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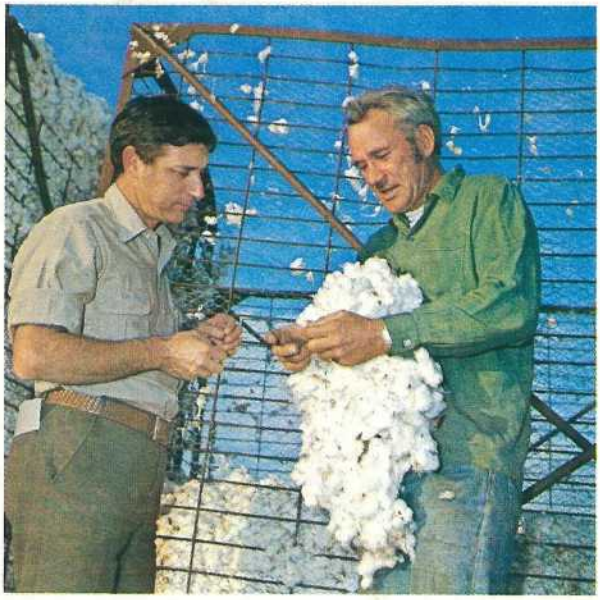

SCHOOL PROJECT NOTES

COTTON

The high price of cotton during the American Civil War (1861–1865) led to the establishment of cotton growing in Queensland, and by 1870 an area of 5 938 hectares was under cotton. The industry, however, rapidly declined and in each year from 1876 to 1920 less than 400 hectares were planted.

A guaranteed price led to an increased area of over 16 000 hectares in the years 1923–1925. A fall to half of this area followed the area to 27 500 hectares and it remained over 16 000 hectares until 1943. Following a fall to 1 088 hectares in 1949, a guaranteed price was set in 1951 and the area recovered to nearly 15 000 hectares by 1960–61.

During the 1960s a change occurred in the cotton growing industry with a swing away from dry-farming methods to a greater use of irrigation.

By 1974 the crop grown under irrigation had increased to approximately 96 per cent of the total area. As a result, areas planted decreased considerably, while substantially increased yields per hectare were obtained.

This resulted in a record crop of 6.6m kilograms of raw cotton in 1971–72 from 6 900 hectares planted. In 1973–74 from a total area of 7 105 hectares planted to cotton, 6.6m kilograms of raw cotton were obtained. This was valued at $6,503,000, and represented over a tenth of the total Australian production.

Of the State's cotton production in 1973–74, more than half came from the St. George Irrigation Area crop which was approximately two-fifths of the total area planted to cotton; the Central Downs and the Dawson-Callide Valleys areas produced about two-sevenths and one-sixth, respectively. Other cotton growing districts are the Lockyer Valley and Emerald areas.

Reprinted from the Queensland Yearbook 1975.

Our cover shows pictures of cotton being harvested in Central Queensland. Pictures by B.C. Toon, Regional Information Officer.

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES.
William St, Brisbane.

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EDITOR: David K. Wheatley

Contents

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Of particular interest

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

IDENTIFICATION OF TRAVELLING STOCK

Cattle travelling to sale, or slaughter, after the 1st July, 1976, must be identified by a numbered tail tag.

Identification is an essential element of the national Brucellosis and Tuberculosis Eradication Programmes and in the traceback of animals showing unacceptable levels of chemical residue in their tissues on slaughter.

Identification requirements have operated in southern States for many months and, acting on experience there, it has been decided to use the wrap-around, self-adhesive type of tail tag in Queensland. Such tags are more reliable, easier to apply and cheaper than alternative tail, or back, tags.

In the majority of cases, tags will carry the identification number issued to the owner, or lessee, of the property of origin of the animals. But owners of less than 11 cattle, or who run their animals on town reserves, or commons, will be issued with serially-numbered district tags by Departmental officers. In addition, ear tags imprinted with the property number will be an acceptable alternative. Stockowners who hold numbered back tags will be permitted to use up their supplies.

There will be certain exemptions, such as—

- Drafts of cattle comprising one or more K wagons or equivalent in the one ownership travelling direct to a place of slaughter and otherwise identified to the satisfaction of an inspector.
- Drafts moving direct from property to property.
- Drafts going to special store, or breeding, cattle sales approved by an officer of Department of Primary Industries.

An owner purchasing sale cattle can resell them within 30 days without applying his own tail tags, provided the original tail tags are still in position.

It will be an offence for any owner to use tags other than those relating to the property of origin of cattle, or district tail tags specifically issued to him by a Departmental officer.

An extensive education and extension programme will be undertaken to acquaint owners and agents with their obligations under the new Regulations. Owners should contact local Stock Inspectors for details.

Dystocia is a dead loss!

A fine wing of heifers—but how many will survive their first calving?

research seeks an answer

by R. T. STRACHAN and J. R. WYTHES,
Beef Cattle Husbandry Branch.

Dystocia—A prolonged or difficult calving, an assisted calving or one which results in a dead calf

TO many cattlemen and women, dystocia means an annual ritual of close supervision at calving, long weary hours pulling calves, and nursing weak animals back into production. In many instances, it means the heartbreak of a dead heifer and her calf and a very real loss of income.

Dystocia in heifers can quickly become an emotional subject. What are the facts, and how serious is the problem?

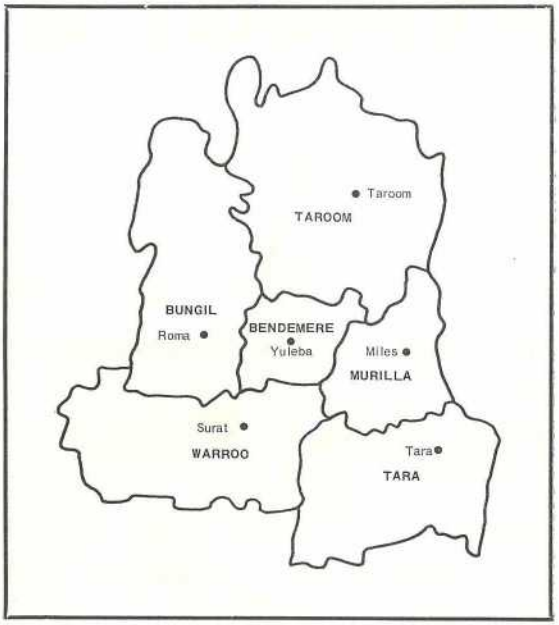
Many beef producers in southern Queensland have expressed their concern about increasing heifer and calf deaths due to dystocia.

To find out just how serious dystocia was, a survey was conducted in the Roma area in July 1974. It examined the records of 23 129 maiden heifers which calved in 1973. The survey included 444 beef herds in the shires of Bendemere, Bungil, Murilla, Tara, Taroom and Warroo and represented 22% of all beef producers. Only herds running more than 50 cows and heifers qualified.

It was not possible in the survey to identify calf losses that were stillborn for reasons other than a prolonged birth. However research reports suggest that the majority of stillbirths are due to dystocia.

Dystocia Losses

The survey confirmed that dystocia was widespread, with very high losses in many herds in 1973. Over one-third of herds surveyed had more than 10% dystocia in heifers, with one herd in every ten reporting more than 30% dystocia. Of little comfort was the fact that only 6% of herds reported no dystocia.



Shires of the Roma region

Dystocia in 1973 meant that of 23 129 heifers expected to calve, 2 431 or 11% had to be assisted and 963 or 4% died during calving. Seven per cent. of calves (1 559) were stillborn or died within 48 hours of birth.

It is significant that nearly half the beef producers surveyed inspected their heifers once a day or more frequently during calving—a costly and time consuming commitment.

Beef herds in southern Australia also suffer losses from dystocia, but little is known of the extent of these losses. Dr. Jim Young in a study of 11 beef herds in N.S.W. recorded 12·7% dystocia among 2 year old mated heifers. Individual herds varied from nil to 23·7%. In four Tasmanian herds Mr. D. A. Pattullo observed 6·9% to 10·3% dystocia in heifers. It would be most unwise however, to conclude from these comparisons that dystocia is a more serious problem in the Roma area.

There has been much argument regarding the relative influence on dystocia of breeds and the role of individual sires. While it was not within the scope of the Roma survey to examine sire effects, it was possible to examine breed differences.

Breeds

Dystocia was highest in Poll Herefords, followed by Herefords (Table I). A greater proportion of Poll Hereford heifers needed assistance. Heifer and calf deaths were also higher. In turn, Herefords had much more dystocia than other breeds. Dystocia losses were similar for Shorthorn, Angus, Santa Gertrudis and crossbred heifers. Overseas reports also indicate more dystocia occurs in Hereford cattle than in other British breeds.

The vast majority of herds with more than 30% dystocia had Poll Hereford or Hereford cattle. Nevertheless, many of the herds with less than 10% dystocia also had these breeds.

Vertical and horizontal pelvic measurements are being used in research aimed at finding ways of preventing dystocia

TABLE I

EFFECT OF BREED ON DYSTOCIA LOSSES

(Only herds included with more than 90% of same breed in herd)

—	Poll Herefords	Herefords	Other Breeds
No. of properties	48	142	46
No. of heifers ..	2 199	8 869	1 494
% Heifers assisted	18	11	5
% Heifer deaths ..	7	4	2
% Calf deaths ..	10	7	4

Why do Herds differ?

Dystocia incidences vary from year to year. But more importantly why does dystocia vary so much from herd to herd in any one year? The reasons for this wide variation between herds with low and high dystocia incidences are not known.

Genetic differences probably explain part of the difference. There is some field evidence to suggest that dystocia is more of a problem in closely supervised herds that do not cull heifers on their calving performance. In recent years many herds have been enlarged. This has meant an abnormally high percentage of heifers have been retained for breeding purposes. Although nutrition plays an important part in the last third of pregnancy, it is most unlikely to fully explain the difference between low and high dystocia herds.

Many producers have recognised dystocia as a problem and taken steps to counter it. Those most concerned closely supervise their heifers, inspecting them at least twice daily. Close supervision probably reduced losses in 1973, since calf and heifer deaths relative to the numbers assisted were lowest in these herds. On the other hand, where heifers are not supervised, dystocia usually means that both the heifer and her calf die.

Dystocia is undoubtedly a complex problem; a problem with many interacting factors.

Current Research

Having established that dystocia causes serious losses in many beef herds, an ambitious programme of research is now being undertaken by the Department of Primary Industries.

Firstly, a number of Poll Hereford and Hereford herds in the survey reporting less than 10% dystocia are being compared with similar numbers of those herds reporting more than 30% dystocia in 1973. Genetic, environmental, nutritional and management factors are being considered. Secondly, with the co-operation of local beef producers, field experiments have commenced involving nearly 1 000 maiden heifers calving in 1975 and 1976. Veterinarians, Mr. P. B. Hodge and Mr. R. D. Newman of Beef Cattle Husbandry are supervising the field programme.

The experiments will assess the usefulness and practicability of measuring the pelvic size and shape of maiden heifers to predict calving performance. Such a technique, if found to be of value, could be used to detect dystocia prone heifers for early culling before they enter the breeding herd.

Other experiments aim to evaluate the relative importance of genetic and environmental factors on the incidence of dystocia. To achieve this, yearling heifers from herds with a low incidence of dystocia are being compared with heifers from problem herds under similar management. Heifers from both herds are being mated to the same bulls and will run together in the same paddock until after calving in 1976.

Another study, initiated in 1976, will attempt to assess the contribution (if any) that close supervision or intensive management, has on the incidence of dystocia in maiden heifers.

This research is not only investigating the likely causes, but hopefully will also find ways to reduce losses and remove the heartbreak associated with dystocia.

It is a pleasure to thank co-operating graziers in this research, Mr. T. K. Fraser and Mr. E. J. Bamford for their valuable assistance in conducting the postal survey.

FACTORS IMPORTANT IN DYSTOCIA

Research overseas and in Australia has shown that there are many causes of dystocia. It is a complex problem, about which we will probably never know all the answers. Research has already identified many important factors.

BIRTH WEIGHT. Very heavy and large calves tend to experience more difficulty at birth and have a higher incidence of stillbirth than calves of average weight for their breed. It is probable most stillbirths are the result of prolonged parturition.

SEX OF CALF. Male calves tend to be heavier than females.

AGE OF DAM. Dystocia is much more common in maiden heifers than in mature cows.

DEGREE OF DEVELOPMENT. In general, a greater incidence of dystocia occurs in under developed heifers which are mated prematurely. Well developed heifers usually experience much less dystocia.

BODY CONDITION. Cows and heifers in poor body condition frequently lack the strength to calve successfully. Over fat dams on the other hand, also lack calving endurance and their birth canals are frequently reduced in size due to excessive pelvic fat.

BREED. Dystocia differences between breeds principally reflect differences in birth weight and size. Calves of the heavier and larger breeds experience most difficulty.

Many of the large European breeds, particularly the Charolais and Simmental, are noted for their high incidence of dystocia. British breeds tend to encounter less difficulty, although of these Herefords experience most dystocia. Very little dystocia occurs in *Bos indicus* breeds.

SIRE. Within any breed, the progeny of individual sires may experience more dystocia than others. The European breed sires are presently being rated according to the percentage of assisted births of their progeny.

SIZE OF PELVIS. If the bony pelvis is small or funnel shaped, then there is a greater likelihood of dystocia, due to a dis-proportion between calf size and that of the dam's pelvis. Unfortunately the fact that a heifer is larger in body size than her mates does not necessarily mean that she will have a larger pelvic area.

THE BIRTH PROCESS. Strong regular uterine contractions are necessary during parturition for the expulsion of the calf. Any disturbance during birth, for example the barking of a dog, will upset these rhythmic contractions and stop the expulsive efforts of a calving cow. Heifers especially are more temperamental during the calving and post-calving period.

SEASON. The occurrence of dystocia will vary according to the season of the year and between years, generally coinciding with abundant nutrition.

Urea Molasses feeder for sheep

by L. DUNLOP, Department of Primary Industries, Charleville.

