazing.

Phosphorus

Applying a phosphorus fertilizer will depend upon either soil analyses or local knowledge that the area is deficient in this element. If superphosphate is required the rate of application will normally range from 50 to 150 kg per hectare depending on soil type.

When and How to Apply Fertilizers

If only a nitrogen fertilizer is needed, this can be applied at sowing provided the seed is to be sown in alternate rows of the combine. Close contact between the seed and urea can sharply reduce germination.

If superphosphate is needed it should be applied with the seed, as the plant requires phophorus very early in its life. Under these circumstances the nitrogen fertilizer should be applied before sowing.

WEED CONTROL

Mechanical

If rain has compacted the seedbed a light harrowing after sowing can be used to break the crust and this will kill any weed seedlings present. Weeds that are not eaten by stock should be slashed following a grazing to prevent them from seeding.

Chemical

If weeds are a problem the use of the 2,4–D type herbicides may be considered. The sorghums are less tolerant to 2,4–D than the winter cereals, so special care must be taken to avoid crop damage when using these weed-killers.

Spraying is recommended when the crop is from 7 to 15 cm high and the secondary roots have developed. The most common chemical used is 2,4–D amine and the rate of application for most broad leaved weeds is 1 100 ml of 50% product per hectare. Symptoms of damage caused by 2.4–D are lodging, brittle stalks, variability of height, head sterilization and yield reduction.

IRRIGATION

Irrigation should begin before the crop shows symptoms of severe moisture stress, such as wilting, rolling and twisting of the leaves.

Sufficient water should be applied at each irrigation to replenish the moisture in the root zone. Light irrigations are inefficient in both water use and time. Normally, the first 60 to 75 cm of soil will contain at least 80 per cent of the root system. Total water requirements (rainfall plus irrigation) vary from 625 to 750 mm for the life of the crop.

USES OF FORAGE SORGHUMS

Forage sorghums are usually treated as summer annuals and are grown at a time when perennial grass pastures are most productive. Methods of use are crop grazing, zero grazing, and conservation as hay or silage.

Crop Grazing

Crop grazing was the earliest method of using sorghum in Queensland and is still the most widely practised. Both early forage sorghum types and Sudan grass were used widely to overcome the seasonal decline in the nutritional value of dairy pastures. Over the years use of the crop in the dairy industry has changed little.

One disadvantage of fattening cattle on forage sorghums is that they are marketed in competition with large numbers of grass-fattened cattle. The chief value of these crops is when they can use conserved soil moisture to produce high quality feed before native pastures make annual growth (2 weeks after spring rains until the end of February). They are also valuable when staggered plantings allow productive grazing after the normal summer growing period of native pastures.

Zero Grazing

Zero grazing is a practice where the crop is cut and fed to stock. This system has gained some favour following the development of the high yielding forage crops and specialized farm machinery.

Two types of zero grazing are practised on the Darling Downs. In the dairy industry zero grazing is termed "green lot feeding". In general, production per hectare has increased although the increase in production per cow has not been as great as was expected.

A less common use of zero grazing is in the intensive finishing of beef cattle.

The value of zero grazing depends on crop management. As well, it must be remembered that although this method produces a greater yield of total digestible nutrients (T.D.N.) per hectare, the nutritive value of the diet is lower than with grazing, as animal selectivity is reduced. A solution to low T.D.N. and high fibre content is the addition to the daily ration of 55 grams of urea and 1 to 3 kg of grain per head. High productivity can be obtained only from young crops of less than 10 weeks old. Zero grazing of sorghum alone is seldom used; a summer legume, urea and/or grain is usually added to the diet.

Sorghum Hay

Only small quantities of forage sorghum are conserved as hay. The main difficulty lies in reducing the moisture content in the stems before the leaf becomes over-dried and is lost. Use of a hay conditioner can reduce the drying time from 15 to 2 days.

The correct moisture content of the hay can be determined by examining the nodes. When they have lost their plumpness and are shrivelled, the hay is dry. An average yield is 3·75 tonnes per hectare.

The forage harvester has been widely used in making sorghum hay. This machine is capable of mowing, bruising the stem and mixing coarse and fine material together for baling, and enables baling to be undertaken two days after cutting. The machine must be adjusted so that the crop is not chopped too finely or the bales will tend to break up during handling.

Sorghum Silage

Silage production is not a widely accepted practice on the Downs. However, some impetus has been provided by the introduction of the high yielding forage sorghums. The availability of efficient machinery and more advanced techniques has also stimulated interest. Sweet Sudan and Sugardrip have been the common silage sorghums, but the other fodder varieties are now receiving an equal share of attention, particularly the hybrid sweet sorghums.

The labour required for successful silage handling, particularly feeding out, and the offensive smell, have been deterrents to its acceptance. Sorghum silage is not a complete feed in itself. The necessary addition of small quantities of protein and energy supplements is always a difficult practical problem for the grazier, particularly in the sheep industry.

Sorghum silage can be useful in the supplementary feeding of cattle in a drought situation.

GRAZING MANAGEMENT

The hybrid forage sorghums available have similar production potential. Because they are higher yielding than the Sudan grass types the area needed is generally much less. Also, because of the rapid growth of the hybrids, they must be grazed early and at high stocking rates. If not, many crops may be very tall and stemmy well before autumn, resulting in wastage of feed.

Crops should not be allowed to grow much taller than 50 to 60 cm before heavy grazing commences. However, they should be at least 50 cm high, because young growth may contain prussic acid in toxic amounts. Protein content is highest—up to 18%—when the crop is from 60 to 90 cm tall.

If strip grazing is used this should begin as soon as possible after the crop has reached 50 cm in height. This enables the crop to be used before plants in later grazed strips become too mature.

When grown under irrigation and used at the recommended times, three or four grazings should be possible. Haymaking may be combined effectively with grazing. A raingrown crop grown under average moisture conditions should yield two to three grazings.

Stock carrying capacities have not been firmly established, but to err on the heavy side is a good fault.

For maximum regrowth a stubble of at least 15 cm should remain. If long, stalky material is not grazed, it should be slashed to promote regrowth from the crowns.

TOXICITY

Two forms of toxicity have been recorded: prussic acid and nitrate poisoning. Prussic acid poisoning (HCN or hydrocyanic acid) is more common than nitrate poisoning but neither is widespread on the Downs.

Prussic acid poisoning is more often recorded in sweet sorghums than grain sorghums, but it may occur in any variety under suitable conditions.

The risk of prussic acid poisoning of stock varies with seasonal conditions and within and between varieties, strains and hybrids.

Forage sorghum contains most prussic acid at the seedling stage. For the first 3 or 4 weeks of the plant's life it is concentrated in the stalks, from which it then disappears but remains in the leaves. Stock losses have been known to occur at all stages of growth, but plants 10 to 15 cm high are usually the most dangerous.

Precautions to be followed are:—

- Allow original growth or any regrowth to grow at least 50 cm high before the crop is grazed.
- Do not turn hungry animals onto short and succulent crops.
- Be extremely cautious in grazing sorghums that are recovering from either drought or frost.

The real danger in grazing droughted plants is not that the dry plants are more poisonous, but that the new growth developing from the crowns will be grazed by the animals in preference to the dry material.

Treatment of affected animals

Cattle—60 grams of photographic hypo dissolved in 550 ml of water. Administer orally.

Repeat at half-hourly intervals if necessary.

Sheep—$\frac{1}{5}$ of above dose rate.

NITRATE POISONING

This type of poisoning is only of minor importance on the Downs.

Nitrate poisoning may occur more often if large amounts of nitrogen fertilizer are used as this can cause concentration of nitrates within the plants. Forage sorghums which are unusually dark green in colour may contain very high nitrate levels. Grazing animals should therefore be watched.

Treatment of affected animals

Cattle—2 grams of methylene blue dissolved in water and injected into the jugular vein.

Sheep—0·25 grams of methylene blue injected as for cattle.

Insects and Diseases

Insect pests and diseases are rarely of economic importance in forage sorghums.

CONCLUSION

Forage sorghum usage on the Darling Downs is expected to change very little in future. Their most important role has been to provide a bulk of feed, particularly for the dairy farm. This role is likely to continue as the provision of adequate bulk is a continual problem on these farms.

Green Panic is widely accepted

by N. E. DELANEY,
Agriculture Branch

The fact that almost half the total quantity of grass seed produced in Queensland during recent years was green panic, indicates its wide acceptance as a pasture grass.

For years this summer growing perennial has been Queensland's main sown pasture species in the 600–1 800 mm rainfall zone. Until recently it had a wider distribution than any other introduced grass. Buffel grass (*Cenchrus ciliaris*) may now hold this distinction.

Plant description

Green panic (*Panicum maximum* var. *trichoglume*) is a fine stemmed guinea grass. Although the guinea grasses are native to Africa, they have become naturalized throughout the tropical and most of the subtropical world.

Only one cultivar of green panic, Petrie, is available. It is a tall, tufted grass which will grow up to 2 metres high but the leaves do not usually exceed 1 metre in height. The seed head is a typical panicle carried well above the leaves on a slender stem. In mature stands the plants develop crowns up to 30 cm in diameter.

History

It is not certain when green panic first reached Australia or where the original seed came from. The grass was recognized in the Gayndah district in 1936 where it had been grown by Mr. A. A. Petrie of "Madoora" since 1932. Mr. Petrie was so impressed with green panic that he encouraged its spread over some 300 hectares of softwood scrub country.

The seed was obtained by other local farmers and soon there was a considerable area of green panic in that district. Green panic is now flourishing in a wide variety of situations from the Atherton Tableland in north Queensland to the Maranoa in the south-west.

For many years the Central Burnett was the main seed producing area. While considerable quantities of seed are still produced there, the Dawson–Callide is now the main seed producing district. Some seed is harvested in most areas where green panic is grown.

Shade tolerance enables green panic to grow under trees which offer some protection from frost. This sheltered green panic pasture is showing copious new growth in September.

Special features

Green panic is tolerant of shade and will grow right up to the trunks of trees and shrubs. It will also compete with lantana and tall growing weeds.

It is more tolerant of drought than Rhodes grass (*Chloris gayana*) but not as tolerant as buffel grass. Top growth is more susceptible to frost than that of Rhodes grass. However, green panic has a remarkable capacity to respond to mild weather in winter and to drought-breaking rain.

It is less tolerant of flooding than most sown grasses and is killed by a few days of saturated soil. Consequently it is not suitable for intensive irrigation.

Soils

While green panic prefers a light textured, fertile, well-drained slightly acid to neutral soil (pH 6·5 to 7·0), it will tolerate acid or alkaline soils (pH 5·0 to 8·0), and clay loams with reasonable surface drainage. It thrives in softwood scrub soils and will grow well on a wide range of brigalow soils and on the dark self mulching clay loams of the open forest or downs country.

The grass is not well suited to deep sands or to strongly cracking clays such as those on the Darling Downs.

Establishment

For satisfactory establishment green panic needs either a well prepared seedbed or a scrub burn. The smooth, free-flowing seed is easily sown through most types of planters and from the air.

An ideal seedbed is fine and firm with adequate subsoil moisture. The seed should be planted about 1 cm deep, which can be achieved by dropping it on the soil surface and covering with lightweight harrows turned

A 10-year-old pasture of green panic and Siratro on alluvial scrub soil near Miriam Vale.

upside down. A fair proportion of seed can then be expected to germinate after the next favourable rain. If light falls of rain occur there may be a series of germinations and it could be some months before the pasture appears to be establishing satisfactorily.

Aerial spreading of green panic seed into the ash of scrub burns has proved a very successful, low cost method of establishment.

As with other summer growing grasses the best planting times are September and January–February. An important requirement for satisfactory germination is to have the soil around the seed moist for several days. For establishment in cooler areas it is essential that the seedlings are well grown before the onset of frosts. In these areas, September is a good planting time because the soil surface takes longer to dry after rain and there is also a full growing season for the pasture to establish before the winter.

In the warmer areas September temperatures are higher and rainfall less reliable; consequently the January–February period is preferred. During these months there is a good chance in most areas of prolonged rainy periods which are ideal for pasture seed germination and establishment. Another advantage of this later planting is that it allows for better control of summer weeds before planting. This planting time is recommended in weedy situations.

Because failures can occur with pasture plantings at any time due to adverse weather conditions, it may be prudent to plant some green panic in September and some in January–February. This strategy is more important in the drier areas or where heavier soils make establishment less reliable.

The success of establishment of green panic is greatly influenced by seed quality. The legal minimum germination and purity percentages for green panic are 20 and 70 respectively. While satisfactory results can be obtained with seed that just satisfies these standards, higher quality seed is a better buy and can give faster establishment.

The common seeding rate is 2–4 kg per hectare but lower rates have been successful with high quality seed (40–50% germination). Farmers who have produced their own seed have at times used heavier rates to hasten establishment but these rates cannot be recommended where seed has to be purchased.

Fertilizer requirements

Over a range of soils and districts numerous trials and demonstrations have shown substantial responses by green panic to applications of nitrogen, sulphur and phosphorus. All three elements need to be present in adequate quantities for best results.