MR. Roger Arden of "Akaray", Augathella developed a method of dispensing urea and molasses to sheep in the 1969 drought.

The design is safe, non-clogging and can be used in paddocks where sheep and cattle run together.

While the Department has no documented evidence of responses to its trial work in the field when supplementing sheep with urea and molasses Mr. Arden claims he has had success at "Akaray".

Mr. Arden said: "We thoroughly recommend a urea molasses mix where it can be afforded. In past droughts our sheep ate false sandalwood and brigalow leaves with a urea molasses supplement and were not impacted. Our ewes lambed successfully on this diet".

Because the feeders can be made from materials found around the property, he says capital outlay is much less than with other feeders.

Parts for the design are:

2 x 200 litre (44 gallon) drums.

40 cm (16″) of 25 nb* (1″) galvanised pipe.

60 cm (2′) of 40 nb (1½″) galvanised pipe.

120 cm (4′) of 32 mm (1¼″) plastic hose.

45 cm (18″) of 12 mm (½″) plastic hose.

A 32 mm (1¼″) to 12 mm (½″) reducer.

A spent ·303 cartridge case and bullet.

A circular wooden float.

A 35 cm (14″) motor cycle tube.

A length of steel welding rod.

Some steel posts, some tie wire and a welder to put it together.

Mr. Arden says, "In a dry time sheep do better spread out. This means many feeders are needed, say up to twenty for 5 000 sheep".

He has had eight of these units working at the same time as well as Davian troughs.

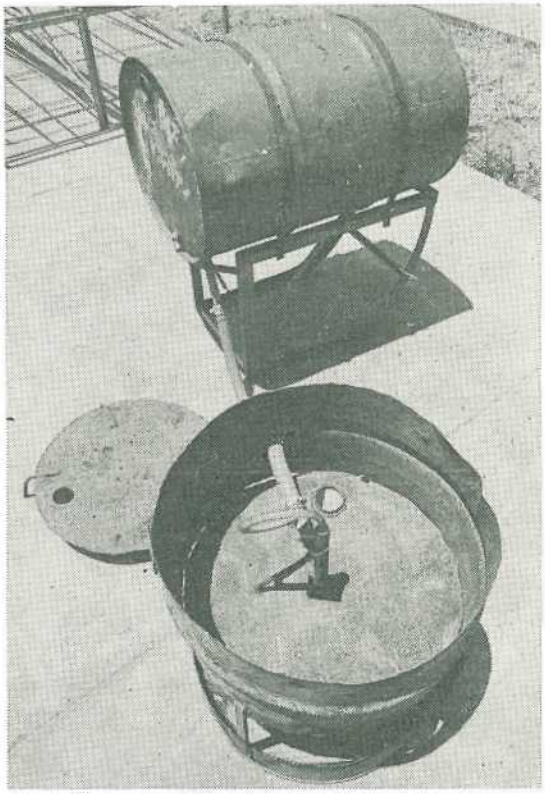
The reasons for this feeder's success are that it needs less servicing than other feeders, and the mixture does not deteriorate as quickly when it is held in a reservoir and not exposed to the air.

The reservoir

The feeder consists of reservoir, feeding trough, valve housing and valve (Figure 1).

The 200 litre (44 gallon) drum which contains the reserve of urea molasses and water mix is mounted horizontally on a stand 50 cm (20″) off the ground. The 32 mm (1¼″) plastic delivery tube is attached to an outlet

* nominal bore.



The feeder with lid removed from valve housing.

pipe of 25 nb (1″) galvanised iron. This outlet is situated about 5 cm (2″) above the bottom of the drum to allow the sludge from the mixture to settle below the outlet and the supernatant to pour freely through the dispensing valve. To protect the delivery tube from stock as it passes to the dispenser it is encased in 60 cm (2′) of 40 nb (1½″) galvanised pipe and tied between 2 steel posts driven into the ground.

The trough

The trough is made from the base of the 200 litre (44 gallon) drum and has 14 cm (5½″) sides. It contains a circular float made from 50 mm x 12 mm (2″ x ½″) softwood battens held together by 150 mm (6″) x 12 mm (½″) cross pieces. An inflatable motor cycle tube rests underneath the float.

The tube can be inflated or deflated to vary sheep intake by lifting or lowering the float in the mix as required. The tube also buoys the float up should it be accidentally stood on by sheep. This reduces the possibility of sheep drinking toxic quantities of urea and molasses.

The valve housing

The housing is made from the end of the drum that made the trough plus an extra drum end for a lid.

It has 30 cm (12″) sides and is mounted 20 cm (8″) above the trough by four metal uprights welded to the outside of the trough and housing.

The valve

The 32 mm (1¼″) delivery hose from the reservoir passes into the housing where it is reduced to 12 mm (½″) plastic hose.

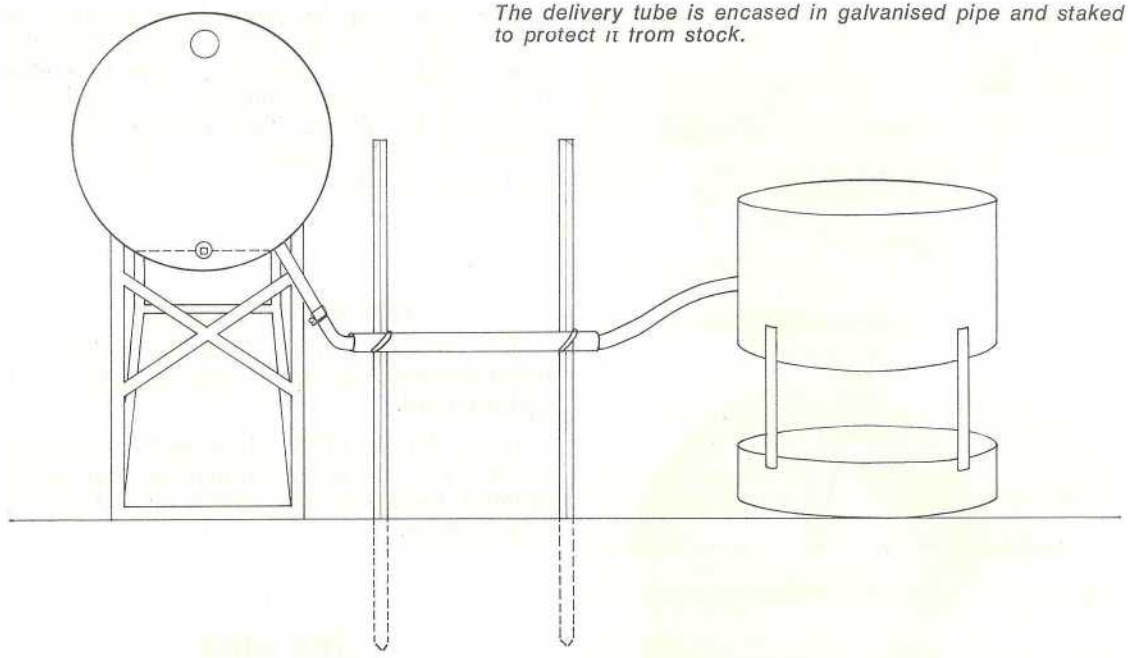
This hose is held in the valve casing by a 12 mm (½″) rubber band cut from a bike tube. The valve casing is 20 cm (8″) of 25 nb (1″) galvanised pipe. A hole is cut in the side of the casing to allow the rubber band to grip the hose. Pushed upright into the end of the hose is the spent ·303 cartridge case with its base cut off.

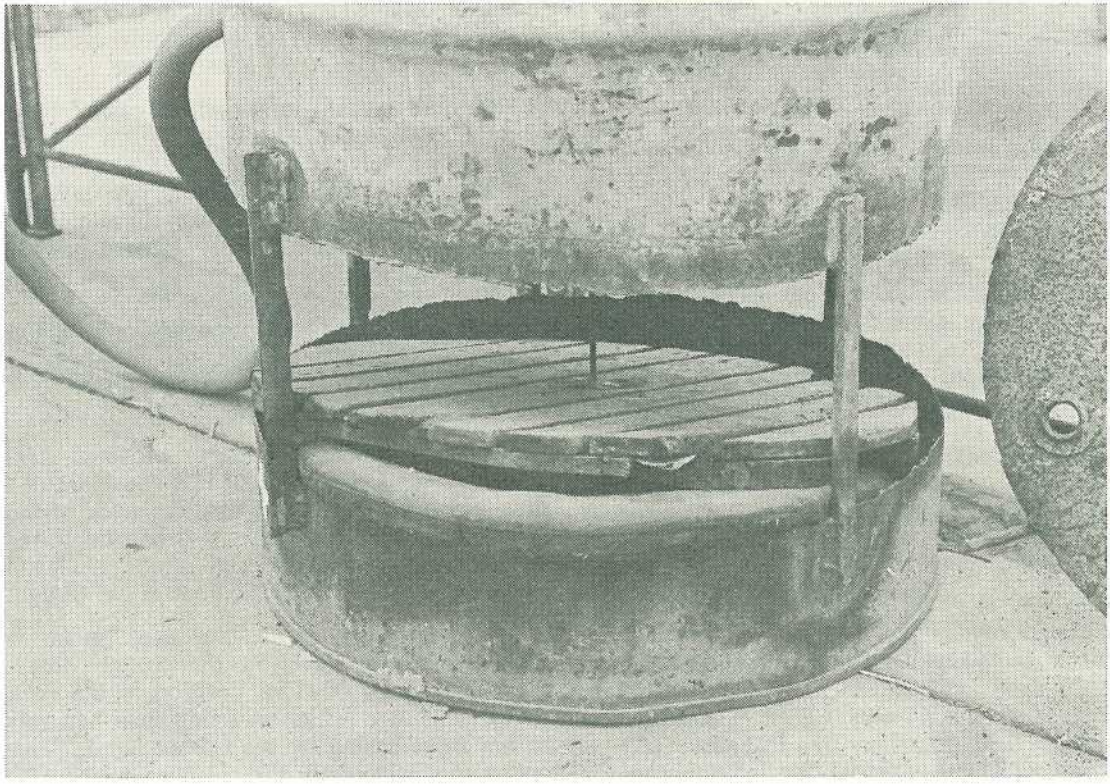
The valve casing is secured vertically about 25 mm (1″) above a hole in the housing floor by a rod welded to it and the floor.

Through the hole in the housing floor passes a 30 cm (12″) length of hard steel welding rod. On the top of this rod is welded the ·303 bullet which fits into the neck of the cartridge case in the delivery tube and forms the valve. The opposite end of the steel rod is attached to the top of the float in the trough.

As the sheep drink the urea molasses mixture and the level in the trough drops, the bullet drops from its position in the neck of the cartridge which is being held securely to the valve casing by the rubber band. This opens the valve and allows more mixture to pour over the float and into the trough.

The delivery tube is encased in galvanised pipe and staked to protect it from stock.





The float and inflated bike tube in the feeding trough.

Points in construction

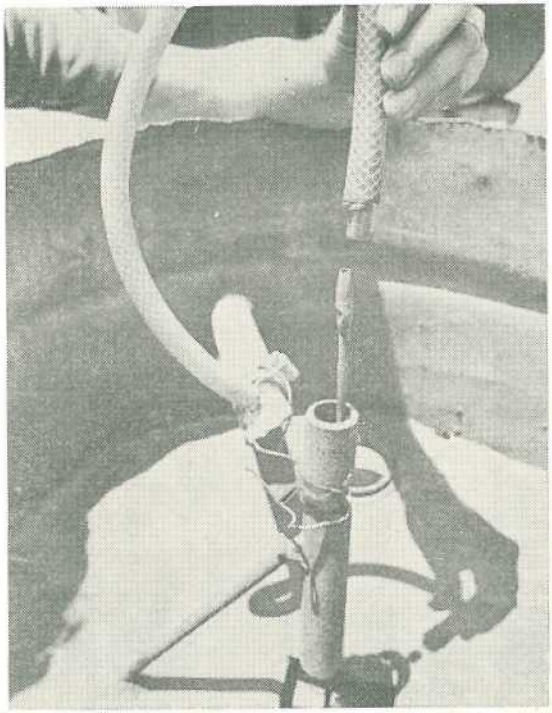
1. The float must be circular so that it can rotate 360° in the trough without jamming. Allow 12 mm (½″) gap between the float and the sides of the trough. Drill 2 x 18 mm (¾″) holes in the centre batten beside the steel rod. This allows the urea molasses mixture to pass quickly into the trough.

2. The feeder can be secured on the ground by three steel posts driven into the ground around its perimeter. Placing the feeder on a large piece of masonite or plywood prevents dust buildup against the trough. It can be swept clean when the trough is visited.

3. A breather hole must be punched into the top of the reservoir.

4. The outlet for the delivery pipe must be 5 cm (2″) above the bottom of the reservoir. This prevents sludge and shale of the drum from entering the delivery pipe.

5. The delivery pipe must be encased in 40 nb (1½″) galvanised pipe and staked to prevent horses and cattle disturbing the unit.



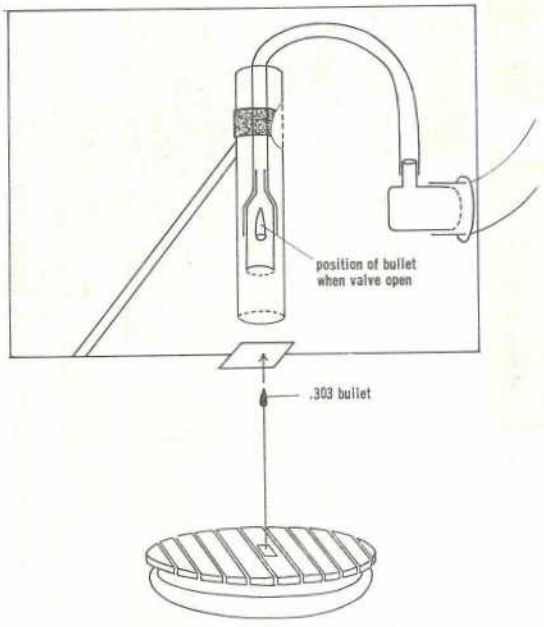
The disassembled valve removed from the valve casing.