Past experience and soil testing can give a useful indication of phosphorus needs. A pale leaf colour in green panic is widely recognized as nitrogen deficiency but sulphur deficiency also causes pale growth. The use of legumes in association with green panic can minimize the need for nitrogen fertilizer and this is discussed further under pasture mixtures. The application of sulphur to green panic and any associated legumes is perhaps less widely appreciated but nevertheless important.

While there are no satisfactory soil tests available to check soil sulphur levels, it is important to be aware of possible sulphur deficiences and use test applications of fertilizer where appropriate. Regular application of superphosphate will supply sulphur as well as phosphorus.

In new pastures on scrub soils there may be little need for fertilizer but older pastures and sowings made on old cultivations or naturally

A new pasture of green panic sown with lucerne and Siratro in the South Burnett. The lucerne provides an early legume component and is eventually replaced by Siratro.

poor soils are almost certain to need some fertilizer. Fertilizers should also be applied to established pastures to correct nutrient deficiencies which develop.

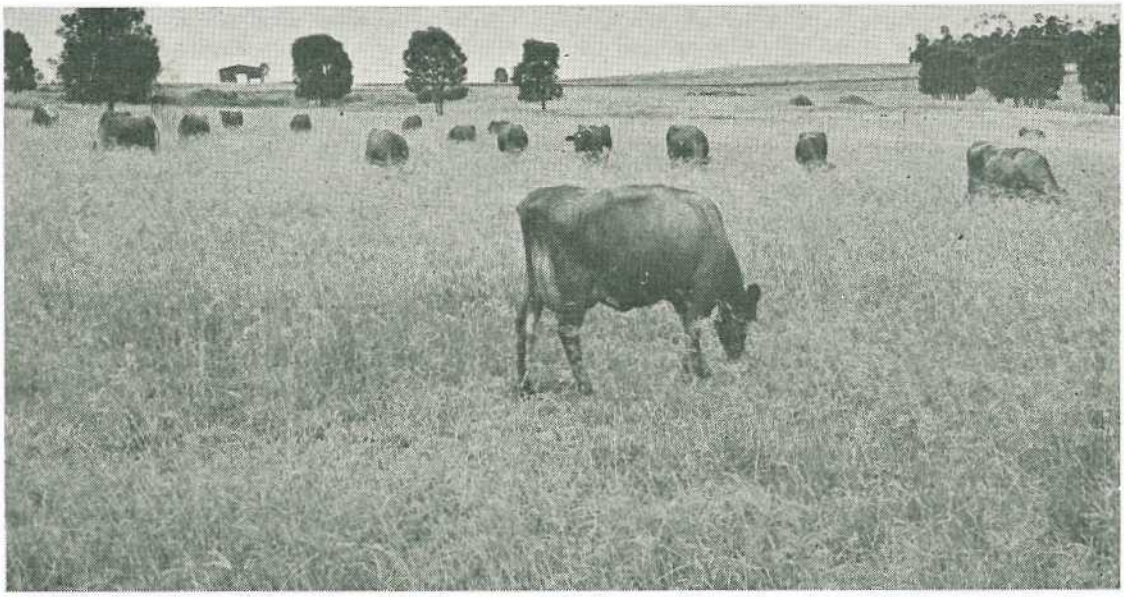
Pasture mixtures

COMPANION GRASSES.—While green panic persists well with other equally palatable grasses such as Nandi setaria (*Setaria anceps*) it is not a match for the less palatable and more aggressive Rhodes grass. Because of this, Rhodes grass should not be planted with green panic in intensive situations. However, Rhodes grass seed is frequently a contaminant of green panic seed and consequently is present in many green panic pastures. The degree to which Rhodes grass increases or decreases in the pasture depends largely on seasonal conditions; in dry years it tends to decrease and in wet years it tends to increase.

For aerial sowings in the ash of cleared and burnt brigalow-softwood scrubs in the Fitzroy Basin, a mixture of 0·5 kg of Rhodes and 1·5 kg of green panic per hectare is used. The Rhodes grass gives quick initial ground cover and excludes weeds. Being poorly persistent in this region, it is eventually replaced by the green panic. *Sorghum almum* at 0·25 kg/ha is sometimes included as well.

COMPANION LEGUMES.—The advantages of additional nitrogen and improved fodder quality from well nodulated legumes are obvious and worth striving for. In the cooler areas of the State it is common to plant lucerne (*Medicago sativa*) with green panic and in some areas annual medics (*Medicago* spp.) can also usefully be included in the mixture.

Harvesting green panic seed on the northern Darling Downs.



Cattle grazing a long established green panic-lucerne pasture on softwood scrub soil on the northern Darling Downs.

The main difficulty in managing a green panic-lucerne pasture is the tendency for the grass to become thicker and for the lucerne to die out. Management should aim to encourage the lucerne. A useful approach is to adjust planting rates to obtain lucerne dominance in the young pasture.

The tropical legumes combine well with green panic and provide excellent pastures in many areas. The legumes used include glycines (*Glycine wightii*), Greenleaf and Silverleaf desmodiums (*Desmodium intortum* and *D. uncinatum*), stylos (*Stylosanthes* spp.) Siratro (*Macroptilium atropurpureum*) and lotononis (*Lotononis bainesii*). Siratro has been outstanding in the recent run of good seasons in the central and upper Burnett districts. In some areas it is now common to plant both lucerne and Siratro with green panic. The lucerne provides the main early legume component and as it declines it is replaced by Siratro.

To ensure satisfactory nodulation and nitrogen fixation by the legumes, it is necessary to pay careful attention to correct inoculation of all legume seed planted.

Performance and productivity

Given reasonable climatic conditions and management, a carrying capacity of better than one beast to 2 hectares can be anticipated for a green panic-legume pasture. Similar performance could be expected from a nitrogen fertilized pure green panic stand. Under more favourable conditions a carrying capacity of one beast per hectare could be achieved for considerable periods. At Gatton and on the Darling Downs, green panic dry matter production of up to 10 tonnes per hectare has been recorded within a growing season.

When grazing beef cattle at a reasonable stocking rate on pure green panic, an annual weight gain of about 140 kg per head can be expected. When a legume is included in the pasture, protein values of the feed are improved and annual bodyweight gains in excess of 180 kg are attainable.

Pasture management

Grazing should be restricted to short periods until the pasture is well established and has set seed. In subsequent years green panic needs at least one chance to set seed every two years.

This is usually not difficult to achieve because of its long season of flowering.

In cooler areas a reasonable ground cover should be maintained during winter to minimise frost damage. However, heavy grazing or mowing in late summer can help to maintain lucerne in a mixture and improve the quality of winter feed. Although rotational grazing may give the best utilization of the feed, recent research suggests that in many situations there is little gain over set stocking. However, if lucerne is present in the mixture, rotational grazing is essential for its persistence.

As quality fodder is usually scarce in spring, it is best to apply maintenance fertilizer about September so that extra growth is obtained at this time. Be sure to allow the grass to make reasonable growth before grazing heavily.

If by late summer it appears that there may be a shortage of feed in the following winter, extra fertilizer can be applied before the end of the wet season.

Green panic will withstand burning and this practice can have a place in extensive situations for assisting to control regrowth of brigalow and lantana. However, in more intensive situations, particularly where legumes are present, burning should be avoided. Urea-molasses licks can improve the acceptability to stock of surplus dry feed in winter.

Hay and silage

Either pure green panic or green panic-legume pastures can be made into good hay or silage if cut when the green panic is flowering. The experience of farmers in many parts of Queensland substantiates the value of green panic for hay and silage production.

Cutting at times when there is surplus growth is a simple way of making better use of a green panic pasture. The alternative of higher stocking rates would lead to overgrazing in poor seasons and a consequent deterioration of the pasture.

Seed production

Most seed is now harvested with auto headers but some landholders still collect seed for their own use by fitting a simple seed harvesting box in front of a suitable vehicle. When driven through a seeding stand of green panic, these simple devices can collect some 30 to 60 kg per hectare of the ripest seed. Such seed can be expected to have a higher germination than that harvested by an auto header, as the latter includes a considerable percentage of immature seed.

For commercial seed production, however, the auto header is faster and can harvest considerably higher yields. Yields of 40 to 100 kg per hectare are common with this method but under favourable conditions more than 200 kg have been recorded. Seed harvesting is a risky operation and lower yields than expected are often caused by rain or wind at harvest time.

To obtain maximum seed yield of acceptable standard when using an auto header, it is necessary to wait until the ripest seed has started to drop. Earlier harvesting results in a high proportion of immature seed while later harvesting results in excessive seed drop and consequent loss of yield.

After harvesting, the seed will still have a high moisture content and it must be carefully dried to ensure a saleable product. In the past this was done by spreading the seed out on a shed floor and regularly stirring it to prevent overheating. Forced air drying is now becoming more common. Green panic seed germination usually improves considerably during the year after harvest.

The future

Green panic will remain a major pasture species in Queensland for many years because of its desirable attributes and readily available, moderately priced seed. In higher rainfall areas the more leafy Gatton panic is replacing green panic as the favoured cultivar. At the drier margin of its adapted zone the various buffel grass cutivars are being more widely planted. In other areas, however, green panic plantings are continuing on a large scale. This situation seems unlikely to change in the near future.

Even if plantings of green panic decrease in the future, the area of green panic pastures could remain substantial for much longer, as the species will persist indefinitely over wide areas of the State. From experience of the natural spread of green panic, we can expect that it will continue to spread around the edge of scrubs and along the banks of watercourses.

Brucellosis-Tested Swine Herds (As at 21 February, 1975)

BERKSHIRE

Clarke, E. J. & Son, "Kaloon Stud", Boonah
Cochrane, S., "Stanroy", Felton
Crawley, R. H., Rockthorpe, Linthorpe
H. M. State Farm, Numinbah
H. M. State Farm, Palen Creek
Handley, Est. J. L., "Meadow Vale", Lockyer
Handley, G. R., "Locklyn" Stud, Lockyer
Kimber, E. R., Tarella, M.S. 805, Mundubbera
Ludwig, A. L., "Beau View" Stud, Cryna, via Beaudesert
Neuendorf, W., M.S. 794, Kalbar
Queensland Agricultural College, Lawes
Research Station, Hermitage
Rosenblatt, G., Rosevilla Biloela
Westbrook Training Centre, Westbrook

LARGE WHITE

Ballon, E. E. & E. Maclagan
Barrier Reef Islands Pty. Ltd., Hayman Island
Batterham, P. & N., Raby Park, Inglewood
Beutel, G. R. and Son, Brookdale Stud, M.S. 786, Boonah
Bool, A. R. and B. E., Rossvale, Crow's Nest
Briskey, R. G. and M. J., Wallingford, Pittsworth
Brosnan, D. J., "Bettafield", Mt. Murchison, via Biloela
Cauley, J. R., M.S. 918, Toowoomba
Cauley, T. P., M.S. Jondaryan 444, Rosalie
Clegg, J. A. & M. A., "Karoma" Stud, Mundubbera
Coleman, C. J., Merriland Stud, Britannia Station, Charters Towers
Corney, F. D. and E. C. W., Pagel, Tara
Cotter, N. J., "Olaroy", Goomeri
Craig, K. F., "Echoes", Bancroft, via Monto
Crawford, B. P. & B. J., M.S. 757, Kingaroy
Department of Aboriginal and Island Affairs, Cherbourg
Diete, E., Ingoldsby, 4343
Duckett, R. and L. M., Fairview, Capella
Duncan, C. P., "Colley", Flagstone Creek, Helidon
Duncan, J. A. & B. L., Ma Ma Creek
Dunlop Meats Pty. Ltd., Coondulla, Robertson Pk., Murray Upper
Eagle, D. R. & J. A., "Walugra", 134 Hogg St., Toowoomba
Fisher, J. & L., Lyndhurst, Jimbour
Flegler, T. C., Wongabeena, Dalby
Fletcher, L., "Par-en-eri" Stud, M.S. 806, Mundubbera
Forster, I. S. & D. E., 112 Drayton Rd., Toowoomba
Fowler, K. J. & B. D., "Kenstan", M.S. 195, Pittsworth
Fowler, K. P., Northlea Stud Farm, 156 Hogg St., Wilsonton, T'ba
Franke, K. H. and B., "Delvue" Stud, Cawdor
Freeman, W. A., "Trevlac", Rosewood
French, A., "Wilston Park", Pittsworth
Gosdon, T. C. & E. A., "Naumai", Dalby
Graham, T., Dunleigh, Highfields
Grayson, D. G., Wodalla, Killarney
Harwood, L. B., Cobar, Tara
H. M. State Farm, Numinbah
Head, G. A., M.S. 825, Ipswich
Hinchcliffe, D. F. & R. K., "Oakview", Milman, 4702
Hockings, J. & M., "Quambi", Kumbarilla
Hudson, R. F. & V. D., "Rondel", Hogg St., Wilsonton, Toowoomba
Jones, K. B. & I. R., "Cefn" Stud, Clifton
Kajewski, C. & D. I., "Glenroy", Glencoe, via Toowoomba
Kanowski, A., "Exton", Pechey
Kimber, E. R., "Tarella", M.S. 805, Mundubbera
Kruger, V. F. & B. L., "Greyhurst", Goombungee
Kuhl, V. and C. A., "The Mounts", M.S. 222, Oakey
Le Gros, W., "Elourea Stud", Marburg
Little, R. S., P. M. & G. W., "Glengarry", Jimbour
Maranoa Stud Piggery, Mitchell
Marsden, M., "Fernflat" Canaga
Mathieson, K. N., "Iderway", Gayndah
Philip, R. J. and M. M., Boolarong Stud, Elimbah
Postle, R. S., G. C. & Son, "Yarallaside" Stud, Pittsworth
Queensland Agricultural College, Lawes
Quilter, P. E., Paga Paga Piggeries, Postman's Ridge
Radel, V. V., "Braedella" Stud, Coalstoun Lakes
Robin, A. B., Blaxland Rd., Dalby
Rosenblatt, G., Rosevilla, Biloela