Adjustments

1. The bullet must never be allowed to drop out of the cartridge case. This can be prevented by correct adjustment of the height of the cartridge case using the rubber band on the valve casing and by inflation of the bike tube which reduces the vertical travel of the float to about 12 mm (½″).

If the trough is unused for some weeks the bullet may become glued to the cartridge case.

2. The softwood float does become waterlogged in time. As this occurs the rubber tube can be inflated. The top of the float should sit 12 mm (½″) above the urea molasses mixture.



The valve closes when the bullet is forced up into the neck of the cartridge case as the trough fills.

Cleaning

The reservoir and feeder can be tipped up and hosed out with the pump that is needed to fill the reservoir with mix. This is necessary once every three weeks or more, or the mixture in the trough becomes too foul for sheep to drink.

CHEMICAL WEED CONTROL GUIDE
WINTER CEREALS 1976

Compiled by S. R. WALSH and J. M. T. MARLEY, Agriculture Branch.

The chart on the following page is a guide to the chemical control of weeds in winter cereal crops.

While chemical herbicides have a valuable part to play in supplementing mechanical weed control, they can never be used to replace sound cultural practices.

Each year the number of chemicals commercially available increases. The successful use of these chemicals depends on a number of factors. These include the choice of the most efficient chemical, the correct timing of the spraying, and the rate and method of application. Careful attention should also be given to applying the chemical at the correct stage of crop growth so that injury to the crop can be kept to a minimum.

It is important that the weed should be identified correctly before selecting the chemical to be used. The weeds listed in the guide are those that occur most frequently in winter cereal crops.

The explanatory notes below are most important and should be read in conjunction with this guide.

When applying herbicides, producers should take care to avoid spray drift.

Further information on weed control may be obtained from your local agricultural adviser.

HERBICIDE RATES IN MILLILITRES PER HECTARE

Cereal Weeds	Avadex BW	Treflan	2,4–D Amine (50% W.V.)	MCPA (27% W.V.)	Tordon 50D	Brominil	Buctril MA Brominil M	Dicamba (20% W.V.)
Wild oats	*2 100	1 000	..	..	..	..	..	..
Paradoxa grass	..	*1 000	..	..	..	..	..	..
Climbing buckwheat	..	..	1 100 (+W)	2 800	*470	1 400	1 400	700
Wireweed	..	1 000	*1 700 (+W)	..	470 + 2,4–D †	1 400 + 2,4–D ††	1 400	700
Turnip-weed	..	..	*700	1 400	470 + 2,4–D †	1 400 + 2,4–D ††	1 400	700 + 2,4–D ††
Mustards } Radish§ }	..	..	*1 100	2 100	470 + 2,4–D †	1 400 + 2,4–D ††	1 400	700 + 2,4–D ††
Variegated thistle	..	..	*1 100	2 100	470 + 2,4–D †	1 400 + 2,4–D ††	1 400	700
Saffron thistle	..	..	*1 700 (+W)	3 500	..	..	1 400	..
Hexham-scent	..	..	*1 700 (+W)	..	470 + 2,4–D †	..	1 400	700
New Zealand spinach	..	..	..	..	*470	..	..	700
Spiny Emex	..	..	1 700 (+W)	..	*470	..	1 400	700

Docks	..	..	1 700	..	*470	..	..	700
Mintweed	..	..	*1 100	..	470 + 2,4–D †	..	..	700 + 2,4–D ††
Sunflower	..	..	*1 100	..	470 + 2,4–D †	..	..	..
Paterson's curse	..	..	*1 700	..	..	..	..	..
Bindweed (perennial)	..	..	*1 700	3 800	..	..	..	..
Hoary cress (perennial)	..	..	*1 700	..	..	..	..	..
Mexican poppy	..	..	*1 700	..	..	..	1 400	..
Growth stages for application to crop	Pre-sowing	Pre-sowing	Tillering	Tillering	Tillering	2-leaf through tillering	3-leaf through tillering	Tillering
Annual weeds	..	..	Pre-emerge	Pre-emerge	Young	Young	Young	Young
Perennial weeds	..	..	..	..	PRE-FLOWERING	PRE-FLOWERING	NOT EFFECTIVE	NOT EFFECTIVE	PRE-FLOWERING
Crop tolerance—								
Wheat	..	..	2 100	Not recomm.	2 200	5 600	Tol.	2 100	2 100	700
Barley	..	..	2 100	1 000	1 700	4 200	Tol.	2 100	2 100	700
Oats	..	..	Non-tol.	Non-tol.	1 100	4 200	Tol.	2 100	2 100	700
Canary seed	..	..	Non-tol.	Non-tol.	1 100	NA	NA	NA	NA	NA
Undersown lucerne	..	..	2 100	Not recomm.	Non-tol.	Non-tol.	Non-tol.	NA	Non-tol.	Non-tol.
Methods of application—								
Boom sprayer	..	..	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aircraft	..	..	No	No	Yes	Yes	Yes	No	MA. No M. Yes	Yes
Misting machine	..	..	No	No	No	No	No	No	No	No
Approximate cost per litre $ as at April 1976	5.28	7.05	2.58	1.37	6.83	5.30	6.20	4.56

NOTE:—

1. The treatment marked with an asterisk is the usual suggestion for cost efficiency.
2. (+W) indicates to add non-ionic wetting agent at 1 part of 50% to 60% product to 1 600 parts of spray mixture.
3. 2,4–D and MCPA formulations vary in the percentage of active ingredient—check the label and adjust the rate accordingly.
4. Tol. indicates the crop is normally tolerant at the suggested rates of application.
5. Not recommended indicates the chemical should NOT be used on this crop as crop damage may occur.
6. NA indicates crop tolerance data not available.
7. 2,4–D esters must NOT be used in declared hazardous areas.
8. + 2,4–D † indicates add 470 ml per hectare of 50% 2,4–D amine.
9. + 2,4–D †† indicates add 700 ml per hectare of 50% 2,4–D amine. When 2,4–D is added to Brominil application must be restricted to the tillering stage of the crop.
10. For linseed and safflower Avadex at the rate of 4 200 ml per hectare is recommended as a pre-sowing application for wild oats control. It is cheaper than Avadex BW but SHOULD NOT be used on wheat or barley.
11. (§) For adequate control of radish extra 2,4–D above the rate indicated in this guide may be required. Consult your Agricultural Adviser.
12. Residual activity of Treflan or Tordon 50D may restrict the choice of the subsequent crop. Consult the manufacturers' labels.
13. For cereals undersown with lucerne 2,4–DB may be used to control some broad-leaved weed species. Consult your Agricultural Adviser.
14. Sprays should be thoroughly mixed before application.
15. To convert millilitres per hectare to pints per acre divide by 1 400.
16. ALWAYS READ LABELS THOROUGHLY before using chemicals.

POMEFRUITS

Summary of Insect Control Recommendations

prepared by Entomology Branch Officers.

THE following tabulation summarises the pesticide recommendations for pomefruits. Further details on identification, control of the pests listed and of minor pests not listed, where necessary, should be sought from extension officers of the Department. Bees are important to the pollination of pomefruits. Insecticide use during flowering should be avoided whenever possible. When necessary, applications should be made when bees are least active.

Pest	Description of Pest	Damage to Crop	Control Pesticide	Notes
San Jose scale *Quadraspidiotus perniciosus* (Comstock)	Sedentary scale insects located on wood, fruit and foliage of all varieties of pomefruits. The adult female is a soft-bodied yellow, tear-drop shaped insect, covered with a hard circular grey-dark brown scale cover, with a central darker raised area, and of about two mm in diameter. Male scale covers are eliptical, with the raised area towards one end. When scales are very dense on woody tissues, the bark has an ashy or scurfy appearance. Scales on fruit are often surrounded by a red "halo"	Adults and nymphs pierce and extract sap from plant tissues. Lightly infested trees show reduced vigour. Heavily infested trees may defoliate and very heavily infested trees may be killed. Recovery of trees after infestation by San Jose scale is slow. Fruits infested with scales surrounded by red inflamed area are unattractive and are downgraded	Superior dormant oil 2%	San Jose scale is potentially a very serious pest, but populations occur very sporadically in orchards in the Granite Belt. Superior dormant oil sprays should be applied to bearing and non-bearing fruit trees during the dormant to green tip stages of tree growth. Sprays used for codling moth control provide some control of scale "crawlers". A san Jose phytosanitary certificate is required for fruit exported to Europe

Plague thrips *Thrips imaginis* Bagnall	Mature adult thrips are small (up to 1·5 mm long), elongate, active, brown, winged insects. Young adults and nymphs are white. The adults' wings are edged with long fine hairs. During October, all stages are found in pomefruit blossom and on young foliage	Thrips feed by rasping plant tissues and sucking up the exuding plant juices. When thrips feed in unopened flowers, premature damage to the female styles occurs and subsequent fertilisation and fruit set is prevented	Endosulfan 0·07% ..	Thrips are present in blossoms every season from early spur-burst to calyx. Control measures should be applied if numbers exceed 6 to 8 per blossom prior to full bloom; after full bloom up to 20 thrips per blossom can be tolerated; endosulfan should be applied when bees are not actively working blossom (i.e. early morning, late afternoon, or at night)
Dimple bug *Campylomma livida* Reuter	Small (up to 2·5 mm), active yellow-green bugs, found amongst pomefruit blossoms and on very young fruits	Bugs pierce and suck sap from developing fruits; the feeding puncture first appears as a small raised area of scar tissue, resembling a wart. As the fruit grows, the damaged tissue fails to grow as fast as the surrounding tissues and is left at the bottom of a depression. At harvest the damage appears as a characteristic dimple	Endosulfan 0·07% ..	Dimple bugs are sporadic pests of pomefruits in Granite Belt orchards. Chemical control measures should be applied when bug members exceed an average of 1 bug per 10 blossom clusters; bugs are attracted to blossom and a spray may be necessary at full bloom; further insecticide applications are only needed if reinfestation occurs. Jonathan apples do not show dimple bug damage. Pears are less susceptible to damage than apples. Endosulfan should be applied at times of the day when bees are least active
Native budworm *Heliothis punctigera* Wallengren	Caterpillars up to 40 mm long, varying in colour from green to brown with varying amounts of black colouration. The adult moths are solid bodied with a wing span of 40 mm. The forewings are reddish brown to light brown while the hind wings are creamy yellow with large marginal smoky areas	Moths are attracted to and lay eggs on, or in the vicinity of flowers. Young caterpillars chew small circular holes in the fruit as they wander through blossom clusters. As the larvae grow, they chew large holes in the fruit surface or may tunnel through fruit	Endosulfan 0·07% ..	A sporadic pest in Granite Belt orchards. Endosulfan should be applied at full bloom and at times of the day when bees are least active
Looper caterpillars *Chloroclystis* spp.	Small dark coloured caterpillars up to about 15 mm long, characterised by their looping movement	Caterpillars feed on the skin of fruits. As the fruit grows, the damage appears as irregular shaped raised calloused areas. The damage is similar to that caused by hail during the blossom period	Endosulfan 0·07% ..	A minor pest in Granite Belt orchards. Endosulfan should be applied at full bloom and at times of the day when bees are least active

POMEFRUITS

SUMMARY OF INSECT CONTROL RECOMMENDATIONS—continued

Pest	Description of Pest	Damage to Crop	Control Pesticide	Notes
Codling moth *Laspeyresia pomonella* (Linnaeus)	Adult moths are small grey moths with a wingspan of about 20 mm. The forewings are grey with a circular bronze area at the tips. The caterpillars which grow to about 20 mm long are white when small and pink when fully fed, and have a black head and black band just behind the head	Eggs are laid singly on or in the vicinity of fruit. Young larvae penetrate the skin of fruit and tunnel towards and feed on the seeds and surrounding tissues. When fully fed, they tunnel to the outside and leave the fruit to pupate. The entry and exit holes are usually surrounded by dark brown sawdust-like frass. Damaged fruit often drop prematurely	Azinphos-methyl 0·05% OR carbaryl 0·1% OR methidathion 0·05%	Codling moth is the major pest of pomefruits in the Granite Belt. It is active from calyx to harvest and insecticides should be applied at calyx, a fortnight later, and then at three-weekly intervals until mid-late February. Carbaryl will cause fruit to drop if applied within four weeks of calyx. Carbaryl will control pear leaf blister mite. Azinphos-methyl and methidathion provide some control of fruit fly. Methidathion controls woolly aphis and San Jose scale crawlers
Light brown apple moth *Epiphyas postvittana* (Walker)	Adult moths are about 20 mm long. The forewings are brown, the basal half being light brown and the back half dark brown. Caterpillars which grow to about 25 mm are green, and are found in silken shelters on leaves or between fruits and/or leaves. When disturbed, the caterpillars wriggle actively forwards or backwards out of their shelters	Caterpillars web leaves and/or fruits together to form a shelter wherein they feed. Leaves are skeletonized and have a ragged appearance. Fruits have shallow irregular shaped areas chewed in the skin. Occasionally, caterpillars may enter fruits at the calyx and feed therein	Azinphos-methyl 0·05% OR carbaryl 0·1% OR methidathion 0·05%	This is usually a minor pest in Granite Belt orchards. LBAM has a wide range of host plants, including many orchard weeds. Clean cultivation in orchards assists in reducing LBAM populations
Pear leaf blister mite *Eriophyes pyri* (Pagenstecher)	Minute, cigar shaped, four legged, white-yellow mites which can only be seen with the aid of a magnifying glass	The feeding activities of mites on young foliage and fruits produces reddish-brown blister-like galls. Damaged fruits may be shed	Lime sulphur 1% OR carbaryl 0·1%	This is a minor pest of pears only. Lime sulphur should be used at the green tip stage of tree growth, and carbaryl should be used during the growing season. The lime sulphur treatment can be incorporated in the pear scab control programme and the carbaryl treatment can be incorporated in the codling moth control programme