LARGE WHITE—continued

Research Station, Biloela
Ruge, A. F. & V. M., "Alvir" Stud, Biggenden
Ruge, G. H. & I. E., "Al-Lester" Stud, Woowoonga, Biggenden
Sharp, D. W. & L. J., "Arolla", Lavelle, Q., 4357
Smyth, R., Barambah Rd., Goomeri
Ward, R. J., "The Plateau", Mulgildie
Whiteman, J. H. & A. B., Long's Bridge, via Warwick
Willdo Farming Co., Southbrook
Willet, L. J., "Wongalea", Irvingdale
Williamson, K., Cattermul Ave., Kalkie
Withcott Stud Piggery, Rowbotham St., Toowoomba
Wolfenden, C. B. & J., Rossmoya

TAMWORTH

Kanowski, S. E., Pinelands, via Crows Nest

WESSEX SADDLEBACK

Douglas, Mrs. W. S. & Son, "Greylight" Stud Goombungee
Smith, C. R. & Son, "Belton Park", Goombungee

LANDRACE

Ballon, E. E. & E., Maclagan
Barrier Reef Islands Pty. Ltd., Hayman Island
Batterham, P. & N., Raby Park, Inglewood
Bertolotti, F. E. J. & N. I., "Mascotte", Wallumbilla
Bool, R. A. and B. E., Rossvale, Crow's Nest
Brosnan, D. J., "Bettafield", Mt. Murchison, via Biloela
Cauley, J. R., M.S. 918, Toowoomba
Cauley, T. P., M.S. Jondaryan 444, Rosalie
Clegg, J. A. & M. A., "Karoma" Stud, Mundubbera
Coleman, C. J., Merriland Stud, Britannia Station, Charters Towers
Crawford, B. P. & B. J., M.S. 757, Kingaroy
Crowle, N. & D., Cooranga North, 4408
Diete, E., Ingoldsby, 4343
Duckett, R. and L. M., Fairview, Capella
Dunlop Meats Pty. Ltd., Coondulla, Robertson Pk., Murray Upper
Fisher, J. & L., Lyndhurst, Jimbour
Flegler, T. C., Wongabeena, Dalby
Fletcher, L., "Par-en-eri" Stud, M.S. 806, Mundubbera
Forster, I. S. & D. E., 112 Drayton Rd., Toowoomba
Fowler, K. J. & B. D., "Kenstan", M.S. 195, Pittsworth
Fowler, K. P., "Northlea", 156 Hogg St., Wilsonton, Toowoomba
Fowler, N. E. P. & M. P., c/- Kewpie Enterprises, Kingaroy
Gosdon, T. C. & E. A., "Naumai", Dalby
Graham, T., Dunleigh, Highfields, 4352
Grayson, D. G., "Wodalla", Killarney
Harwood, L. B., Cobar, Tara
Hinchcliffe, D. F. & R. K., "Oakview", Milman, via Rockhampton
Hockings, J. & M., "Quambi", Kumbarilla
Hudson, R. F. & V. D., "Rondel", Hogg St., Wilstonton, Toowoomba
Jones, K. B. & I. R., "Cefn" Stud, Clifton
Kajewski, C. & D. I., "Glenroy", Glencoe, via Toowoomba
Little, R. S., P. M. & G. W., "Glengarry", Jimbour
Maranoa Stud Piggery, Mitchell
Marsden, M. "Fernflat", Canaga
Marsh Pastoral Co., Brymaroo
Nielsen, L. R., "Sunny Hill", Ascot, via Greenmount
Peters, L. A., "Moonlight", Bongeen
Philip, R. J. and M. M., Boolarong Stud, Elimbah
Quilter, P. E., Paga Paga Piggeries, Postman's Ridge
Radel, R. M., Turua Stud, Biggenden
Robin, A. B., Blaxland Rd., Dalby
Rosenblatt, G., Rosevilla, Biloela
Ruge, A. F. & V. M., "Alvir", Biggenden
Sharp, D. W. & L. J., "Arolla", Lavelle, Q., 4357
Trout, L. B. and L. J., "Caminda", Crawford, Kingaroy
Whiteman, J. H. & A. B., Long's Bridge, via Warwick
Willdo Farming Co., Southbrook
Willet, L. J., "Wongalea", Irvingdale
Williamson, K., Cattermul Ave., Kalkie

Kikuyu Grass

by T. J. QUINLAN, K. A. SHAW, Agriculture Branch and W. H. R. EDGLEY, Dairy Cattle Husbandry Branch

KIKUYU grass (*Pennisetum clandestinum*) derived its name from the Kikuyu people of Kenya within whose tribal boundaries it thrives. It is a native of the upland areas of eastern and central Africa at altitudes between 1 950 and 2 700 m. Although close to the equator, the elevation gives these areas a sub-tropical climate. Kikuyu was first described and named in 1903.

THE earliest recorded attempt to grow the grass in Australia was in 1908 by Mr. Edward Hawker of East Bungaree, South Australia, who received from the Government Broker in Kenya, Mr. V. M. Newland, cuttings collected in the Molo district.

These cuttings failed to survive but a further introduction of cuttings from both the Molo and Kabete districts by the same two gentlemen, either just before or after the 1914-18 war, resulted in successful establishment of the Molo material.

In 1919 seed from the Belgian Congo was received at the Botanic Gardens in Sydney. Only one seed germinated and the material from this was multiplied vegetatively at Hawkesbury Agricultural College in 1920. From there, cuttings were distributed throughout New South Wales, Queensland, Victoria, South Australia, Western Australia, New Zealand and Fiji.

Three further introductions of seed and cuttings were made to The Waite Institute in South Australia in 1940. The most important recent introduction was in 1960 from Kenya to the Grafton Research Station in New South Wales, from which the cultivar Whittet was finally released.

DESCRIPTION

Kikuyu is a vigorous, creeping perennial grass which spreads by means of underground rhizomes and above ground stolons. Both stolons and rhizomes root strongly at the nodes. The rhizomes can send up shoots from 70 cm below the ground surface.

Root measurements in Kenya have shown that 95% of roots are in the top 70 cm of soil with only sparse roots below 1·7 m but extending as deep as 5·5 m.

Stems are succulent and leaves are bright green and smooth except for slightly rough margins. The grass can reach a height of 1 m when ungrazed, but is more usually 30–70 mm, lodging and regrowing, forming a dense mat of stolons and stems below the leaf canopy.

Inflorescences are small and inconspicuous, being borne in the leaf axil on short, erect, lateral culms. Flowers are best seen with the early morning dew still present on grass kept short by mowing or grazing. The inflorescences are reduced terminal spikes consisting of 2–4 spikelets. Each spikelet is made up of a fertile upper floret and a sterile lower floret. The upper floret can be hermaphroditic (consisting of both male and female parts), or male sterile (only female parts developed).

Inflorescences are almost completely enclosed by the leaf sheath and the only visible parts are the stigma and where present, the anthers. The feathery stigma emerges from the flower first and has normally withered by the time the anthers appear. The yellow anthers are carried on fine filaments up to 45 mm long. There are three anthers per spikelet.

Seeds are carried well down in the leaf axils and can only be found by pulling the leaves apart. They are dark brown, flat-ovoid, approximately 2·5 mm long by 1·5 mm wide, and pointed at the lower end. The remnant of the style (which bore the stigma) is found on the upper end of the seed.

CULTIVARS

In Kenya three distinct ecotypes, Molo, Rongai and Kabete have been identified. In Australia, the widespread common kikuyu is probably a mixture of strains.

Whittet kikuyu was selected from seed introduced from Kenya in 1960 and grown at the Grafton Agricultural Research Station. It is a uniformly fertile line. At Grafton it was more productive and had a higher protein content than common kikuyu. Leaves are coarser and stolons thicker than common kikuyu and it may be more persistent on poorer soils. It also tends to form a more open sward and may be more compatible with legumes, although it is likely to be less efficient than common kikuyu as a soil stabilizer.

Experience in Queensland with Whittet is limited but so far it does not appear greatly different in production from common kikuyu. It does, however, appear less susceptible to tip yellowing, and this, plus the availability to seed, is its main advantage. Whittet was registered by the New South Wales Herbage Plant Liaison Committee (H.P.L.C.) in March 1970.

Breakwell was selected from common kikuyu. It derives from seed harvested from a well defined patch of hermaphrodite kikuyu growing in the lawn at the Grafton Agricultural Research Station. Approximately 80% of plants grown from Breakwell seed are hermaphrodite and all are female-fertile. In all other respects it appears similar to common kikuyu. It was registered as a commercial cultivar by the New South Wales H.P.L.C. in November 1971.

CLIMATIC AND SOIL REQUIREMENTS

In Africa, kikuyu is found in areas of high altitude with annual rainfall between 1 000 and 1 500 mm, on deep lateritic loams derived from porous lava. The region is subject to typical tropical upland conditions of cool nights, warm days and frequent mists.

In Australia kikuyu has adapted to a wide range of conditions and is found in all States. It survives on a wide range of soil types from sea level to over 1 100 mm altitude, with rainfall as low as 500 mm and in areas as cold as Glen Innes in New South Wales. However, it is most suited to areas with rainfall above 1 000 mm., relatively mild winters and deep, free-draining soils.

SOIL FERTILITY

Kikuyu requires moderate to high levels of soil fertility for productive growth. In Kenya it dominates the grassland vegetation following clearing but is gradually replaced by inferior species as soil fertility declines. A parallel situation has occurred in Queensland where kikuyu grew very vigorously following clearing of the rain forest; as soil nutrient levels fell, kikuyu became unproductive and was gradually replaced by paspalum (*Paspalum dilatatum*). As degradation continued this in turn was invaded by inferior species such as narrow-leaf carpet grass (*Axonopus affinis*). Provided some kikuyu still persists, this process can be reversed by the use of appropriate chemical or organic fertilizers. A striking example of kikuyu response to increased fertility can be seen around bails, yards and other areas of stock concentration.

FROST TOLERANCE

Kikuyu will withstand moderate frosting without burning off and is only slightly less tolerant than Narok setaria. It is markedly more frost tolerant than the commonly grown tropical grasses. Heavy frosts will completely kill top growth but the plant will regrow quickly with favourable soil moisture and temperature conditions.

DISTRIBUTION

Kikuyu is an important pasture species of the Atherton Tableland of northern Queensland, the Eungella Tableland of central Queensland, the Maleny, Beechmont and Tamborine plateaux of southern Queensland, the

A kikuyu flower (centre). The three anthers (pollen sacs) are carried on tall filaments while the stigma (the female part) is seen as a feathery structure at the base of the filaments.

coastal strip of south-east Queensland as far north as the Wide Bay area, and on the eastern edge of the Darling Downs around Ravensbourne and Crows Nest. There is increasing interest in irrigated kikuyu in the West Moreton district. The grass is also employed in soil erosion control on the Darling Downs where rainfall is greater than 625 mm per annum.

GROWTH RHYTHM

The seasonal growth of kikuyu varies in different parts of the State. It is determined by a combination of temperature and rainfall effects.

Eastern Darling Downs

Figure 1 illustrates the growth rhythm measured at Crows Nest by Messrs. C. N. Jacobsen and D. A. Ivory of the Queensland Department of Primary Industries. Low temperatures severely restrict growth in winter and spring and the main growth period is in summer and autumn.

South East Queensland

No actual figures are available for this area, but climatic conditions are somewhat similar to those of the North Coast of N.S.W. Data supplied by Dr. R. L. Colman of the N.S.W. Department of Agriculture have been used in Figure 2 as an example of expected growth rhythm in this area. Growth is markedly reduced in winter, but the recovery in spring is much more rapid than on the Darling Downs.

The much lower production obtained from pastures receiving no nitrogen is also shown. The sharp drop in growth during March was due to unusually dry conditions and growth would normally be as good as in February. The trial site was frost free and growth rates would be virtually nil on frosty sites during July and August.

Seedlings of fertile strains are commonly found in dung pats and this is the usual method of seed dissemination in grazing areas.

North Queensland

The mild winters allow the grass to continue growing vigorously with little drop in production except over the dry season in spring. Figure 3 illustrates the growth rhythm as measured at Kairi Research Station near Atherton. At Millaa Millaa, south of Atherton, where winters are slightly warmer and wetter, the growth curve is even flatter, and on occasions higher growth rates have been measured in autumn-winter than in summer. On the cooler Evelyn plateau, kikuyu's growth rhythm is more akin to that of south-east Queensland.

SEED PRODUCTION

With the development of practical methods of seed production, commercial seed of Whittet kikuyu first became available in August 1972. Its production is an exacting and specialized business.

Grazing or mowing kikuyu stimulates lateral shoots which bear the flowers. The seed of kikuyu, unlike that of many grasses, is strongly held in the leaf axils. These two features are being exploited in the commercial production of seed with the use of specialized machinery.

The ground used for seed production must be even and free from obstacles. Once established the grass is mown to a height of about 25 mm. and the cuttings are removed. This stimulates flowering and consequently seed production. The mower is then raised slightly so that at the next mowing leaf growth is removed but the first crop of flowers is untouched. This promotes a second flush of flowers. Mowing continues over the growing season, with the height of cut being raised at each subsequent cut. Cuttings are removed at each mowing.

Successive seed sets are allowed to accumulate and are collected at the end of the season. Seed yields of 25 kg per hectare from new stands and up to 500 kg per hectare from established swards have been obtained. The seed has a germination of 75 to 90%.

At present all seed is produced in N.S.W., mainly in the Quirindi and Coffs Harbour districts.

ESTABLISHMENT

Kikuyu can be established successfully using turves, sprigs (runners) or seed.

Turves

Turves are used where a quick cover is necessary, such as on key sections of waterways, lawns and sports fields. A turf size of 30–40 cm square and 5–8 cm thick is the most convenient to handle. If high velocity water flows are expected before proper establishment the individual turves should be pegged to the ground with wooden or wire pegs.

Sprigs

Planting by sprigs has been the most common method of establishing kikuyu. Time of planting should coincide with the growing period of the grass, which is from spring to autumn in southern areas but on the Atherton Tableland sprigs may be planted over a longer period. Where frosts and cold weather are common, plantings should not be made after April.

A well prepared, firm, moist seed bed will give the best results. Each sprig should be a piece of thick stem with three or more nodes. When planting waterways, sprigs placed every half metre on the square will give a rapid cover.

In paddocks, plant spacings of 1–3 metres have achieved a complete cover in 12 months, although the wider spacings should only be used to aid the establishment of a companion legume.

The planting density and area involved will determine the amount of planting material needed. Collection methods vary from hand picking to flail forage harvesting. Slashers, mowers, rotary hoes and disc harrows are also successful.

Where sprigs are plentiful they may be spread on the soil surface, disced or rotary hoed in, and rolled. If scarce, they can be placed in furrows, covered and rolled.

A number of machines can be modified to open, close and compact a furrow while an operator drops the sprigs.

Seed

Seedbed preparation and planting time are similar to those for sprigs except that seed should not be planted later than March in frosty areas. Adequate soil moisture is essential and irrigation may be needed with spring planting. Late summer and autumn plantings

This degenerating kikuyu pasture in the Wide Bay area is being replaced by mat grass and bracken (background). Cattle camps and gullies which remain higher in fertility still support vigorous kikuyu. Improving the fertility in run down areas will restore healthy kikuyu.

will encounter reduced weed competition which is generally strong in early and mid summer. A fungus disease (*Pyricularia grisea*) has caused high mortality of kikuyu seedlings on the Atherton Tableland during the wet season. This is a further reason to delay planting.

A seeding rate of 1 kg per hectare sown either by seed drill or broadcast, buried 1–2 cm and then rolled will produce a successful stand.

Where mixed pastures are planted the timing should favour the legume. If planting temperate legume based pastures the most suitable planting time is March–April. November to February is the best planting time for tropical legume based pastures.

If the legumes are being introduced into existing kikuyu pastures then the area should be thoroughly cultivated beforehand to minimise competition between the legume seedlings and the grass. In all situations any practice designed to induce a quick cover is advantageous, and the area should be only lightly stocked until all bare ground is covered. Regular slashing to control weed competition and encourage runner formation is recommended.

Atrazine at 2 kg per hectare has been successfully used in the Gympie area as a pre-emergent herbicide. Most of the problem weeds are controlled. Nut grass is an exception but can be checked with 2,4–D following germination of kikuyu. Atrazine should not be used where legumes are being planted with kikuyu.

BASIC FERTILIZER

Without reasonable levels of soil fertility kikuyu will not persist productively. The fertilizer required will vary from one area to another depending on soil fertility. In general, district fertilizer recommendations for phosphorus, potassium and trace elements for establishment and maintenance of other grass-legume pastures, will be applicable to kikuyu pastures.

NITROGEN

For high production, kikuyu requires adequate nitrogen. Nitrogen produced by an associated legume is cheaper than that applied as fertilizer. Kikuyu does, however, respond well to applied nitrogen and its use can be justified in the following situations:

- Where no suitable companion legume is available.
- In early property development. Large amounts of feed can be produced off small areas while other parts of the farm are being developed.
- For provision of winter feed. In north Queensland feed supply can be extended into the cooler months by taking advantage of kikuyu's potential for cool season growth.
- Provision of dry season feed. Kikuyu is suitable as carry over feed because of its ability to maintain nutritive levels. It is also very suitable for irrigation during the dry season.

How Much Nitrogen?

Kikuyu responds well to nitrogen (N) rates of up to 45 kg of N per hectare per month or 90 kg every 2 months. The initial application should be 90 kg per hectare and in very deficient situations the follow-up rates could be increased.

45 kg N = 2·5 bags of ammonium nitrate or 2 bags of urea.

90 kg N = 5 bags of ammonium nitrate or 4 bags of urea.

When to Apply

Nitrogen is expensive and should only be used when feed is needed, or to build up carry over feed for an expected shortage in the months ahead. The main periods of feed shortage are winter and spring, and nitrogen fertilizer recommendations are aimed at providing extra feed in these periods. Grass-legume pasture will normally provide sufficient high quality summer feed.

This 6-year-old pasture on Mr. Owen Daley's farm on the Atherton Tableland is still an excellent kikuyu-Greenleaf desmodium mixture. It is managed as described and high milk yields are achieved.

Figure 1

SEASONAL GROWTH DISTRIBUTION AS MEASURED AT CROWS NEST 1970–74

(C.N. Jacobsen & D.A. Ivory)

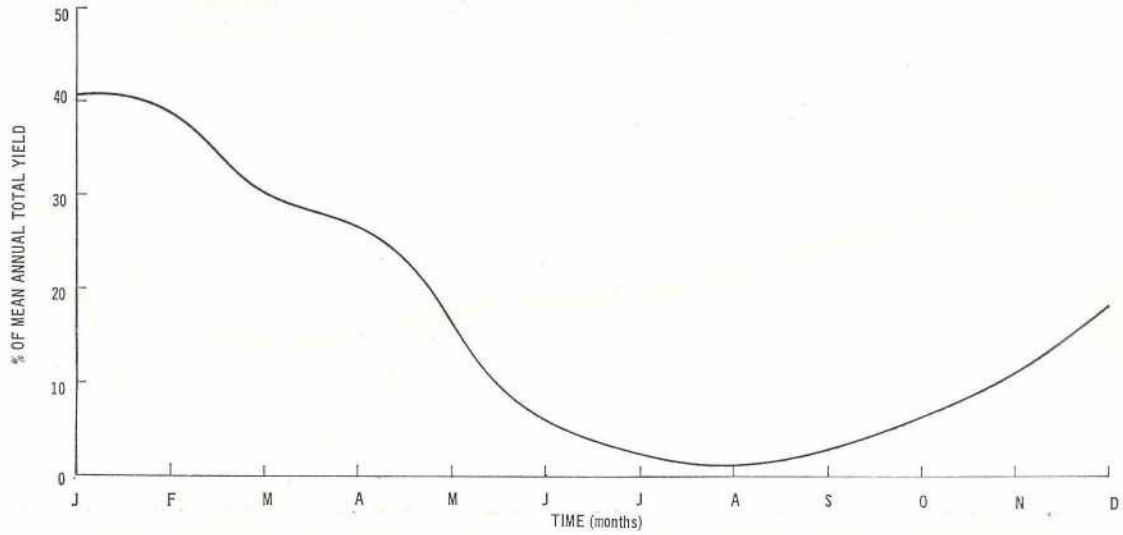


Figure 2

GROWTH RHYTHM OF KIKUYU WITH AND WITHOUT NITROGEN AT WOLLONGBAR N.S.W. 1964–65

(R.L. COLMAN)

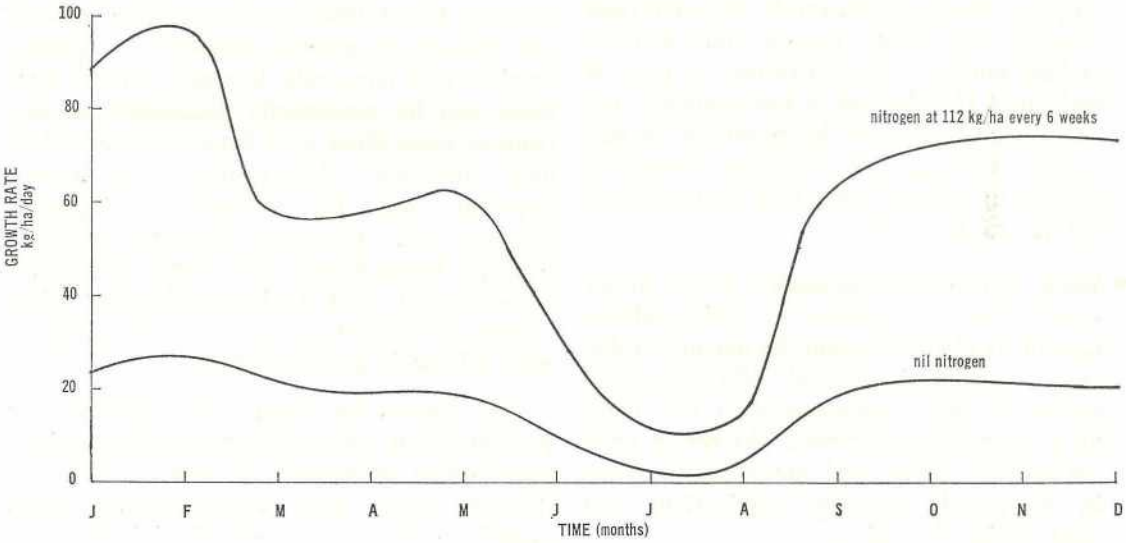
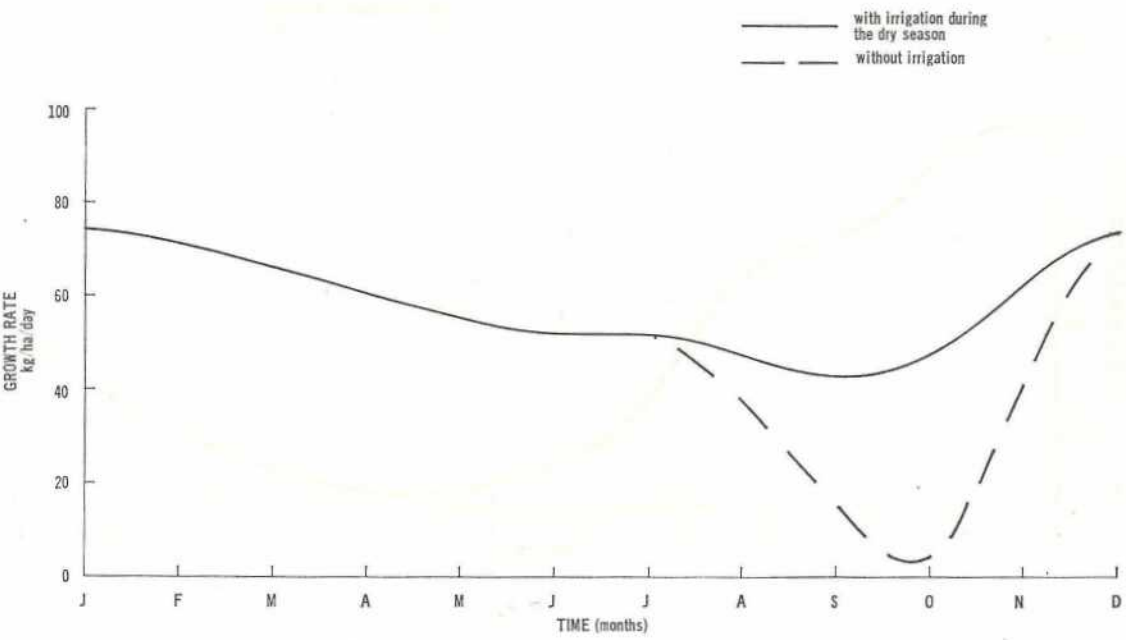


Figure 3

GROWTH RHYTHM OF KIKUYU ON THE ATHERTON TABLELAND. (KAIRI RESEARCH STATION)



- *North Queensland*—Applications should begin in March–April and continue to July–August. Strong growth can be expected right through the winter months and will be limited only by heavy frosting or lack of moisture. If irrigation is not available any carry over feed must be produced in this period. Consequently, fertilizer should be applied to a larger area than that required for day to day needs.

- *South Queensland*—Kikuyu's poor winter growth can be overcome by taking advantage of its ability to retain its nutritive value over a considerable period. Nitrogen applications in late summer–autumn will build up a valuable feed reserve. As spring rains are usually earlier and more reliable than in the north, nitrogen applications can start again after winter.