Woolly aphid *Eriosoma lanigerum* (Hausmann)	Colonies of soft-bodied, purplish-brown, sluggish, sucking insects, which are covered with white woolly material, located on the woody tissues of apple trees	The feeding activities of large populations of aphids reduces the vigour of trees. Laterals may be defoliated prematurely and buds may be destroyed. Infested wood becomes severely swollen and gnarled. The aphids also produce a sticky secretion (honey dew) on which black sooty mould rapidly develops. Fruits covered with honey dew and sooty mould are unattractive and are downgraded	Vamidothion 0·05%	A pest of apples only. Vamidothion should be applied during November. It has a withholding period of 42 days. Methidathion, when used for codling moth control, also controls woolly aphis. Orchard populations may be minimised by using resistant rootstocks (e.g. Northern Spy and Malling-Merton stocks). The parasitic wasp, *Aphelinus mali*, is also effective is reducing populations in young non-bearing unsprayed orchards
Two-spotted mite *Tetranychus urticae* (Koch)	Adults and nymphs are white-yellowish, spider like mites, with two dark spots on the back. Adults are up to 0·5 mm long. Eggs are clear-white and are spherical. Colonies of mites produce webbing on leaves, usually the undersides. Large poputions produce large amounts of webbing in trees in Autumn. This species overwinters as orange coloured adult females sheltering in litter and soil at the base of trees, or as the two-spotted form breeding slowly on evergreen alternative hosts	Mites feed on leaves by piercing the surface tissues and extracting sap from the underlying cells. Subsequently trees become mottled and bronzed and defoliate prematurely. Fruit from damaged trees fails to colour or size properly and juice content is reduced. Premature defoliation exposes fruit to sunburning. On pears, mites induce severe blackening of the foliage and fruit, during hot weather (pear leaf scorch)	Cyhexatin 0·02% ..	Applications of chemicals should be made at 4–6 weekly intervals, commencing in early November. On apples, a programme of binapacryl or oxythioquinox for powdery mildew control, also controls mites. Thorough spray coverage is essential
European red mite *Panonychus ulmi* (Koch)	Small (up to 0·5 mm long) dark red, globular shaped spider mites. Eggs are orange-bright red and are spherical with a fine hair projecting from the upper surface. This species overwinters in the egg stage. This species does not produce webbing on foliage. On severely damaged trees, adult female mites can be observed suspended on silken threads, which are blown by wind, enabling mites to disperse	Mites feed on leaves by piercing the surface tissues and extracting sap from the underlying cells, thereby reducing their chlorophyll content. Heavily infested trees become bronzed and mottled and may defoliate prematurely. Fruit from mite damaged trees fails to colour and size properly and juice content is reduced. Premature defoliation exposes fruit to sunburning. Fruit buds may be weakened thereby reducing the next-season crop	Superior dormant oil 2% OR cyhexatin 0·02%	Superior dormant oil should be applied during the dormant to green tip stage of tree growth. This spray controls the overwintering egg stage. Cyhexatin should be applied in early November and at 4–6 weekly intervals thereafter. On apples, binaparcryl and oxythioquinox, when used regularly for powdery mildew control, also control mites. Thorough spray coverage is essential. This pest is rarely a serious problem on pears

POMEFRUITS

SUMMARY OF INSECT CONTROL RECOMMENDATIONS—continued

Pest	Description of Pest	Damage to Crop	Control Pesticide	Notes
Queensland fruit fly *Dacus tryoni* (Froggatt)	Adults, which are about 7 mm long, are brown wasp-like flies, with yellow markings on the sides of the thorax and a yellow band on the abdomen just behind the thorax. The adult females may be observed walking over fruit surfaces with their wings held at right angles to the body. While walking over fruits they repeatedly pierce the fruit skin with the ovipositor and deposit eggs just below the surface. The pale cream maggots, which grow to about 13 mm long, tunnel extensively through fruits	The stings made by the females when laying eggs appear as small discoloured, often black spots. Rot organisms are introduced with the eggs. Internal tissues of fruits are destroyed by the tunnelling of the maggots and the development of the rot organisms	Dimethoate 0·03% OR fenthion 0·04%	A serious pest in the Granite Belt orchards. Dimethoate and fenthion kill adults by contact action and also kill eggs and maggots inside fruit. Fruit fly activity can be gauged by proprietary lure traps. Chemicals should be applied when flies are trapped. A programme of azinphos-methyl or methidathion, for codling moth control, also controls fruit fly

QUANTITY OF MATERIAL PER 100 LITRES OR 100 GALLONS TO OBTAIN RECOMMENDED SPRAY CONCENTRATION

Material (Common Name)	Percentage Concentration active constituent	Strength of Product (no particular company's formulation is favoured)	Quantity per 100 litres	Quantity per 100 gallons
Azinphos-methyl	0·05%	25% wettable powder	200 g	2 lb.
		50% wettable powder	100 g	1 lb.
Carbaryl	0·1%	80% wettable powder	125 g	1 lb. 4 oz.
		50% emulsifiable concentrate	200 ml	1 pt. 12 fl. oz.
Cyhexatin	0·2%	50% wettable powder	40 g	6·4 oz.
Dimethoate	0·03%	30% emulsifiable concentrate	100 ml	16 fl. oz.
Endosulfan	0·07%	35% emulsifiable concentrate	200 ml	1 pt. 12 fl. oz.
Fenthion	0·04%	55% emulsifiable concentrate	75 ml	12 fl. oz.
Lime sulphur	1·0%	20% solution	5 l	5 gal.
Methidathion	0·05%	40% emulsifiable concentrate	125 ml	1 pt.
Mineral Oil	2·00%	100% emulsifiable concentrate	2 l	2 gal.
Vamidothion	0·05%	40% emulsifiable concentrate	125 ml	1 pt.

Withholding periods: To ensure that spray residues diminish to an acceptable level, the following periops should be observed between the last application of the pesticide and harvest.

	Days
azinphos-methyl	14
carbaryl	3
cyhexatin	2
dimethoate	7
endosulfan	14
fenthion	7
lime sulphur	withholding period not required
methidathion	14
mineral oil	1
vamidothion	42

LOOKING BACK

Some items of interest which appeared in the Queensland Agricultural Journal, seventy-five years ago, in May and June 1901.

*The first sale of wheat by public auction was held in Brisbane in April. The results were hardly satisfactory. Of the 5,560 bushels offered for sale, not a single bushel was sold, as the reserve price was not reached.

*In a reply to a correspondent, a horticulturist answered—

You ask: *"What is the least objectionable weed in a potato field?" The least objectionable weed is a dead one.*

*There was a review of a new invention *destined to relieve man of heavy and tardy manual labour*—in this case, a hand-driven horse-clipping machine.

*Sparrows were causing problems, both in the city and in the country. *The shooting with pea-rifles indulged in by numbers of young people in the suburbs has not the slightest effect upon the survivors, and is positively a dangerous practice. We would suggest to those who are troubled with the sparrows that they should take steps in the way of forming an association having for its object the destruction of these and other bird pests.*

LAMBING PERCENTAGES

by C. I. YOUNGER, Sheep and Wool Branch.

MINIMISING lamb losses will mean more sheep in the flock at little extra cost. This gives the owner a wider selection for high wool producers in his breeding flock and more surplus sheep for sale.

Lambing percentages vary with districts and individual properties. Some breeders blame poor conception rates for low lambing figures. Others report losses between birth and marking or marking and weaning. Losses after weaning are usually slight.

Seasons cannot be controlled but many other factors influencing lambing percentages can. Good sheep husbandry is often the only difference between good and mediocre lambings.

Careful husbandry at the following stages can help to increase lambing percentages:—

1. Pre-joining.
2. Joining.
3. Pregnancy.
4. Lambing.
5. Post-lambing to weaning.

Pre-joining

Four to six weeks before joining inspect the rams and ewes. Make sure they are healthy and free from internal and external parasites. Protect them against fly strike.

Rams

Remove all aged, infirm and diseased rams and those with faults in the testes.

It is essential not to overheat rams during this period.

For two to three months before joining they should be on good feed. If this is unavailable supplement them with 0·5 kg lucerne hay or 0·25 kg grain or sheep nuts per head per day.

If dry conditions have prevailed for six months or more a dose of Vitamin A should be given.

Do not jet or dip rams with arsenic within six weeks of joining as it can cause temporary infertility.

Ewes

Check all ewes and reject potentially bad mothers. Woolblind ewes should be discarded from the breeding flock at classing. Those with faulty udders, e.g., mastitis, blind teats, no teats, invariably lose their lambs through lack of milk and should be culled at crutching or shearing.

Joining

If any distance is involved it is best to transport the rams to the joining paddock in the cool part of the day so that they do not become overheated.

Muster the ewes to the water and introduce the rams. Put out the stronger half of the rams first—the mere presence of rams will stimulate the ewes. Introduce the rest 10 to 14 days later.

For successful mating the rams should be in daily contact with all the ewes. Where there are multiple watering points in a paddock sheep tend to become scattered. For this reason it could be advantageous to yard the rams with the ewes occasionally to ensure regular contact.

Young vigorous rams should be joined to the maiden flock.

Joining usually lasts six to eight weeks.

Put the rams on good feed two to three months before joining starts.

Pregnancy

For the first three months after the rams have been removed the ewes can be treated as dry sheep.

They should be in forward store condition for the last six weeks of pregnancy and during lambing.

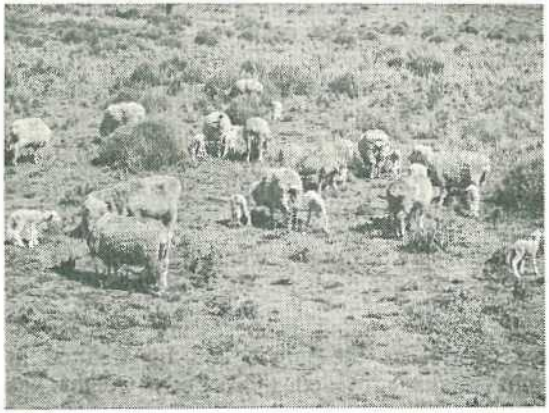
To control parasites drench the ewes with a broad spectrum anthelmintic and jet or crutch them if necessary about six weeks before lambing is due to start. The less disturbance during lambing the better.

At this pre-lambing time intensify your campaign against predators. Pigs, foxes, dingoes, eagle hawks and crows can play havoc with both ewes and lambs unless checked. Neighbouring properties will usually co-operate against predators.

Lambing

If the ewes have been well fed and are healthy there should not be any trouble during lambing.

Below: Good lambing percentages come from good husbandry practices.



If an outbreak of hypocalcaemia or pregnancy toxaemia occurs it should be treated with calcium borogluconate or glycerine respectively, and the ewes given better feed or some supplementary feed.

Older ewes have a steadying effect on maidens so it is a good idea to mix them for lambing.

In intensive sheep farming areas drift lambing is practised widely. Suitable paddocks are sown down to fodder crops or improved pastures and the freshly dropped lambs are moved into these paddocks with their mothers.

Post-lambing to weaning

Lamb marking losses can be kept to a minimum with a little extra effort.

Old dusty yards are a breeding ground of anaerobic infection and should not be used for lamb marking. Erect clean temporary yards in a new spot each year and water them regularly to reduce dust.

Sterilise all instruments and keep them in antiseptic when not in use.

If the property has a history of tetanus inoculate the lambs with anti-toxin and the toxoid. A booster given a year later will give the sheep a lifetime immunity.

Unless the tail docking operation is done correctly the lamb will be susceptible to repeated fly attacks. The tail must be cut to the point of the vulva and have a bare skin flap over the stump.

The mules operation is best done at lamb marking. This will protect the sheep from flystrike during the critical first year.

Lambs are normally weaned at four to six months of age.

If early weaning is necessary because of dry conditions the lambs can be weaned at eight weeks provided their body weight has reached 9 kg.

Young lambs consume little feed so it is economical to give fully hand fed lambs an unrestricted diet. It is important to keep them in very small paddocks until they learn to feed—about 1 200 to 1 600 lambs per ha —with plenty of water and shade. Good quality lucerne chaff and grain in equal parts by weight plus 1% finely ground limestone is a good ration for young weaners. It is a good plan to run 5% of adult dry sheep with them to act as coaches. A vitamin A supplement should be given if dry conditions persist.

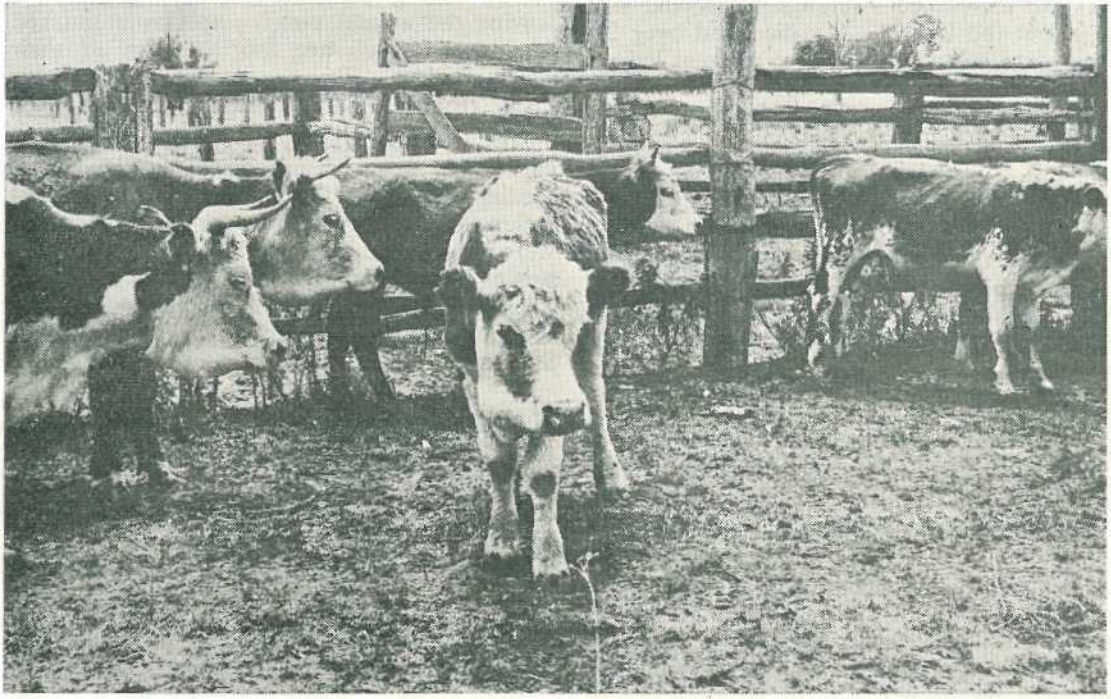
If sheep have been well cared for to this stage they should be healthy well grown wool growers.