COMPATIBILITY WITH LEGUMES

Although many farmers and research workers have found difficulty in combining legumes with kikuyu, the grass is compatible with many tropical and temperate legumes. Mixed pastures can be particularly successful in subtropical areas where such legumes as Greenleaf and Silverleaf desmodiums (*Desmodium intortum* and *D. uncinatum*), Tinaroo, Cooper and Clarence glycines (*Glycine wightii*), Safari Kenya white clover (*Trifolium semipilosum*), and Ladino and other white clovers (*Trifolium repens*), have all combined with kikuyu in stable mixtures.

The reasons for legume disappearance are poor nutrition, unsound management practices, unsuitability of legume, or insect attack and disease, rather than over-aggressive grass growth. If the systems described in the next

section (Management and Utilization) are followed, a stable permanent pasture can be expected. As a general rule, if a legume grows well in an area it can be successfully combined with kikuyu.

MANAGEMENT AND UTILIZATION

The growing habits of the grass allow it to withstand severe overgrazing without damage; even heavy stock traffic under wet conditions causes less damage to kikuyu than to most other grasses.

Nitrogen fertilized pure grass sward

Maximum production per unit area can be obtained from frequent hard grazing but the definition of this varies from area to area and with time of year. Trial work has shown that with the same regrowth periods there is virtually no difference in yield of herbage when cut at either 5 cm or 13 cm. By defoliating to a height of 13 cm at each grazing a valuable dry matter reserve is left. In general a grazing cycle of 3–4 weeks is recommended in the main growing period and this is increased to up to 6 weeks as growth slows down in the cooler months.

Kikuyu/temperate legume pasture

Since white clover is very susceptible to shading, the legume content of the sward can be manipulated by altering grazing frequency and severity. The pastures should be grazed heavily in autumn to remove the grass canopy and allow regeneration of white clover. This is an important factor in maintaining white clover in kikuyu pastures.

Grazing to a height of 3–5 cm every 3–4 weeks will increase and maintain the proportion of legume in the sward. Less frequent or less severe grazing will cause grass to build up which in turn will dominate the legume. In the absence of serious insect or fungal attack on the legume, grass dominance is the main reason for the loss of white clover in kikuyu/clover pastures.

On the Atherton Tableland the mixture of kikuyu and white clover is unstable and erratic even under good grazing management and in most cases reverts to pure grass after 18 months. Clover rust (*Uromyces trifolii–repentis*), pepper spot (*Sphaerulina trifolii*) and climatic unsuitablility are the causes of white clover's disappearance from these pastures.

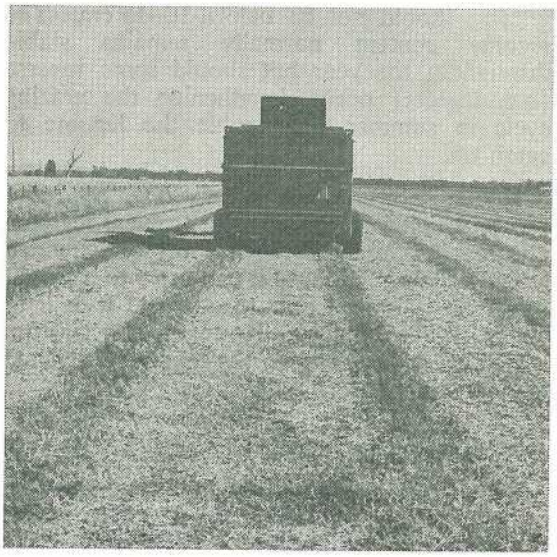
Kikuyu/tropical legume pasture

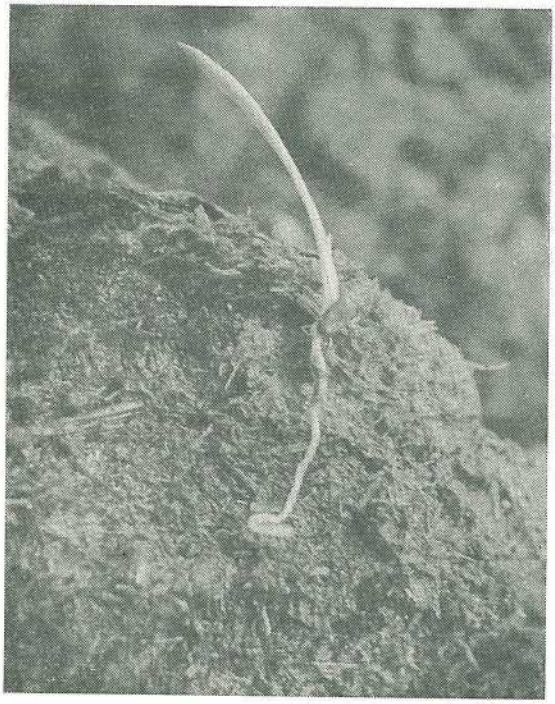
Tropical legumes are intolerant of too frequent grazing.

In southern areas, where the legume is short seasoned, careful grazing management is needed to maintain it. Grazing every 6–8 weeks to a height of 10–15 cm will do this but tends to under-utilize the grass. Rotational or strip grazing is normaly necessary since continuous grazing usually results in the legume being lost unless stocking rates are kept low.

On the Atherton Tableland tropical legume/kikuyu pastures are much easier to manage because of the longer growing season of both species. The legume slows down during its seeding phase but then makes good growth

Seed harvesting at "Glengowrie", Quirindi, N.S.W. The crop has been mown, allowed to dry in the sun and threshed once by a self-propelled header harvester. Not all the seed is collected in this operation and the picture shows the threshed material being collected for a second threshing by a stationary header.





The seed case is still retained on this seedling and can be seen at the junction of the root and the stem.

where soil moisture is available and in the absence of frosts. The grazing cycle may be reduced to 3–4 weeks but sward height after grazing should not be below 10–15 cm. The legume content normally remains stable throughout the year but should some reverse (e.g. insects) occur, lengthening the grazing cycle in summer will enable the legume to catch up.

Kenya white clover (*Trifolium semipilosum*), which is regarded as a tropical legume, appears indifferent to both short or extended grazing cycles. Because it can grow to a height of 35 cm it is well able to compete with 8 to 10 week-old kikuyu. However, the pasture is best used by following the temperate legume recommendations.

Grazing systems

Rotational grazing is strongly recommended in all situations. An interval of 3 weeks between grazings is recommended for the period of fastest growth and this is lengthened as growth rate declines.

Strip grazing will give even more efficient utilization and higher production but it is not always convenient. Recommended stocking densities for strip grazed pastures are 50 beasts per hectare per day for kikuyu-legume paddocks or those fertilized with around 150 kg N per hectare per year, and up to 100 beasts per hectare per day on pure grass pastures receiving 300 or more kg N per hectare. On a 3-week rotation, the stocking rates in the examples above are 2·5 and 5 beasts per hectare respectively.

Sod seeding temperate species for winter production

The poor winter growth of kikuyu in south-east Queensland means that pure stands are unproductive over this period. Under irrigation sod-seeding of temperature species such as oats, ryegrass (*Lolium* spp.) and/or white clover has been successful.

In preparation for sod-seeding, the kikuyu should be heavily grazed and/or slashed, and rotary-hoed to a depth of 10 cm.

A seeding rate of 10 kg of ryegrass and 3 to 4 kg of Louisiana white clover per hectare is recommended. Some of the Louisiana can be replaced with red clover (*Trifolium pratense*). The best result is obtained by planting in March so that the seedlings are sufficiently well established before the onset of winter.

Where clover is combined with kikuyu, the growth of the legume through the cooler months becomes more important than that of the grass. However, should temperate grasses such as ryegrass be included in the mixture they will provide the greater cool season growth. The clover offers its greatest contribution through spring to early summer.

Because of unreliable rainfall there are few districts where this practice has succeeded as a raingrown venture. Fodder conservation provides a more reliable feed source.

NUTRITIVE VALUE

Kikuyu compares favourably with other tropical grass species in digestibility and protein levels. Digestibility of dry matter is in the range of 60% to 70% and decreases more

slowly than in the taller tropical grasses. The slow decline is due to kikuyu's inobtrusive flowering and seeding habit plus the fact that it continues to grow strongly during this phase. Crude protein levels are high (15%–18%) while the grass is being supplied with adequate nitrogen. Kikuyu retains its protein content well and a level of over 12% has been measured in 4-month old regrowth.

Kikuyu has a low sodium level which may be insufficient for normal levels of animal production. Consequently, a salt supplement is recommended where kikuyu forms a signficant part of the diet and stock water is also low in sodium. Levels of phosphorus in adequately fertilized stands may reach 0·4 to 0·5% on a dry matter basis. However, in many situations, plant phosphorus levels are only 0·2 to 0·3% which will support only moderate levels of milk production even where appetite is being satisfied. Where P levels are low in pure grass swards, the level of calcium, although usually present in greater amounts, may fail to meet the daily needs of lactating animals. A vigorous legume component with its inherently high calcium level will compensate for low calcium levels in the grass.

ANIMAL PRODUCTION

The high digestibility and protein percentages of kikuyu suggest that the grass should give a high level of animal production both per beast and per hectare.

Production per beast. On nitrogen fertilized kikuyu beef cattle liveweight gains (0·5 kg per beast per day) and dairy production (100 kg butterfat or 2 500 kg 4% fat-corrected milk (FCM) per cow per lactation) are lower than would be expected. Intake of kikuyu is low when compared with that of other tropical grasses and this is the most likely explanation for the poor animal performance.

Where kikuyu is grown with legumes intake is not a problem. High levels of milk production (4 100 litres per cow per lactation) have been recorded from predominantly kikuyu-Greenleaf desmodium pastures on the Atherton Tableland.

Production per hectare. In contrast to the mediocre production per beast, high production per hectare has been measured with high levels of applied nitrogen. Applications of 350 kg N per hectare per year will support 4–5 dairy cows per hectare or 6–7·5 steers or heifers from weaning to either turnoff or calving at 21–24 months of age. Production of around 450 kg butterfat (11 250 kg 4% FCM) or 1 000 kg liveweight gain per hectare can be expected.

Lower levels of nitrogen (50 kg per hectare per year) will maintain kikuyu, but carrying capacity will only be one cow and 100 kg butterfat production per hectare. Stocking rates of 2·5 cows per hectare can be maintained with 150 kg N per year.

STOCK PROBLEMS

In New Zealand in 1969 and Western Australia in 1973, sudden deaths were recorded on kikuyu pastures. Not all animals in the herd showed symptoms and some affected animals recovered. In the two reported outbreaks in Western Australia the mortality rate was approximately 20%. The cause is unknown but a fungus has been implicated. No cases of this disease have been recorded in Queensland.

Kikuyu can accumulate toxic levels of nitrate when soil nitrogen levels are high, adequate soil moisture is present and cloudy or cold conditions apply. However, problems are rare.

Isolated cases of bloat have been reported on young fresh growth.

PESTS AND DISEASES

Provided soil fertility is maintained kikuyu is not greatly troubled by pests and diseases. Periodic attack by non-specific insects such as army worms (*Spodoptera* spp.), webworms (*Oncopera* spp.) and grass caterpillar (*Herpetogramma licarsisalis*) are fairly common but damage is not permanent.

"Kikuyu yellows" in northern N.S.W. and "kikuyu dieback", on the Atherton Tableland, are the two most serious diseases recorded.

Yellows is characterized firstly by yellowing of apparently normal leaves giving distinct yellow patches. The plants eventually die leaving bare patches which are invaded by other species. The cause is unknown. To control yellows the paddock must be cultivated and cropped until all infected material is killed out. Natural reseeding can then be allowed or replanting carried out.

A pasture of kikuyu and Safari Kenya white clover on the Evelyn Tableland. This mixture appears promising for increasing farm productivity when adequate seed becomes available.

The cause of kikuyu dieback is also unknown although it is usually associated with insect attack. At first it was thought that soldier fly (*Inopus rubriceps*) was the sole cause but entomological studies have shown that large numbers of fly larvae can be present without dieback symptoms showing up.

Kikuyu normally recovers from dieback within 6 months. If a strong companion legume is present it will rapidly colonize bare patches and little production is lost. Kikuyu will grow back through the legume as it recovers.

Tip yellowing is common on the Atherton Tableland during dry conditions, particularly after a period of rapid growth. This appears to be a physiological condition and is of little practical concern.

KIKUYU DECLINE

Symptoms of this condition are pale colour, shortened internodes with very small leaves giving a rosette appearance, a dense mat of stolons and very poor production.

These symptoms have been recorded in many areas of the world including most parts of Queensland where kikuyu is grown. A mirid bug (*Halticus* sp.) and a microscopic mite (*Steneotarsonemus* sp.) were suspected of being implicated on the Atherton Tableland, in the 1960s. Regular ripping or renovation of some description was the general recommendation but response was only temporary.

Although insects may cause some physical damage, it now seems quite clear that the condition known as kikuyu decline is nutritional in origin. Provided soil nutrient levels are adequate kikuyu decline does not occur and is no longer considered a problem.

SOIL CONSERVATION

Kikuyu's low growth habit, lack of tussocks and heavy matted growth make it ideal as a soil stabilizer. It has been used in waterways, spillways, gullies and in areas of heavy stock traffic. Irrigation channels, road embankments and other earthworks have also been stabilized using kikuyu.

Kikuyu has been used as a secondary stabilizer on coastal sand dunes, particularly hind dunes where salt spray is negligible. Primary colonizing plants are used to control drift and kikuyu may be introduced if the fertility is improved.

On soil conservation structures, kikuyu may be planted far outside its area of suitability as a pasture grass provided grazing is limited. Where possible a legume should be encouraged to combine with the sward. Temperate and tropical legumes have been used and in drier areas annual clovers and medics have been successful. Whether they persist depends on fertilizer and management, including strategic grazing to aid the legume.

Speed of cover is normally essential in soil stabilization, and provided runners are thickly planted they will achieve a cover much faster than seed. Weed competition may also be important with seed planting.

In waterways the grass should always be kept short so that while maximum soil protection is maintained, flow impedance is at a minimum. These areas cannot be renovated because they must at all times be ready to carry the maximum flow of water. If the stand shows signs

of opening up or losing its soil binding qualities then a program of heavy fertilization should be introduced to restore it to maximum effectiveness.

ERADICATION

Kikuyu is a weed in cultivation areas because of its aggressive creeping habit and ability to regrow from cut pieces. Repeated thorough cultivation in dry weather to expose rhizomes and stolons to heat and dry air will give good control and is the recommended method. The use of cutter bars, raking with tined implements and rotary hoeing all aid in killing the vegetative parts.

Herbicide applications of 10–15 kg of 2,2–DPA or 40–60 kg of TCA per hectare followed by further applications as regrowth becomes apparent, will control kikuyu. The cost, however, is prohibitive on anything but small areas. Spraying should only be carried out when soil moisture is adequate and good growing conditions prevail.

Seeds of kikuyu eaten during grazing are passed out intact in the dung which provides an excellent medium for establishment. By this means kikuyu can be easily introduced into other pastures by grazing animals. Thus, the location and grazing management of special purpose pastures where kikuyu would be an unwelcome intruder needs to be carefully considered in relation to any existing or proposed areas of kikuyu.

LARGE CONTAINERS A PROBLEM?

BEFORE you dispose of large containers which have held pesticides, check for remains of any material in the container. Empty this into a pit on the container site in a place where contamination of water sources will not occur. Remember to double rinse the containers with water after emptying.

Do not convert empty drums into livestock feed troughs, water storage containers or raft floats. They could be sources of food or water contamination.

Dispose of large metal drums (e.g. 50 to 250 litres) in one of these ways. (Do not forget to double rinse them before return.)

- Return them to the supplier.
- Sell them to a firm dealing in used drums or barrels that is equipped to neutralise the toxicity of adhering materials. Contact your pesticide dealer for the names and addresses of such firms in your state.
- Take them to a sanitary land fill type of dump. Inform the operator of the dump that the drums contain residues of poisonous materials. Warn him that poisonous vapours may be produced if the containers are burned. Before leaving, remove lids or bungs from the containers; chop holes in the containers with a sharpened pickaxe to prevent re-use. Make sure the site cannot contaminate a water supply.
- If none of the preceding disposal means are available to you, find a private disposal site of the type above which you will use only for empty containers and unwanted pesticides. Correct site selection is most important. Before leaving, again ensure lids or bungs are removed from the containers and chop holes in them with a pickaxe to avoid re-use.

By courtesy Agricultural and Veterinary Chemicals Association.

Marketing rice in Queensland

EXPERIMENTAL trial plantings of rice were conducted at the Millaroo Research Station during the 1950s and 1960s. After testing and evaluating numerous varieties of rice, the Department of Primary Industries selected the variety Bluebonnet 50 for further evaluation under semi-commercial conditions in 1965–66.

When it was confirmed rice could be grown commercially in the Burdekin, the need arose for a rice mill. Rice growers formed The Lower Burdekin Rice Producers' Co-operative Association Limited which was registered on 15 March, 1968. The Co-operative purchased a mill from the Ord and set this up in the old powerhouse at Home Hill. Milling operations began in August 1968.

Another mill at Brandon owned by Burdekin Rice Mills Pty. Ltd. began operations on 14 December, 1968. This mill was later sold to the Ricegrowers' Co-operative Mills Limited of Leeton.

With the rapid expansion in production in 1969, 1970 and 1971, the industry petitioned the Minister for Primary Industries to set up a marketing board.

Although this expansion occurred mainly in the Burdekin, a few growers in the Ingham area started producing rice in 1971 and have continued to plant small areas each year since.

Table 1 shows area production and yield for each rice crop since 1968.

TABLE 1

RICE—QUEENSLAND—AREA, PRODUCTION AND YIELD

Year	Area		Production		Yield	
	Winter Harvest	Summer Harvest	Winter Harvest	Summer Harvest	Winter Harvest	Summer Harvest
	ha	ha	t	t	t/ha	t/ha
1968	..	28	..	87	..	3·11
1969	918	294	3 876	996	4·22	3·39
1970	1 242	852	5 887	5 011	4·74	5·88
1971	1 770	2 102	7 916	7 380	4·47	3·51
1972	1 450	2 096	3 818	8 619	2·63	4·11
1973	2 138	1 649	7 685	4 439	3·59	2·69
1974	400	1 475	909	8 104	2·72	5·49

(Source: The Rice Marketing Board)

The Rice Marketing Board

The Board was constituted under the *Primary Producers' Organisation and Marketing Act* 1926–1973 on 11 November, 1971 for a period of three years. Since then the life of the Board has been extended for a further six years.

The two rice milling organisations in the Lower Burdekin were appointed agents by the Board for the purposes of handling, milling, storing and marketing of rice. During 1972, The Lower Burdekin Rice Producers' Co-operative Association Limited became the Board's only agent after it had purchased the land and storage facilities at Brandon from Ricegrowers' Co-operative Mills Limited.

The Board is comprised of seven grower members, six from District No. 1 and one from District No. 2, and the Director of Marketing. Members are elected for a three-year term and the Chairman is appointed by the Minister for Primary Industries on the recommendation of the Board.

District No. 1 comprises the Local Authority Areas of Ayr and Thuringowa while District No. 2 comprises all that part of Queensland not included in District No. 1.

Election of Board Members

The following persons are entitled to vote at the elections:—

(a) a person currently holding a grower's basic quota under and pursuant to the provisions of the *Rice Industry Stabilization Act* 1973 (hereinafter called a "quota holder");

(b) a sharefarmer who, pursuant to an agreement or an arrangement with a quota holder, which agreement or arrangement is in force at the time of voting at the election, has grown or is growing within the period of twleve months immediately preceding the election, rice for delivery to the Board.

However, this entitlement is subject to the normal conditions applying to sharefarmers and the growing of a commodity in more than one electoral district.

During 1974 steps were taken to reorganise and unify the industry by the virtual amalgamation of the directorate and management of the Board and of the Co-operative. This is in the long-term interest of the industry and will result in savings to the growers in the form of reduced operating costs.

Stabilisation

In 1972 the Board requested the Minister for Primary Industries to investigate the possibility of stabilising rice production in Queensland, as the industry feared that uncontrolled expansion in the formative years would inhibit future viability. Subsequently, a supply/management scheme was introduced under the Rice Industry Stabilisation Act 1973.

The Queensland quota was originally set at a level of 22 000 tons which was later increased for the 1975 quota year to 23 500 tonnes. Although growers have been granted quotas for each quota year, the Board, since the introduction of quotas, has taken all rice grown in Queensland, whether quota or non-quota rice.

Marketing

The Board, which is situated in Home Hill, is required to accept all rice grown in Queensland and to market it on behalf of growers.

As already mentioned, The Lower Burdekin Rice Producers' Co-operative Association Limited is the Board's agent. At Home Hill the Co-operative has eight 1 000 tonne storage bins adjacent to the mill which has a capacity of six tonnes per hour. The Co-operative also has a further six 1 000 tonne storage bins at Brandon.

Payments to growers

The Board pools receipts from sales and makes advances to growers according to the estimated clean weight of their individual deliveries. The Board pays growers a first advance on their deliveries to the Board's agent.

Finance is obtained by the Board from the Reserve Bank to meet this first advance. Other advances to growers are made as money becomes available after the advance of the Reserve Bank has been repaid.

Seasonal deliveries to the Board, together with returns to growers and bonuses paid to members by the Co-operative, are shown in Table 2.

TABLE 2

RICE—QUEENSLAND—DELIVERIES AND RETURNS TO GROWERS

Harvest	Deliveries	Payments to Growers			
	Paddy	Payment	Bonuses		Total
			Debentures	Cash	
	t	$/t	$/t	$/t	$/t
1971—Summer	7 380	70.00	0.83	1.54	72.37
1972—Winter	3 818	64.21	2.41	9.15	75.77
Summer	8 619	83.67	2.41	4.92	90.90
1973—Winter	7 685	99.66	4.00	2.37	106.03
Summer	4 439	100.72	4.00	2.37	107.09
1974—Winter	909	98.00	n.a.	n.a.	n.a.
Summer	8 104	108.00*	n.a.	n.a.	n.a.

* Estimate
n.a. Not available.

(Source: The Rice Marketing Board and The Lower Burdekin Rice Producers' Co-operative Association Limited)

6th International Course on Vegetable Growing

THE 6th International Course on Vegetable Growing will be held from August 9th to November 19th, 1976 at Wageningen, The Netherlands.

The Course, organized by International Agricultural Centre (foundation of the Ministry of Agriculture and Fisheries) is meant as an in-service-training for mid-career horticulturists primarily from the developing countries; applicants from developed countries will be considered on second priority basis.

The programme, given in the form of lectures, practicals, demonstrations and excursions covers various aspects of vegetable growing with emphasis on: climate and soil factors, seeds, mass seedling production, variety testing, soil fertility, operation of machines for small holdings, post-harvest handling and marketing. Help is also given to organize optional programmes suited to individual needs.

The deadline for receiving applications is May 7th, 1976. For further details apply to the Director, IAC, Post Box 88, Wageningen, The Netherlands. Candidates wishing to apply for the Netherlands Government Scholarships are advised to contact the Netherlands Diplomatic Representative in their countries.

THE FARM FAMILY

How to extend the vase life of cut flowers

by MARGARET E. McKAY,
Horticulture Branch.

CUT flowers are living parts of a plant. But since they are removed from their natural sources of materials needed to keep living, additional substances must be supplied if flowers are to provide their longest possible decorative role.

Not all the needs of a cut flower have yet been established and so efforts to supply these needs are not completely successful. Nevertheless the addition of the following substances will significantly increase the vase life of cut flowers.

Water

Water is the first and a self evident need of cut flowers. Many studies have been carried out to help determine the factors affecting the rate of water absorption by and movement through cut flowers stems.

When flowers are cut from a plant under moisture stress air bubbles are drawn into the vascular tissues and impede moisture flow. This is the basis of what benefits might come from recutting flower stems under water.

Bactericide

Water flow can be reduced by stem plugging which is related to the presence of micro-organisms in the holding water. Many substances have been used to improve vase life because they inhibit the growth of mircro-organisms.

These include copper coins, chloride bleaches, silver nitrate, aluminum sulphate or nitrate, 8-hydroxyquinoline nitrate (8HQC) and several others. However, it has been found that using only any of these bactericides does not increase the vase life significantly.

Acid

In addition to microbial-induced stem plugging, another form of stem plugging occurs even under aseptic conditions. This is thought to be a result of injuring the stem when cutting flowers. Acid solutions pH3 are effective in reducing but not completely inhibiting this form of stem plugging. 8HQC at concentrations of 300 to 600 ppm w/v is also useful to reduce this type of vascular blockage.

Sugar

Another factor causing cut flower deterioration is the depletion of food reserves in the flower stem. If sugar is added to the holding water significant increases in vase life of the cut flowers can be expected partially due to the supply of food and because sugar aids in

Miss McKay working with cut flowers at the Redlands Horticultural Research Station.

preventing water loss from the flower by closing stomata. Concentrations of from 2–10% have been used.

Other factors

Other substances called 'anti-senescent' agents or substances to aid in colour stability have been used and can aid in increasing the vase life of cut flowers but their exact role has not been clearly determined.

Factors Detrimental to Flower vase life

Water quality is an important factor which in some cases may be detrimental to vase life. Some workers have found that softening of hard water by the sodium substitution process generally has a damaging effect on the keeping quality of carnations. In many cases deionization of the water improves the vase life depending upon the exact chemical composition of the original water source. Water containing fluoride is reported to cause severe necrosis of petal and leaf tissue of Gladioli being held in it and this damaging effect cannot be overcome by the addition to the substances already mentioned.

Other chemical substances such as ethylene are also detrimental to flowers.

Household Compounds to extend the vase life of Cut Flowers

The main ingredients involved in extending the vase life of cut flowers are: Water, sugar, acid and substances to prevent microbial growth. There are substances in many households which can be used to do this.