Some aspects of St. George disease

by S. G. KNOTT, Vet. Services Branch.

ST. GEORGE disease in south-west Queensland was shown by I. A. Clark at the Animal Reseach Institute to be caused by the ingestion and/or inhalation of *Pimelea trichostachya,* commonly referred to as flax weed.

At about the same time New South Wales researchers found that *Pimelea simplex,* known as desert rice-flower, produced the same symptoms. S. L. Everist in his book "Poisonous Plants of Australia" states that there are about 80 species of Pimelea in Australia, but the majority of these occur in south-west Western Australia. He further states that most of them appear unpalatable, but it seems likely that any of them could be toxic if eaten in sufficient amount.



These cattle show extensive swelling below the jaws and are very typical of animals affected with St. George disease.

Symptoms and Distribution

Before discussing plants and conditions which induce St. George disease, the reader should understand that pimelea species are capable of causing two separate conditions, an acute one typified by diarrhoea, and a chronic form associated with swellings under the jaw and/or lower neck and brisket. It is this latter syndrome associated with congestive heart failure, anaemia and liver damage which is referred to as St. George disease.

It is commonly observed in cattle in the Maranoa and Warrego areas, especially on the lighter red country of the Maranoa. However, the same syndrome has been noted on other occasions in areas unrelated to western Queensland. For instance symptoms of St. George disease have been recognised on occasions in cattle in the Brisbane Valley, North Burnett and Rockhampton districts, where *Pimelea trichostachya* is not known to occur.

Pimelea Species Known to Cause St. George Disease

Recently young calves on a property near Blackbutt developed swellings under the jaw and about the brisket. Six died and over 20 others were effected. The post mortem lesions were typical of St. George disease.

A pimelea species, *Pimelea altior* was found to be growing on the property and feeding trials with it were undertaken by R. Rogers at the Animal Research Institute, Yeerongpilly. Four calves were fed at varying dose rates and all developed diarrhoea and swellings under the jaw, which varied from slight to marked. Three exhibited distension of the jugular vein and all developed anaemia, lost weight steadily and became weak. Post mortem findings were those of classical St. George disease.

In western Queensland, two types of *Pimelea trichostachya* are found and they are referred to as Form A and Form B.

Pimelea trichostachya Form A extends from the Darling Downs westwards to about as far as Quilpie and northwards to about the Tropic of Capricorn and is usually found on sandy soils. *Pimelea trichostachya Form B* extends from Charleville westward to Windorah and northward to about as far as Winton and is commonly found on the edges of clay pans.

Pimelea continua has a similar distribution *to Pimelea trichstachya Form B*, and is commonly found on low stony ridges and in small depressions in red-brown to brown loamy soils. Recent work published by W. R. Kelly of the Queensland Veterinary School has shown that *Pimelea continua* also produces symptoms and lesions typical of St. George disease.

Toxicity of Pimelea

There is much field evidence to suggest that sheep do not develop St. George disease and this was confirmed by Clark's research work which showed that a sheep required 10 times the intravenous dose rate of pimelea plant extract to cause fatal pulomonary blood vessel constriction when compared with calves. This was attributed to the well developed muscle coat of these blood vessels in cattle while those in sheep are poorly developed.

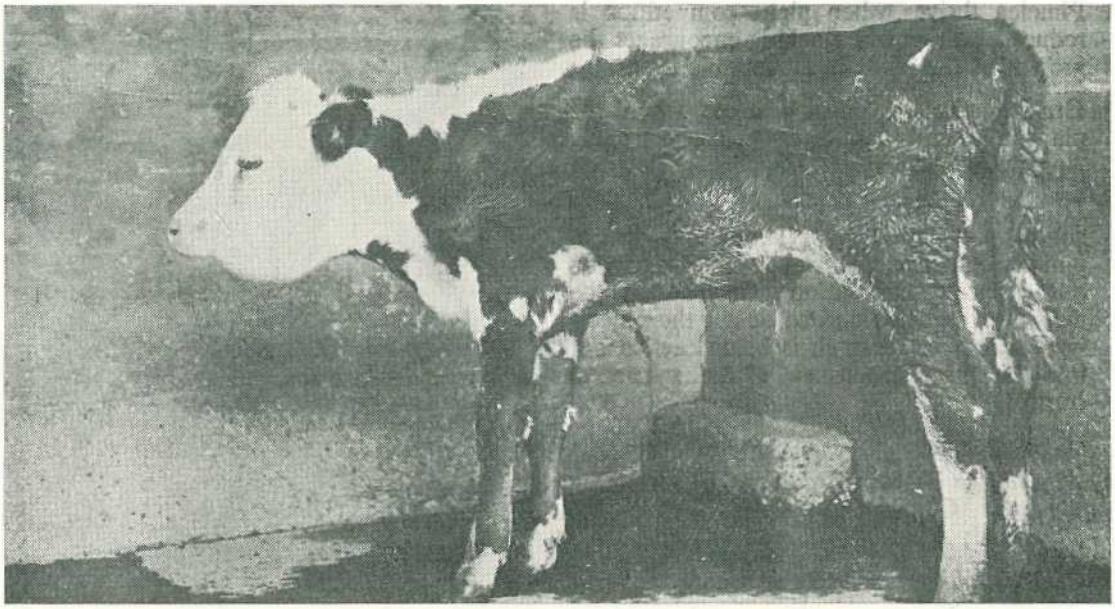
However continued grazing by sheep influenced the increased prevalence of St. George disease when some properties increased cattle numbers at the expense of sheep during the period of low wool and good meat prices. The sheep had selectively grazed out other plants during the succession of dry years, leaving the annual pimelea species untouched for cattle, which are less selective in their grazing habits. This situation made for heavy losses from St. George disease.

The extreme toxicity of pimelea species for cattle was again demonstrated in the recent feeding trial with *Pimelea altior*. In this trial rations containing as little as 0·2% pimelea were toxic to calves. So it will not be surprising if other species of pimelea are subsequently shown to cause congestive heart failure, anaemia and liver damage so typical of St. George disease.

Management of St. George Disease

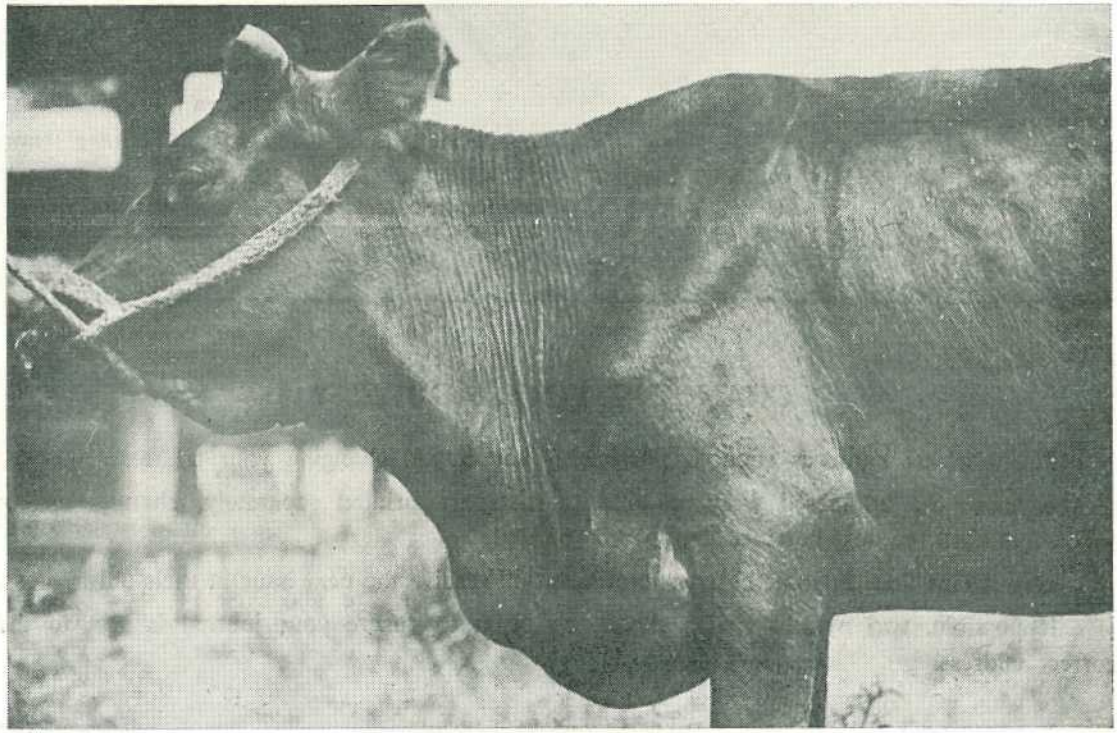
It is unlikely that a simple remedy will be evolved in the near future. But knowing the cause of the condition, owners and managers can try to adopt management procedures which will minimise the impact of St. George disease. Such managemental procedures include:—

- Keeping a body of grass in paddocks free of pimelea, so that stock can be shifted from infested paddocks as soon as symptoms appear.



This calf was fed at the Animal Research Institute, Yeerongpilly with Pimelea altior *from Blackbutt and developed marked sub-mandibular and facial swelling. The post mortem examination findings were typical of St. George disease.*

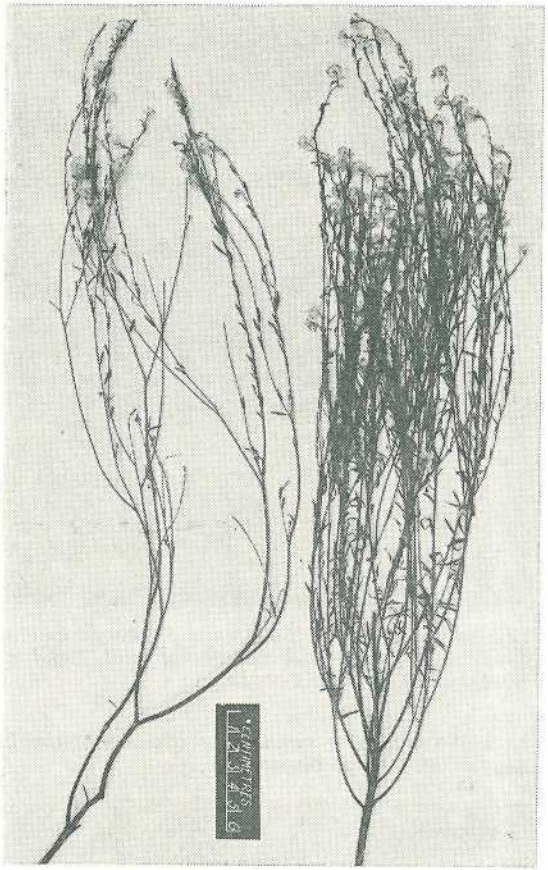
Note the extensive swelling or oedema of the brisket, also along the neck and under the jaws in this case of St. George disease.



- Pimelea thrives when plant competition is reduced, so that overstocking encourages the growth of the plant in susceptible areas.
- Grazing pimelea infested areas when the plant is green is less likely to cause trouble than when it is dry.
- Pasture improvement offers an avenue of control as a good grass sward will control pimelea growth. However unless carried out properly, cultivation can increase the density of pimelea and so defeat the objective. However research is being carried out into this promising aspect of managemental control.

Further Reading

1. *St. George Disease Traced to Flaxweed* by I. A. Clark—Queensland Agricultural Journal; April 1972.
2. *Pimelea altior Poisoning of Cattle* by R. J. Rogers and K. H. Roberts—Australian Veterinary Journal 1976; Vol. 52; p. 193.
3. *The Pathology and Haematological Changes in Experimental Pimelea SPP. Poisoning in Cattle* by W. R. Kelly—Australian Veterinary Journal 1975; Vol. 51; p. 233.



Pimelea trichostachya Form A

This plant is to be found from the Darling Downs west to Quilpie and north to about the Tropic of Capricorn and is commonly responsible for causing symptoms of St. George disease in cattle on the Downs and in the Maranoa and Warrego regions.

CHANGING YOUR ADDRESS?

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Safari . . . a new pasture legume for the sub-tropics

by K. A. SHAW* and T. J. QUINLAN†

Safari Kenya white clover (Trifolium semipilosum **cv. Safari) shows great potential as a pasture legume for sub-tropical areas of Queensland with annual rainfall of 1 000 mm or more. Its performance has been outstanding in some trials and under commercial grazing conditions in demonstration paddocks.**

AS the name implies, Safari comes from Kenya, where it grows naturally with kikuyu grass *(Pennisetum clandestinum)* in highland areas.

Safari was introduced to Australia in March 1960 and released as a commercial cultivar in June 1974.

Safari is a perennial legume with a strong taproot. Stems radiate from the crown and root strongly at the nodes. Under moderate to heavy grazing the plants intertwine to form a dense mat. Under lenient grazing the stems can grow upwards.

The leaves are trifoliate, with leaflets being usually notched at the outer end and finely toothed around the margins. Most leaflets are unmarked, but approximately 30% of plants have a broad white mark along the midrib of the leaflets and some 5% have a red inverted "V" across the leaflets. The upper surface of the leaflets is hairless; the under-surface is hairy along the midrib of all three leaflets and on one half (lengthwise) of each lateral leaflet. The specific Latin name *semi-pilosum* means "half hairy". The petiole (leaf stalk) may be more than 26 cm long in ungrazed or lightly grazed situations.

Safari inflorescences (flower heads) are globe shaped and consist of from 4 to 40 flowers. Flower colour varies from white to dark pink although most flowers are light pink. Seed colour varies, with dull yellow, light brown, olive grey and even black seeds being found. Safari seeds are approximately twice the size of those of common white clover (*Trifolium repens*).

Advantages

Safari is a tropical legume which combines many of the better qualities of existing commercial tropical and temperate legumes.

It is capable of year round growth although it slows down in winter. By comparison, tropical legumes make good summer growth but are poor in winter, while common white clover makes good growth only from mid-autumn to late spring with some slowing down in winter. Safari is slightly less frost tolerant than white clover but is more drought tolerant.

* *Agriculture Branch.*
† *Formerly an officer of Agriculture Branch.*

This was once a run down pasture of mat grass (Axonopus affinis) *and paspalum with a small amount of kikuyu remaining. As Safari raises the soil nitrogen level, kikuyu regrows and replaces the poorer grasses.*

Once established, Safari is less sensitive to grazing than either the tropicals or white clover, both of which demand careful management. Most tropical legumes are intolerant of too frequent and too severe grazing; thus, if managed to maintain the legume the grass is under-utilized. White clover is sensitive to shading, and grass competition is difficult to control.

On the Evelyn Tableland Safari is not attacked by clover rust (*Uromyces trifolii-repentis*) and pepper spot (*Sphaerulina trifolii*). These fungal diseases severely damage white clover.

Digestibility and protein content of Safari are similar to those of white clover, around 75% and 25% respectively. Most tropical legumes are of lower quality, with a normal protein content of 18 to 20% and a digestibility of 60 to 65%.

Safari tolerates soil acidity better than white clover.

Weaknesses

Although Safari has been very successful on the Evelyn Tableland and in some trials in south-eastern Queensland, there have also been some failures. In many cases these are inexplicable but may be due to rugose leaf curl disease (see section on pests and diseases) and subsequent grass competition.

Farmers on the lower tablelands of northern Queensland and in south-eastern Queensland should seek advice before planting Safari.

Trial Results

Trials on the Evelyn Tableland have highlighted the potential of Kenya white clover for the Evelyn, Chilverton and Ravenshoe areas. During 1972 a Safari-grass pasture produced 10 000 kg per hectare of total dry matter, of which 6 000 kg was legume. Over the same period Louisiana white clover produced only 225 kg per hectare of legume. Actually Louisiana disappeared from the pasture over the summer of 1973 while Safari continued to grow vigorously.

Liveweight gains of beef cattle grazing pastures based on Safari and common white clover have been measured by CSIRO in south-eastern Queensland. Both pastures were stocked at 2·5 beasts per hectare. From July 1971 to July 1972 the liveweight gain per head was 191 kg from the Safari pasture and 126 kg from the white clover pasture.

Establishment

Quickest establishment is obtained where the legume is sown into a fully prepared seedbed. A seeding rate of 3 kg per hectare is recommended and Safari should be planted between January and early May. Safari must be inoculated with the correct rhizobium strain (CB 782) before planting, as it is highly specific in its rhizobium requirements.

The seed should be lime pelleted if it is to be broadest without covering or sown in contact with fertilizers. Molybdenum trioxide may be included in the pelleting mixture to ensure a molybdenum supply. Sodium molybdate is toxic to the rhizobia and must not be used in the pellets.

Greatly improved germination has been observed where the seedbed was rolled after planting, and this practice is strongly recommended.

The fertilizer requirements for establishment and maintenance are similar to those of other tropical legumes, and district recommendations should be followed.

A trial on the Evelyn Tableland compared partial cultivation (ripping) and no-cultivation, with full cultivation for introducing Safari into a degenerated kikuyu pasture. Although full cultivation gave the quickest establishment, ripping and even no-cultivation eventually produced good stands of Safari in this favourable environment. Winter plantings did not establish under any cultivation treatment.

Safari seedlings are sensitive to weed and grass competition. Grass control is particularly important where minimal cultivation has been employed in seedbed preparation. Grass growth should be grazed using a high stocking density for a short period. Weeds are best controlled by regular slashing.

Companion Grasses

The upright growth habit of Safari enables it to combine better with grasses than white clover. On the Evelyn Tableland Safari combines well with kikuyu grass. In trials in south-eastern Queensland it has been successfully grown with paspalum (*Paspalum dilatatum*) and Nandi setaria (*Setaria anceps*). For the success of any grass-legume combination correct management is important.

Grazing Management

When grown with kikuyu, Safari will tolerate both undergrazing and severe overgrazing without damage. Because it can grow to a height of 35 cm it is able to compete with kikuyu after 10 weeks' regrowth. Safari is extremely palatable to cattle, but even where grazed repeatedly to ground level it has continued to thrive.

On the Evelyn Tableland highest production can be obtained by strip grazing. The stocking intensity on each strip during the main growing period should be 50 beasts per hectare and a new strip should be provided each day. Highly productive stands may carry up to 75 beasts per hectare on each new strip. Where dairy farmers provide two new strips per day then stocking densities should be doubled. After each grazing the strip should be allowed three to four weeks to regrow before cattle are reintroduced.

During winter when growth slows down, the grazing cycle should be lengthened to six to eight weeks while maintaining the same stocking density.

If strip grazing is not convenient, rotational grazing should be employed. The grazed area should be spelled for three to four weeks between grazings.

Deferred Grazing

Both Safari and kikuyu maintain their nutritive value well. Using this attribute a reserve of feed can be built up in frost prone areas during autumn for winter feed. When frosted the material holds up well as standing hay.

In frost free areas grazing can be deferred during winter for dry season feed.

Bloat

The bloat problem with Safari may not be as severe as with the temperate white clovers but cattle deaths have been recorded on the Evelyn Tableland. Normal precautions should be taken.

Pests and Diseases

Rugose leaf curl disease

Most plantings of Safari clover have been slow to establish. A common cause of slow stand establishment is rugose leaf curl disease. The causal agent of this disease is believed to be a small, bacterium-like organism transmitted by a specific leafhopper (*Austroagallia torrida*). Other species of clover are affected but apparently not as severely.

Symptoms of rugose leaf curl disease on Safari clover consist of yellowing and curling of young leaves together with a reduction in leaflet size. The surface of the individual leaflets between the veins is usually bubbled (rugose). An increase in the amount of red pigmentation in affected leaves is common, particularly in older leaves. Growth reduction occurs and petiole and internode lengths are usually reduced.

Rugose leaf curl appears to be a disease affecting clover seedlings rather than older, more established plants. Also many plants affected by the disease are able to produce apparently healthy stolons. Plants subsequently derived from these "recovered" stolons may be less susceptible to re-infection with the disease. Therefore, although new plantings of Safari clover may suffer high initial infection and mortality, the surviving plants usually give rise to vigorous, productive stands. this process may take up to two years. Experimental evidence from trials on the Evelyn Tableland suggests that the addition of nitrogen fertilizer may improve the growth of diseased clover plants.

Nematodes

Galls of root-knot nematodes (species of *Meloidogyne*) have been observed on the roots of Safari. In pasture, heavy nematode infestation is indicated by patches of stunted plants which make partial recovery when conditions favour rapid growth of clover. Chemical control is uneconomic.

Others

Damage by pasture webworms (*Oncopera* spp.) and various leaf eating caterpillars has been recorded but the effects are not permanent. No other major pests or diseases have been recorded.

Seed Production

Flowering is most pronounced in autumn and spring, with ripe seed being available from August to December.

Detailed management procedures for seed production have not yet been worked out; however, pilot harvesting studies by Dr. R. J. Jones of CSIRO have provided some useful leads.

A Safari-kikuyu pasture ready to graze on the dairy farm of Mr. Barry Brotherton on the Evelyn Tableland.

Dr. Jones has found that some 30% of the seed is borne below 4 cm. Thus, low cutting is important to achieve high seed recovery and an even land surface is an obvious advantage. If conditions are dry and the crop uniform, direct heading, provided the cut is low enough, can recover a high proportion of the seed. The harvested material is then dried and threshed. An alternative method is to cut low with a mower, windrow the crop, and after a few days pick up and thresh with a header.

For high germination seed needs to be scarified before sowing.

Seed increase is progressing and commercial seed could be available in late 1976.

Persevere!

Because of the high nutritive value and dry matter yield of Safari, pastures containing the legume should be capable of high levels of milk or beef production. The disadvantage of slow establishment will be more than compensated for by its later production. It is emphasized that Safari does eventually recover from rugose leaf curl disease. Farmers should persevere with infected stands and not be discouraged by their poor early appearance.

A closer inspection of Mr. Brotherton's paddock reveals a dense, high quality pasture that can be easily harvested by the grazing animal. Note the white midribs on the clover leaves left of centre. This feature occurs on some 30% of Safari plants. The height of the marker is 38 cm.

Brand Directories

NEW editions of the Horse and Cattle Brands Directory and Sheep Brands and Earmarks Directory are now available.

The price for the Horse and Cattle Brands Directory, compiled to 30th June 1971, is $45. Due to steep increases in labour, printing and paper costs, it has not been possible to approve the sale of this directory at a lower price—this price is set almost at cost.

Superseded copies of the Horse and Cattle Brands Directories are still available to the public. These are priced as follows:—

- to 31st December 1962 .. .. $1.50

The Sheep Brands and Earmarks Directory, compiled to 31st December 1974 is priced at $5.00.

All prices include postage.

Any person who wants to buy any of these Directories should forward the required amount and advise the relevant details to the Registrar of Brands, Department of Primary Industries, William Street, Brisbane, 4000.

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., "Deivue" 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

Horticulture in the dry tropics

By P. R. BEAL, Senior Plant Breeder.

THE dry tropical zone extends from Carmila (22°S latitude) just south of Mackay, northwards approximately 450 km to Rollingstone (19°S latitude). The area includes the river systems of the Don, Burdekin, Haughton, and the Ross, and several islands off the coast.

Bowen, with the adjacent settlements at Longford Creek, Guthalungra and Gumlu, is the largest and most densely populated centre of horticulture. Horticultural crops are also extensively grown in the lower Burdekin Valley, including the delta area. Horticulture in the Bowen area mainly involves specialist enterprises, whereas fruit and vegetable growing in the lower Burdekin area is generally a side line to sugar cane growing.

Development in these regions has occurred because of the relative freedom from frosts, a dry growing season, ready availability of deep well-drained soils, and abundant supplies of good quality water.

Other small farming centres are Woodstock, Rollingstone–Mutarnee (pineapples and vegetables), Charters Towers (citrus), Bloomsbury and Proserpine (vegetables), and Mackay (pineapples and vegetables).

Bowen is the largest horticultural centre of the Dry Tropics district and the first town established in North Queensland. Townsville, established four years later in 1865 and now Queensland's second largest city and a major port, provides a sizeable local market for the fruit and vegetables produced in the Dry Tropics.

Climate

The coastal and sub-coastal part of the Dry Tropics district experiences moderate summer and mild winter temperatures. Winter frosts are not common and seldom severe or extensive. The prevailing south-east winds, however, can be sufficiently strong to cause injury to crops in exposed situations.

Far greater variations between summer and winter temperatures are experienced in the inland areas. Summer temperatures are frequently high and winter temperatures can fall to freezing point.

The average annual rainfall for Bowen and Charters Towers is 1 014 mm and 643 mm respectively. Seventy per cent. or more of the total rainfall is registered in the December–March period, and irrigation is practised over the relatively dry winter and spring period.

The mean maximum and minimum monthly temperatures and the average monthly rainfall for Townsville, Bowen and Charters Towers are shown in Table 1.

TABLE 1

CLIMATIC DATA FOR THE DRY TROPICS ZONE

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Mean Maximum Temperature (°C)													
Bowen . .	31	30·8	29·7	28·3	26·5	24·6	24	25·1	26·9	28·7	29·9	31	28·1
Townsville . .	30·5	30·6	30·1	28·9	26·9	24·8	24·2	24·9	25·4	28·1	29·2	30·1	27·9
Charters Towers	33·5	32·6	31·4	29·9	27·3	21·4	24·6	25·4	29·4	32·4	32·5	34·5	30·1
Mean Minimum Temperature (°C)													
Bowen . .	23·9	23·6	22·8	20·8	17·4	15·2	13·6	14·7	17·2	20·2	22·1	23·3	19·6
Townsville . .	24·3	23·8	23	20·9	17·9	16	14·7	15·8	18·4	21·4	23·1	24·2	20·3
Charters Towers	21·6	21·2	20·1	17·2	14·1	11·7	10·5	11·8	14·5	17·2	19·6	20·7	16·7
Average Rainfall (mm)													
Bowen . .	264	224	147	71	33	41	23	18	20	28	33	112	101
Townsville . .	289	290	188	989	33	33	15	13	20	36	46	137	1 191
Charters Towers	145	114	99	41	20	33	115	15	18	18	36	89	643

Soils

The cultivated soils are mostly alluvials, some of very recent origin and some much older. Seasonal flooding is common to the Burdekin, Haughton and Ross Rivers, and fresh deposits may be made every year or so. Flooding is most extensive on the flood plains of the Burdekin with its large catchment.

Some of the soils used for pineapple production near Rollingstone are of granite origin and very low in organic matter. The soils of alluvial origin, however, are generally quite fertile. The most commonly deficient element after intensive cultivation is nitrogen, and fertilizers containing this element are normally recommended for horticultural crops. Zinc deficiency is also widespread in most Dry Tropics soils.