Lemonade contains all these requirements and good results such as extending the vase life of carnations from four to ten days obtained when it is used. If lemonade is not available the addition of 20 gms of sugar and a couple of capfuls of vinegar or some aluminum sulphate (alum) to a litre of water is also satisfactory.

Care and Storage of Dairy Foods

BECAUSE untreated milk deteriorates rapidly, it is subjected to various treatments to increase its storage life.

All dairy foods that are not sealed in cans will deteriorate. However, all of them will last longer if they are handled carefully and stored properly so that contamination is reduced and bacterial growth is slowed.

Liquid milk

Modern packaging, pasteurization and ultra high temperature (UHT) treatment can prolong the life of milk, although it can still deteriorate in these ways—

1. BY LIGHT. The vitamin, riboflavin, is destroyed by light. Half of it is destroyed after 2 hours in the summer sun. If vitamin C (ascorbic acid) is subjected to sunlight, it is changed into a form that is rapidly broken down by heat. Exposure of milk fats to sunlight gives a "cardboard" flavour.

2. BY CONTAMINATION. If bacteria are allowed to get in, they grow and the milk spoils. Besides, if milk is exposed to strong flavours during storage, these flavours may be absorbed so that the milk tastes "off".

3. BY TEMPERATURE. Warmer temperatures allow the growth of any enzymes or organisms present so that the nutrients in the milk are broken down and "off" flavours develop.

Pasteurized milk will keep for 10 days, if it is stored at a constant 4·5°C (40°F) which is the normal household refrigerator temperature. Milk should be kept COOL, DARK and COVERED.

Liquid milk can be frozen for 4 to 6 weeks before flavour changes occur, but freezing is not a practical method of storage. Frozen milk is bulky and thaws unevenly so that UHT milk and evaporated or powdered milks are more convenient.

UHT milk

UHT milk is completely sterile and can therefore be stored for 3 months or longer without refrigeration. After this time, chemical changes may alter the flavour of the milk. Once opened, the carton should be refrigerated since bacteria from the air will contaminate the milk and spoil it.

Powdered milk

Problems with powdered milk are the absorption of "off" flavours, the fat becoming rancid, and the powder's absorption of moisture. To avoid these problems, powdered milk must be kept in completely dry, sealed containers. The reconstituted milk should be stored in the same way as any other liquid milk.

Evaporated and sweetened condensed milks

Both evaporated and sweetened condensed milk will keep indefinitely in the can. After opening, evaporated milk must be kept in the refrigerator but sweetened condensed milk, because of its high sugar content can be kept at room temperatures. (Like a high salt content, a high sugar content prevents the growth of bacteria.)

Yoghurt and buttermilk

Cultured milk products like yoghurt and buttermilk, may be kept in cool storage for 7 to 10 days. After this, the acidity will have made the food unacceptable to most people.

Cream

Fresh and soured creams have a life of about 7 to 10 days in the refrigerator. Canned, reduced cream will keep for months on the shelf so long as the can is sealed. However, once the can is opened, the cream should be treated in the same way as fresh cream.

Low fat creams are less suitable for freezing than high-fat creams. Pasteurized cream with more than 40% fat can be frozen for up to 3 months. Sometimes the fat and the liquid tend to separate on thawing, but a light whipping will restore the smoothness.

Butter

Butter should be kept cool to reduce oxidation of fats which cause the rancid flavour characteristic of butter that has been held at high temperatures. Light can also produce rancidity, and "off" flavours can be absorbed from surrounding foods. To avoid this, butter should always be kept covered.

Butter can be frozen and will keep for up to 6 months if it is wrapped in a vapour-proof material.

Cheese

Cheese with a high moisture content have a shorter shelf life than low-moisture cheeses. Fresh cheeses such as cottage cheese will last for 7 to 10 days. Soft cheeses like blue vein and mozzarella will keep for a few weeks at low temperatures. Firm cheeses such as cheddar keep for several weeks, but hard, low-moisture cheeses such as parmesan keep almost indefinitely.

The storage life of cheese is limited by—

1. Drying out
2. Absorbing off flavours
3. Continued biological changes such as the growth of mould or development of acidity.

Cheese should be properly wrapped during storage. Fresh cheeses should be kept in the coldest part of the refrigerator while the firmer cheeses are best kept in the lower shelves or door shelves.

Small, left-over pieces of cheese can be grated and stored in plastic containers for later use.

Cheese should be served at room temperature and should be taken from the refrigerator about half an hour before use, except for fresh cheeses which are best served chilled.

Cheese tends to crumble after freezing but it can be used for cooking, provided it has been adequately stored in a vapour-proof material such as heavy aluminium foil.

For further information contact The Otto Madsen Dairy Research Laboratory, 19 Hercules Street, Hamilton, Brisbane.

TICKS . . . a peril to pets

TICKS feed on mammals (including man), birds and reptiles and harm them in several ways.

The bite of some ticks is irritating and, if the tick remains on the animal long enough, tick paralysis may follow and this can be fatal, particularly in dogs and cats.

Secondly, ticks live on blood so if the animal has many ticks on it, it may suffer from a significant loss of blood.

Thirdly, many species of tick can spread diseases of the blood from animal to animal.

Where do ticks live?

Ticks need warm, humid conditions to survive and the scrub areas in coastal Queensland are ideal for them. They are commonly found in and around Brisbane and pet owners in this area must make daily searches for ticks on their animals, particularly from late winter to early summer.

Life of the tick

Four stages are recognised in the life cycle of a tick: egg, larvae, nymph and adult. The development from egg to adult may take place while the tick feeds on one, two or three hosts.

For the two important ticks on pets, the egg hatches to larva and attaches to host 1 and feeds, then it drops to the ground and moults to the nymph stage.

The nymph then attaches to and feeds on host 2 and later drops to the ground where it moults to an adult.

The adult attaches to host 3 and feeds. It is this host that is most likely to suffer ill effects.

When filled with blood (engorged), the tick falls to the ground and lays eggs to begin the cycle again. These are called three-host ticks.

Ticks and pets

Two types of tick commonly attack pets. Several others, which normally affect cattle or native animals, are only occasionally found on pets.

The most dangerous tick is *Ixodes holocyclus* commonly known as the **scrub** or **paralysis tick.** It has long mouthparts, yellowish legs and affects most domestic and native animals.

The natural hosts are bandicoots that live by day in secluded scrub areas in gullies, and feed by night on snails, slugs and insects. They commonly enter domestic gardens in search of food.

Thus, the greatest danger to pets is in bushland, but animals are commonly infested on pasture or suburban allotments.

The various stages of the tick climb on vegetation, particularly during moist periods. When a host animal (including dogs and cats) brushes past, the tick will attach.

The young adult female is a slate-grey colour, with a yellowish tinge and it has a light brown shield covering most of its back. As it feeds and takes in more blood, the colour deepens to grey-green with a brown line encircling the body. It can reach a size of 15 to 18 mm.

It causes paralysis by injecting a poison produced in its salivary glands. This poison is produced at all stages of the life cycle but the

adult female is the major source of fatal doses. These produce most of their poison in the later stages of feeding and a SINGLE FEMALE TICK CAN KILL THE LARGEST DOG.

The earliest stages of tick paralysis vary. In dogs and cats the first signs observed may be a change in voice, possibly accompanied by a cough. Vomiting may then occur after feeding but is more common at a later stage.

Paralysis begins with the slight incoordination or swaying of the hindquarters, and spreads at varying rates until the muscles of the hindlumbs, trunk, forelimbs and finally the throat and head are affected.

As the chest muscles become progressively involved, breathing becomes more laboured and may be accompanied by grunting and frothing at the mouth. Death results from paralysis of the respiratory or heart muscles.

Symptoms usually appear 4 to 7 days after attachment of a femal tick. If there are several ticks, paralysis may develop sooner. On the other hand, symptoms have been known to be delayed for 13 days.

Rhipicephalus sanguineus is commonly known as the **brown dog tick.** As the name suggests, it is usually found on dogs, but occasionally on cats or horses. The adult female has short mouthparts and dark legs and is shiny brown in colour. It does not grow bigger than 12 mm, so is smaller than the scrub tick when fully engorged.

Heavy infestation on the dog may lead to serious irritation and anaemia causing a great drain on the dog's vitality.

This tick is often carried on dogs into homes and although it seldom attacks the human occupant, large numbers of larva or nymphs may constitute a household pest.

The two cattle ticks, *Boophilus microplus* and *Haemaphysalis longicornis* have been found on pets but they do not cause them any harm.

Identification

It is **important** to have ticks identified correctly. If you have a tick you would like identified send it to the Director of Pathology, Animal Research Institute, Fairfield Road, Yeerongpilly, Q. 4105.

Include a letter with it telling us your name and address and what type of animal the tick came from.

Treatment

It is **very** important that scrub ticks are removed before they have time to inject poison or as soon as they are found. Carefully search all pets for ticks. Because ticks are more readily felt than seen, the examination is best made by running the tips of the fingers over the whole surface of the dog. Pay particular attention to less accessible sites such as the ears, jowls, corners of the lips, between the claws and under the tail. Do not stop the examination when one tick is found and removed, as there may be more.

The best way to remove an attached tick is to bring the tips of a pair of scissors together at the point where the mouth parts of the tick are attached to the skin. Then, by jerking the scissors upwards, the tick is removed. If scissors are not readily available, use tweezers, or grasp the tick between finger and thumb and pull away from the skin. The mouth parts usually come away with the tick. It does not matter if they remain, as the salivary glands that produce the toxin will come with the body of the tick.

The application of kerosene or other chemicals to the tick has been recommended in the past, but it is of no benefit, and often causes severe skin irritation.

The only effective treatment when paralysis has begun is the injection by a veterinarian of anti-tick serum as soon as practicable. Even when symptoms are mild and the tick has been removed, fatal paralysis can still occur if treatment is not given. Make the dog as comfortable as possible and turn it from side to side several times daily. Do not attempt force feeding or dosing, as entry of the material into the lungs may cause pneumonia.

The common brown dog tick does not cause paralysis.

For further information contact The Animal Research Institute, Department of Primary Industries, Yeerongpilly, Brisbane.

Gardening notes . . .

Lettuce all year round

Horticulture Branch.

LETTUCE can be grown almost all the year round in most vegetable gardens in Queensland.

Varieties have been developed to suit seasonal conditions, so it is important to select the right one for the right season.

The most popular winter varieties are Yatesdale, Winterlake, Sunnylake, Rumseylake, and Imperial Triumph. Pennlake has proved the most suitable summer lettuce in Queensland. It is quick maturing, but produces a slightly smaller head than some of the winter types.

Other lettuce varieties that can be grown in the garden are Green Mignonette and Mignonette.

SOILS

Lettuce can be grown successfully on most soil types provided that they are well-drained. The light sandy loams are more suited for winter production and the heavy loams and clay loams for summer lettuce.

The soil should be dug to the full depth of the spade or fork, provided this does not bring up the sub-soil. Well rotted animal or poultry manure, if available, is very beneficial, and should be incorporated during the preparation of the bed.

Lettuce does best when the acidity or pH of the soil is between 6·0 and 6·5, and an application of lime or dolomite at 200 to 300 grams per square metre should be applied if the pH falls below 5·5. The lime is best applied a few weeks before planting.

FERTILIZERS

Even when the soil has received a dressing of animal manure, a pre-plant dressing of 100 grams per square metre of a complete fertilizer mixture containing approximately 5% nitrogen, 6% phosphorus, and 4% potash (5–6–4 NPK) should be applied. If the garden bed has been heavily fertilized for a previous vegetable crop, the quantity may be reduced. The fertilizer can be broadcast over the beds or applied in bands along the planting row a week or so before planting and cultivated into the soil.

For the production of good hearts, 1 or 2 side dressings of 15 g ammonium nitrate (Nitram (R)) or 10 g urea per square metre at each application is usually necessary. The first is applied soon after thinning, if the seed has been sown direct in the garden bed. The second dressing is given when the plants are nearly half grown.

The side dressing fertilizer is best place in a band along the row. Excessive nitrogen should be avoided when the plants are hearting as late applications of this kind may produce loose heads.

Any fertilizer that falls on the leaves may mark them, and it is therefore a good practice to water the plants immediately after a side dressing to wash off any fertilizer that may have contacted them.

PLANTING

The seed may be sown in a seedbed for transplanting, or planted direct in rows in the garden. With the latter practice the seed is sown 10 mm deep in rows 30 cm apart. Seeds can also be placed on the top of the soil and covered with a loose mulch of wood shavings. Deep sowing is a common cause of uneven germination in lettuce.

When the seedlings are 50 to 80 mm tall they are thinned out to single plants 25 to 30 cm apart. Any blanks in the rows can be filled by transplanting some of the thinnings. Overcrowding of plants in the row can cause poor heading of lettuce.

When the seedlings are raised in a seedbox they are planted in the garden 25 to 30 cm apart in rows 30 cm apart.

CULTIVATION

Weeds should be kept under control at all times as they compete with the lettuce for moisture, nutrients and sunlight. They also provide conditions suitable for the development of disease.

WATERING

Lettuce has a high water requirement. Lack of soil moisture is soon followed by a reduction in head size, bitter flavour and it increases the tendency for the plant to bolt in warm weather.