Irrigation

The area under horticultural crops in the Dry Tropics is about 4 000 hectares and about 80% of it is irrigated, mainly by the furrow method.

Furrow irrigation is almost universally practised in vegetable growing in the Dry Tropics because of the availability of underground water, low cost of application and the cultural advantages. The underground water is available in most areas from sources 5 to 15 m deep. Centrifugal pumps are normally operated to give a free flow of water from screened spears placed in the aquifer, or from protected pump intakes in stream beds.

Irrigation is obligatory for satisfactory horticultural cropping, particularly of annual vegetables, over the dry winter and spring growing season. Tomatoes and beans usually receive a total of 300 to 500 mm of water. Perennial crops such as citrus and grapes generally receive about 800 mm of summer rainfall, as well as additional water in the dry months of the year.

Weekly applications of water are normally recommended for commercial plantings to sustain plant growth and crop development. Crops on the light soils and late season vegetables in the Dry Tropics demand more frequent irrigations. This increased water requirement in the late season is essential because the

TABLE 2

HORTICULTURAL PRODUCTION IN THE DRY TROPICS

Crop	Major Producing District	Estimated Area	Average of 1973 and 1974 Production
		ha	tonnes
Tomatoes*	Bowen	1 100	16 600
Capsicums	Bowen	100	1 800
	Burdekin	100	1 000
Eggfruit	Bowen	6	160
	Burdekin	50	1 030
Bean Seed†	Bowen	113	329
	Burdekin	1 014	1 359
Cucumbers	Bowen	100	1 560
	Burdekin	120	1 270
Watermelons	Bowen	100	1 800
Rockmelons	Bowen	120	640
Mangoes	Bowen	320	1 040
	Burdekin	160	530
Pineapples	Rollingstone–Mutarnee	60	2 400
	Mackay	35	1 200

* The Bowen area produced about 50% of Queensland's total tomato production in 1972 and 1973.

† Bean seed mainly produced in the Burdekin area as "disease-free seed" for resowing, has recently been meeting most of Australia's requirements.

weekly evaporation of 60 mm per week, occurring in October and November, is nearly twice that occurring in winter. As a result, tomatoes are commonly irrigated up to 12 times in the mid-season and 16 times in the late season.

Good quality water is generally available in aquifers in the delta lands of the coastal rivers. Salt problems in the soil and water however, have been recorded in some lower delta farms of the Don and Burdekin Rivers.

Horticultural Production and Markets

The area under crop and the average production of the major fruits and vegetables for the years 1973 and 1974 are listed in Table 2.

The horticultural industries have generally been quite stable but production of tomatoes, the main crop grown in the area, has steadily expanded over the past decade.

The Dry Tropics is a major winter fruit and vegetable producing area and tomatoes, bean seed, cucumbers, capsicums, mangoes and melons are the most important crops.

With minor exceptions, all fruit and vegetables produced in the Dry Tropics are supplied to the fresh market. About 70% of all fruit and vegetables produced here is marketed in Sydney. Small consignments are forwarded to the local markets of Townsville and Mackay and the remainder to Brisbane.

Quality deterioration in fruit and vegetables destined for the distant markets can be a serious risk. However, the ability to preserve quality is not as difficult as it was twenty years ago.

High and stable returns to the Dry Tropics vegetable industry are in part due to the high level of grower expertise. Changes have been made over the last ten years which have led to improvements in quality control and marketing.

These improvements in quality control have been possible because of the availability of more dependable varieties, the use of precooling and artificial ripening, and cooled transport to both the Brisbane and Sydney markets. Marketing changes have been made to offset

Transplanting tomato seedlings into varietal plots in the field at Bowen.

the disadvantages of high marketing costs compared to those in other producing areas closer to the major markets. Changes have included the provision of a fast train service each day to southern markets, use of volume fill containers, the development of bulk handling methods, and a minimum price clearance scheme.

Crop Culture

Commercial horticulture in the Dry Tropics demands a high standard of expertise. Intensive management is needed and critical decisions are necessary in cultivation and irrigation practices, pest and disease control measures, harvesting and post-harvest handling.

The successful use of furrow irrigation necessitates the use of raised beds for the plant row, placement of proximate furrows, and adequate inter-row weed control.

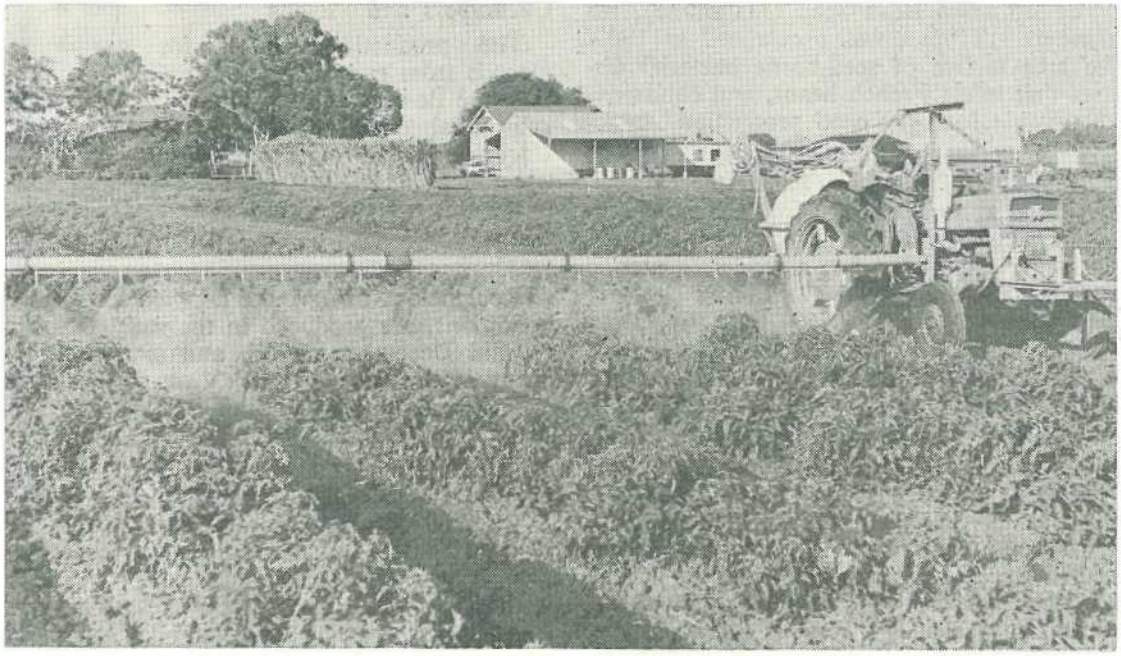
Farm layouts for tomatoes commonly involve eight row lands separated by farm roads. These roads facilitate crop management for manual harvesting and over-spraying with tractor supported booms for pest and disease control. The climate, and furrow irrigation are conducive to a low incidence of leaf, fruit and pod diseases.

Tomatoes

The tomato is the most important horticultural crop grown in the Dry Tropics, and most of the fruit is produced in the Bowen district. It is mostly consigned to the fresh fruit markets in Sydney and Brisbane during the early June to mid November period. Most Bowen fruit is sent in a green-mature condition.

However, in recent years increased consignments have been sent in a forward or coloured stage following the introduction of pre-cooling, artificial ripening, cooled transport and the establishment of a fast train service.

The tomato varieties must be adapted for use in ground crop culture in the Bowen district and must have a determinate or bush habit of growth. They must also be resistant to prevailing diseases, be high yielding and



Spraying a ground crop of tomatoes with a fungicide and insecticide, using a tractor supported 9 m boom.

produce fruit of good quality. The fruit must be tolerant of transport damage, free of growth disorders, and suitable for artificial ripening. The previous commercial variety "VF 1402" grown in the district was susceptible to the soil borne disease, Fusarium Wilt, and was replaced during 1970–71 by the current variety "Walter", which has resistance to the disease and good fruit quality.

Insect and weed pests can severely limit production, particularly in the warmer weather. Reduced productivity and a lowering of fruit quality by heat blemish are also problems in late season crops.

Capsicums

At present capsicums are consigned mainly to the major fresh markets of Brisbane and Sydney, with some forwarded to Melbourne. Over 70% of the district's capsicum production is marketed in Sydney. Consignments to Melbourne can be expected to increase substantially with the further development of fumigation facilities for fruit fly disinfestation.

Total Dry Tropics production has consistently exceeded 1 300 tonnes per annum in the years 1970 to 1973 (Table 2), and a trend towards increased production has been apparent. The Bowen and Burdekin districts are both significant producing areas. However, the Bowen district has tended to displace the Burdekin district as the major producing area over the last four years.

The capsicum production season in the Dry Tropics is from June to November.

The major varieties are the typical bell type "Yolo Wonder", and the elongate "Long Sweet Yellow". A suitable variety for the district must have an adequate yield and fruit size, and tolerance to virus diseases.

Bean seed

The bulk of the green, processing, and culinary bean seed produced in the Dry Tropics is grown within the Burdekin Bean Seed Quarantine Area, where the major producing districts are Mona Park and the irrigation settlements of Clare and Millaroo.

The Burdekin Bean Seed Quarantine Area in the Dry Tropics was proclaimed in 1967. The area is free of seed-borne bacterial diseases that infect French beans, and conditions are suitable for bean seed production.

In 1974, sowings for seed totalled 1 014 ha in the Area. (Table 2). Outside the Quarantine Area, minor plantings for seed are made in some years in the Home Hill district. Further south, at Bowen, a moderate area is sown for seed each year, and during 1973–74 the industry extended to the Proserpine region. In these areas 113 ha were planted for seed in 1974. Seed from all Dry Tropics districts supplies all requirements for the rest of Australia.

The purpose of the Burdekin Bean Seed Quarantine Area is to prevent the entry of bacterial diseases into the proclaimed area. Regulations regarding the production of bean seed in the Dry Tropics are aimed at providing disease-free bean seed to Queensland growers and bean growers in other parts of Australia. Only seed approved by the Queensland Department of Primary Industries is allowed to be sown in the Quarantine Area. There are no restrictions on the planting of beans for seed production outside the Burdekin Bean Seed Quarantine Area, apart from regulatory and contractual provisions which apply to any areas registered with the Queensland Department of Primary Industries for the production of Certified, Special Mother and Approved Bean Seed.

Bean seed growers generally take advantage of good soil moisture levels at the close of the wet season and plant in the late March to late May period. Weeds can be a severe problem before and during harvesting and the use of the herbicide E.P.T.C. has become the standard weed control measure in recent years.

Harvesting normally occurs in the relatively dry period from July to September.

Bean seed production in the Burdekin has been largely dependent on plantings by sugar cane growers on unassigned land. The industry generally competes poorly for water and attention with the expanding sugar industry, and the developing rice industry. Average seed yields of 1 to 1·5 tonnes per ha in the Burdekin have not been as high in recent years as the seed yields of 1·5 to 2·5 tonnes per ha in the Bowen and Proserpine areas.

Cucumbers and Melons

The production season for cucumbers extends from early May to late October, with both the Bowen and Burdekin areas producing substantial quantities for southern markets. Cucumbers are commonly double cropped because of their short growth cycle and relative freedom from disease. The major cucumber varieties grown are Ashley and Green Gem.

Rockmelons being more adapted to warmer conditions, are produced in the early October to mid December period, and almost exclusively in the Bowen area. Virus and mildew diseases can be major limiting factors in rockmelon production. The commonly used varieties are Hales Best, Gold Pak and Gulfstream.

Watermelons are generally produced in the Bowen district from September to November, a slightly earlier period than rockmelons. A feature of the industry in recent years has been the contract growing of substantial quantities of watermelons for processing.

The increasing incidence of Fusarium Wilt has lead to the partial replacement of the popular variety Candy Red, with Calhoun Grey. The major varieties now in use are Calhoun Grey, Crimson Sweet and Candy Red.

Sundry vegetables

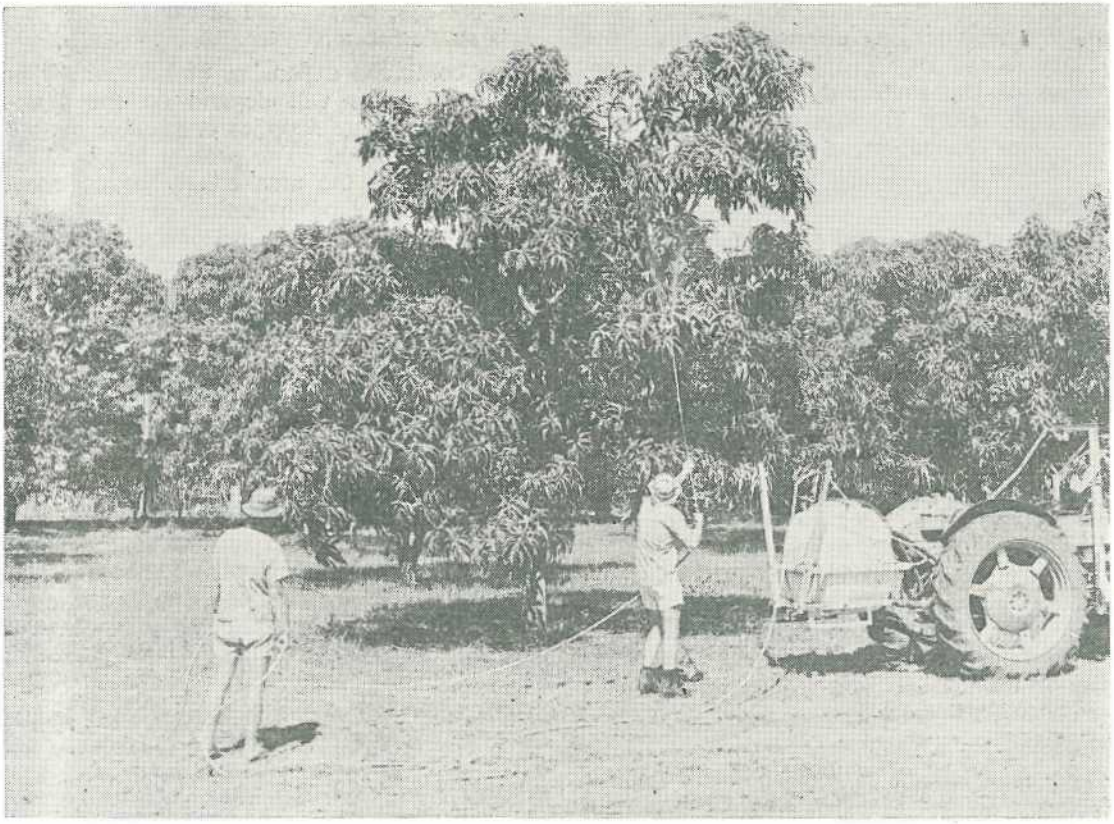
Eggfruit are produced from July to November. The Burdekin area is the most important producing centre, and a substantial proportion of the crop is consigned to the Sydney and Melbourne markets.