On the other hand, over-watering can be quite harmful by favouring the development of fungus diseases.

HARVESTING

Lettuce are usually ready for picking as soon as the heart is firm to the touch. Overmature plants tend to be bitter and unpalatable.

DISEASES AND PESTS

Occasionally lettuce can be infected by downy mildew disease. The first symptoms are light-green to yellowish spots on the leaves. White downy growth on the lower leaf surfaces appears if conditions are moist.

If plants are kept healthy during early growth, little trouble should occur. Sow seed thinly and thin out as early as posible to permit free air circulation.

If the disease has appeared in previous crops, applications of maneb or mancozeb after the first true leaves have formed and again a week later would be advisable. Spraying should be completed 3 or 4 days before transplanting in order to avoid a double check being administered to the plants.

Sclerotinia rot is another disease that attacks lettuce. The fungus infects the stem of the plant and a soft grey-brown rot develops usually at ground level, but any part of the plant may be involved. A white cottony fungal growth develops on the rotted area.

This disease is favoured by cool wet shaded situations. Planting lettuce in a sunny well-drained bed will help to keep the disease in check. Also, avoid growing lettuce in a bed where Sclerotinia rot has occurred in other vegetable plantings.

If the disease appears, benomyl sprays at 10 to 14 day intervals will give control. In small plantings, uproot and burn diseased plants.

The pests most frequently encountered in lettuce are aphids, leaf and stem eating caterpillars and slugs and snails.

Aphids may be controlled by an application of dimethoate (Rogor (R)) as required.

When caterpillars are a problem spray with trichlorphon (Dipterex (R)).

Slugs and snails may be controlled by using one of the proprietary baits.

Use all pest and disease control sprays or baits as directed by the manufacturer and observe the safety measures printed on the label.

the unchecked apple

CRISP, crunchy apples straight from a tree, a basket or a paper bag are delicious, yet have you realised the apple's unchecked progress into a number of diversified products—as puree, as compact instant pie fillings or miraculously dried into rings? With cream cheese, nutty swiss, processed cheddar and feta the diversified apple completes a dessert pie; a pork aniseed flavoured casserole; a super hamburger; and an unusual mint and lemon butter cake.

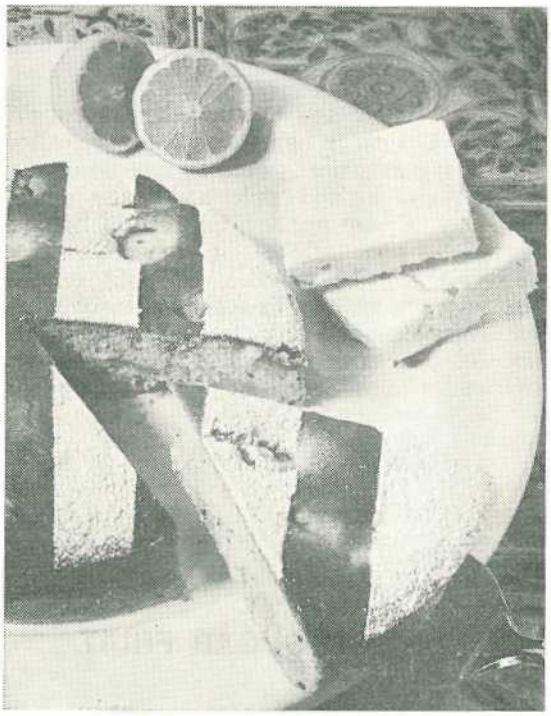
Why not then, check out the apple—a fruit with many possibilites!

In these recipes a standard 8 oz. measuring cup is used and all spoon measurements are level.

★ ★

APPLEBURGERS IN A BUN

6 hamburger buns
butter
Mix together thoroughly in a bowl:
1 lb. minced steak
1 small onion, grated
1 large cooking apple, grated



Mint Apple Cake

1 cup grated Australian processed Cheddar cheese
¼ cup sultanas
¼ cup wheatgerm
½ teaspoon allspice
salt and pepper

Shape meat mixture into 6 flat hamburgers. Place on buttered baking tray. Bake in hot oven (400°F) for 30 minutes. Ten minutes before burgers are ready, place six hamburger buns in oven. Split buns, butter on both sides. Place burgers in each centre and top with fruit chutney or tomato sauce. Serves 6.

MINT APPLE CAKE

1, 10 oz. packet dried apple, chopped and soaked in 1 cup hot milk until all milk is absorbed
3 oz. butter
3 oz. Australian Feta cheese
½ cup honey
2 tablespoons castor sugar
3 eggs
1½ cups S.R. flour, sifted
1 teaspoon grated lemon rind
1 teaspoon dried mint

Cream butter and feta together thoroughly in a bowl. Beat in honey and sugar well. Beat in one egg at a time. Fold in half flour, then lemon rind, mint and apples and finally remaining flour. Spoon mixture into an 8″ buttered sandwich pan. Bake in moderate oven (350°F) for 45 minutes, or until cake is cooked when tested with skewer. Remove, turn onto wire rack and allow to cool. Wrap in foil and keep overnight. Serve in wedges with whipped cream. Serves 6.

★ ★

BROWN SUGAR FRUIT

The Pastry

1½ cups stoneground wholemeal flour or plain flour
4 oz. Australian Cream cheese
2 oz. butter
½ cup castor sugar
Combine together:
1 egg yolk
1 teaspoon lemon juice
2 teaspoons water

In a large bowl, rub cream cheese and butter into flour until it resembles fine breadcrumbs. Add sugar. Mix in egg mixture to make a soft dough. Wrap and chill for 1 hour.

The Fruit Filling

Mix together:
1, 15 oz. can unsweetened pie apple
1, 4 oz. can passionfruit pulp
½ cup brown sugar

Roll half pastry out to ⅛″ thickness. Line a 9″ aluminium pie plate. Add fruit filling. Roll out remaining pastry to 1″ larger than pie plate. Lift over fruit. Trim, seal and decorate edges. Make 3–4 slits in centre. Brush with cold water. Sprinkle lightly with A1 sugar. Bake in hot oven (400°F) for 20 minutes. Reduce oven to moderate (350°F) and bake further 25–30 minutes. Serve warm with whipped cream. Serves 6.

★ ★

ANISEED PORK CASSEROLE

2 tablespoons butter
1 medium onion, sliced
1 lb. pork leg, cut into ½″ pieces
1 tablespoon flour
1 chicken stock cube, dissolved in 1 cup water
2 cooking apples, unpeeled and chopped
½ teaspoon whole aniseeds
salt and pepper to taste
½ cup rice, cooked and drained
1 cup grated Australian Swiss cheese

Melt butter in heavy based saucepan. Saute onion for 3 minutes. Add pork and brown on all sides. Sprinkle flour over meat and blend in thoroughly. Pour in chicken stock. Add apples and seasonings. Cover and simmer for 1 hour. Place in a 5 cup casserole. Top with rice then sprinkle over Swiss cheese. Bake in hot oven (400°F) for 20 minutes. Serves 4.

Journal Subscription to Rise

THE continuing pressures of rising costs, particularly with postage, has meant that the Queensland Department of Primary Industries can no longer maintain subscription rates at the present levels.

As from 1st January 1976, subscriptions to both the *Queensland Agricultural Journal* and the *Queensland Journal of Animal and Agricultural Sciences* will rise.

The new rates for the *Queensland Agricultural Journal will be* $6.00 per annum for ordinary subscriptions, with a concession rate of $2.00 per annum.

Persons eligible for concession rate include commercial farmers whose principal source of income is from primary production, students of agricultural courses, libraries and educational institutions (all resident in Queensland). Students' applications should be endorsed by the lecturer or teacher.

The subscription for the *Queensland Journal of Animal and Agricultural Sciences* will rise to $10.00 per annum.

While the Department regrets the need to apply these increases, the rise in costs since the last increase (in 1964) have meant that these journals still continue to be excellent value.

As in the past, the *Queensland Agricultural Journal* will continue to publish practical, up-to-date information for the man on the land.

QUEENSLAND AGRICULTURAL JOURNAL

ORDER FORM

Subscription Rates—

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NAME Mr / Mrs / Miss ..... (BLOCK LETTERS) ..... INITIALS

ADDRESS .....

..... POSTCODE .....

OCCUPATION .....

I hereby enclose $ for years subscription to the *Queensland Agricultural Journal.*

Signature .....

New Subscriber ☐

Renewal ☐

(Tick the one that applies)

Office Use Only

Anne Cook's farm home

WITH holidays uppermost in most people's minds, here are some hints from the Queensland Health Education Council on keeping safe through the holiday season.

• Car travel to the chosen site can be all part of the fun of holidays. Don't spoil the fun by distracting the driver's attention long enough for an accident to mar the trip. Children should remember that cars are not suitable places to squabble or play.

• Campfire cooking can be fun. But NEVER skylark around a campfire. Flames can quickly lick out and "catch" on any loose clothing—or you may trip and fall into the fire.

• Never dive into an unknown creek without thoroughly checking the depth of the pool. There could be rocks just below the surface—or maybe that water is not as deep as it appears. A split skull could turn your holiday into a real headache!

• Watch out for broken bottles when you're walking barefoot on the beach, or out in the bush. And always put your empty cartons and cans in a trash can.

• Don't throw your empty bottles on the ground or in the ocean or creeks, to become a hazard to yourself and others. Find out if there's a depot for bottle collection nearby. Your empties could aid charity. If there is no known depot, put all empty bottles in a trash can.

• Guns are not toys. If there is a gun among your holiday gear, treat it with the respect it deserves as a lethal weapon. NEVER point a gun at anyone, even in fun when you THINK there is no bullet in it. More people have been killed or injured by "unloaded" guns than by guns they KNEW were loaded.

• If you plan to go out in a small boat this holiday, make sure you don't become another holiday boating statistic. Take along approved lifebelts, don't overload the boat, and make sure some reliable person knows where you are going and when you plan to return.

• Sunbathe—don't SUNBAKE this holiday. Sunburn can make you ill—and can be very painful. Repeated over-exposure can cause skin cancer. Make full use of shade, protective clothing and sunscreen creams.

• You will save yourself a lot of discomfort if you wear those new sandals for a few short periods before packing them for holidays. New shoes can rub feet and cause blisters if worn for the first time on long walks.

• If you are camping this holiday, be sure you have a cool, fly-proof place to store food. Heat and/or flies, cockroaches and other vermin can cause contamination.

• Don't use kerosene lamps in a tent or a caravan. They can easily tip or be knocked over, and cause a fire.

• Don't allow small children to wander along about a camping ground or caravan park. Child-molesters may approach them.

• Don't leave a toddler in the care of a slightly-older brother or sister while you are beyond call this holiday. Many an older child has been drowned while trying to save a struggling toddler in the water—and a young child hasn't the experience to deal with a would-be molester either.

• Are you travelling by car this holiday? If so, make sure the car is packed so that cases don't fall on the driver or passengers. Packages that fall every time there's a bend in the road can fray nerves and cause ill-temper. Remember that the safest driver is the one who is relaxed and free from tension.

• Before you set off for a beach holiday, learn how to identify marine stingers, and how to treat the stings. Even minor stings from marine creatures can be painful. Send for the Queensland Health Education Council pamphlet "Marine Stingers".

• If you are fishing from rocks at the coast, make sure your position doesn't go under water when there's a big wave. A ton or so of water falling on you won't help you to enjoy your holiday.

• Before you go on holidays, learn about emergency resuscitation. You may need the knowledge to save a life. The methods are described in the Queensland Health Education Council's pamphlets "Rescue Breathing", "You Too Can Save A Life", "Safe Swimming", and "Heart/Lung Resuscitation".

• Are you going bushwalking this holiday? It can be fun, but take a few necessary precautions. Tell someone where you are going, and when you expect to be back or in touch with them. Don't climb in dangerous places. Someone else may be injured when trying to rescue you. Take along a first-aid kit, and know how to use it. TAKE SAFETY ALONG—it won't add any weight to your pack!

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S. G. Reid, Government Printer, Brisbane

Zinc sprays increase Navy Bean yields

Navy bean crops on the southern Darling Downs

Navy bean crops on the southern Darling Downs need foliar applications of zinc.

Trials at Emu Vale have given yield increases of up to 73%.

The varieties Gallaroy and Kerman gave the greatest response to zinc.

Zinc applications on Kerman can increase growers' returns by up to $270 and on Gallaroy by up to $130 – according to results of departmental trials.

Zinc should be applied as zinc sulphate heptahydrate at the rate of 1 kg in 100 l of water per ha at each application. Two or three applications may be needed.

Zinc sulphate heptahydrate must be applied as a foliar spray in the early stages of crop growth.

Navy beans are a very zinc sensitive crop. From the available evidence foliar applications are superior to soil applications – further work is continuing.

The above information is a summary of the article which appears in this issue of the Queensland Agricultural Journal. For further information you should consult this article, or contact your local extension officer.

Navy Beans need zinc

ZINC DEFICIENCY IN NAVY BEANS

Typical zinc deficiency symptoms on Navy Beans.

Leaves dying off.

Kerman without zinc applied; on either side Navy Beans with zinc applied.

Close-up Kerman without zinc.

Gallaroy severely affected by zinc deficiency.