Root and leaf vegetables are grown in moderate quantities in areas adjacent to the larger towns which serve as small but ready local markets.

Mangoes

Mangoes have been grown in the Dry Tropics since before the turn of the century, and the industry is well established on the flood plains of the Burdekin and Don Rivers. Numerous trees are also grown in home gardens in the district.

Fruit production from the Dry Tropics in recent years has ranged from about 1 000 to 2 000 tonnes a year, with the Bowen district



Spraying mango trees with a fungicide, using a 2 m hand lance.

producing 50 to 60% of the total production (Table 2). The most important present outlet for mangoes is the fresh fruit market, and 75% of the crop is normally forwarded to the Sydney market. A substantial private order trade in fresh fruit has also developed. In addition, a processing market exists, but this is not large or stable.

The most important commercial mango varieties presently grown in the Dry Tropics are Kensington Pride (or Bowen Special) and the "Common" variety. Kensington Pride or Bowen Special is believed to be of Indian origin. Fruit of this variety is sweet, juicy and fibreless, and is very suitable for high quality canned or quick frozen dessert fruit products. The fruit is yellow-green when mature, with an attractive red blush. The Common variety has been in demand for some years to supply chipped and sliced fruit for chutney and also ripe fruit for flavouring of confectionery.

Mango production is over a narrow 6 to 8 weeks period in November and December, due to the almost total dependence of the industry on the one variety, Kensington. The Common variety is of minor significance on the fresh fruit market and then only in early November, because it begins maturing about three weeks earlier than Kensington. The narrow production period results in relatively sharp changes in supply to the fresh fruit market.

It is anticipated that the utilisation of introduced varieties with different cropping habits may have real promise in extending the present short production season. In addition, the cyclic annual variation in fruit production

(alternate bearing), makes forecasts of ultimate financial returns uncertain. Also, the industry in the Dry Tropics competes poorly because of the preferred attention given to other high return crops, such as sugar cane and winter vegetables.

Pineapples

The small pineapple growing industry is centred in the Rollingstone–Mutarnee and Mackay areas. It relies on natural cropping, and the fruit is harvested during November and December. The efficiency of the industry is improving and good returns are generally received because the harvest period coincides with a period of low production in other districts.

The rough leaf variety, comprising about 40% of the area under pineapples has been preferred in the past, as the fruit is readily accepted at the Townsville and Brisbane markets, and ratoon production can extend over 2 to 3 years. The Smooth Cayenne variety is now being grown more because of its popularity on the markets in southern States.

Bananas

The small banana growing industry is most developed around Mackay, where the rainfall is high and well distributed. The 'Mons' variety is almost exclusively grown. The fruit is sent mainly to local outlets including Townsville.

Sundry fruits

Grape and citrus growing are both small industries centred in the Charters Towers area. Grapes are grown almost exclusively for the Townsville market. The "Royal Ascot" is the major variety and the fruit is marketed in December. The main citrus fruits grown include oranges and mandarins, and some lemons and grapefruit, which are available from April to December. However, the industry has been static for some years.

Future Prospects

The Dry Tropics zone has a substantial advantage over the other areas in Queensland for winter horticultural cropping mainly because of its dry, frost-free growing season and the extensive areas of suitable soils. For these reasons, horticulture in the Dry Tropics has a stable future.

The continued expansion of horticulture in the Dry Tropics will depend on the availability of adequate supplies of suitable quality water for irrigation. The present horticultural crops grown in the area either require complete dependence on irrigation or supplementary irrigation for good performance. Water supplies are limited in the present major horticultural areas of the Dry Tropics. Existing water supplies for irrigation are obtained from the major rivers and adjacent aquifers which have limited size. Therefore, expansion in horticultural cropping in the Dry Tropics, depends largely on the availability of additional water supplies.

The present problems in the Burdekin of lack of sufficient water and land for bean seed crops is due to the expansion of the sugar industry. The building of additional water storage facilities to serve the Bowen and Burdekin areas and the ultimate utilisation of land on the southern bank of the Burdekin will presumably eventuate.

The high status of the horticultural industry in the Dry Tropics can be preserved only if existing markets are retained, and new markets developed. Improved quality control of produce would be possible with more protective transport and a faster uninterrupted transport service, from the district to the Sydney market. Appropriate changes in varieties, cultural and handling techniques, will presumably be made in the future as they have in the past.

Specific procedures which could lead to better quality produce and reduction in marketing costs offer Dry Tropics fruit and vegetable growers real opportunities for improving the efficiency of their industry. Vibration-fill of containers is being accepted readily by Bowen tomato growers. Development of commodity treatments for the control of post-harvest fruit rots and for fruit fly disinfestation of mangoes is nearly completed. Additional interstate markets should then be available to growers in the Dry Tropics.

The long term stability of the Dry Tropics fruit and vegetable growing industry would be further supported by continued growth of local markets including the establishment of local processing plants.

Beekeeping in Queensland

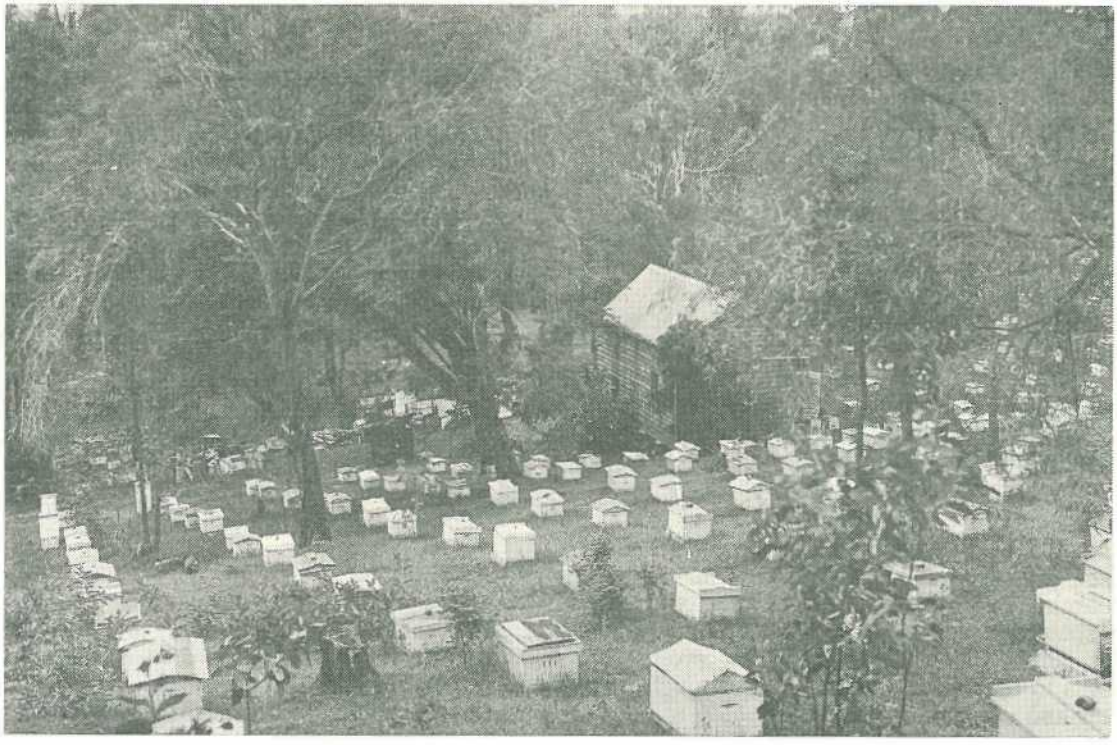
By C ROFF, Chief Adviser in Apiculture.

IN Queensland the beekeeping industry is developing steadily. Successful beekeepers are those with both practical and theoretical knowledge of the subject. Before any investment is made in honey bees and equipment, all phases of beekeeping must be considered.

The honey bee is not native to Australia. In beekeeping literature there is reference to black bees, *Apis mellifera mellifera* L., being kept near Montague Road, South Brisbane, in 1854.

Black bees from Rio de Janiero were landed in Sydney in 1810 and 1822 and from the second introduction stocks were propagated elsewhere in Australia. These black bees quickly became established in the bush and spread over much of coastal Queensland.

One of Queensland's early breeders of Italian queenbees was Mr. H. L. Jones of Redbank Plains, via Goodna, who reared queens on this site. This photograph was taken in 1948 *when the business was being conducted by his son Mr. H. M. Jones.*



Italian bees, *Apis mellifera liqustica* Spin., were imported in 1866 to Brisbane from the United States of America but they did not survive. At various times from 1866 to 1883 Italian bees from the U.S.A. and Italy were successfully introduced to Brisbane. Due to their resistance to wax moth invasions they quickly supplanted black bees in apiaries and today even wild bush bees may often be an Italian-black hybrid. The Cyprian bee, *Apis mellifera syriaca* v. Butt. R. (=*A. mellifera cypria* Bollm.) was introduced to Warwick from Maitland, N.S.W., about 1918, the Carniolan bee, *Apis mellifera carnica* Polm. to Warwick from South Australia in 1924, and the Caucasian bee, *Apis mellifera caucasica* Gorb. to Millmerran from the U.S.A. in 1933.

Early Queensland beekeepers did not have the advantages of the moveable frame hive, comb foundation, the honey extractor or even the bellows smoker. By 1865 the Woodbury bar-frame hive was in use in Brisbane and in 1874 the first centrifugal honey extractor was imported from the U.S.A.

Australian equipment tends to follow the American pattern, with various modifications and improvements. The standard hive is the ten-frame full depth Langstroth, which is often used with only nine frames in brood chambers and honey supers. A few beekeepers prefer the eight or twelve frame sizes; others use smaller hives known as "W.S.P.", "Ideal" and "Half-depth". Hive equipment is manufactured in Brisbane, Maryborough and Atherton and imported from New South Wales.

The permanent honey house and the mobile extracting van of today are equipped with power-driven multiple-frame stainless steel extractors, steam boiler or pressure hot water system, an automatic uncapping machine and a honey-wax separator either using rigidly controlled heat or whirled mechanically, all compactly arranged. Mechanical hive lifting devices and controlled hot rooms are used by the modern Queensland beekeeper.

Systems of management vary from the "let alone" systems of small beekeepers to those used by progressive apiarists who manage colonies intensively in accordance with bee husbandry practices. These include migrations for spring build-up, followed by progressive shifts to the various nectar flows through summer and often during winter.

The use of high quality plastic and fibreglass equipment is being gradually developed in the industry: transport cages for queenbees, bee frames, poligenic beeware such as honey tanks and dispensers, uncapping units and extractors and hive components. These developments are centred around the use of modern plastic technology. Most of the units are designed with the smaller beekeeper in view. They are in fact tailor-made in both size and cost down to units for the one or two-hive beekeeper.

Industry Location

The industry is conducted mainly in the south-east part of the State and its easily accessible market. The principal districts are Moreton, Darling Downs, Burnett and Wide Bay. Farther afield, the Rockhampton district and the Atherton Tableland are important areas. With an improving road system, the Channel Country in far south-west Queensland lying between the Warrego, Paroo and Bulloo Rivers, has become important.

Nectar and pollen are obtained mostly from trees, especially species of *Eucalyptus, Tristania* and *Melaleuca.* Until recently ground flora, important in other parts of the world in providing major nectar producers has been unimportant. Urban and rural development involving tree clearance has resulted in a gradual decline in honey production from more closely settled areas. Under Queensland climatic conditions, replacement by natural ground flora is unlikely but in several areas cultivated pasture legumes such as irrigated clover (*Trifolium repens* L.), glycine (*Glycine wightii* L.), lotononis (*Lotononis bainesii* Baker) and some others have become significant. On the other hand, reafforestation projects, involving eucalypts, are of increasing importance and state Forest Reserves are prized by commercial beekeepers as sites for apiaries.

Beekeepers

Interest in beekeeping stems from the type of outdoor work entailed, and the financial returns, which can be discussed only in general terms. As income is dependent on variable and unpredictable factors such as availability

This Coowonga apiary was established in 1883, about 30 km from Rockhampton and is still being worked.

and abundance of nectar and pollen-producing plants, favourable weather, knowledge and skill of the beekeeper, the number of profitable hives maintained and market fluctuations.

There are some 2 500 beekeepers in Queensland managing more than 100 000 colonies. The number managed by an individual beekeeper may range from one to over 3 500. About 100 are commercial beekeepers with 500 colonies or more. One beekeeper can manage successfully at least 500 colonies, which are kept in out-apiaries of 40 or more. As more colonies are acquired help is needed. Semi-commercial beekeepers or sideline beekeepers operating 40–350 colonies number about 400. The remaining 2 100 or more beekeepers are hobbyists and enthusiasts who keep bees privately for recreational and educational value. Twelve commercial queen breeders produce about 100 000 Italian (50%), Caucasian (40%), Carniolan (2%) and other (8%) queenbees for sale to beekeepers. These queenbees are sold both within Australia and overseas. Two queenbreeders have installed equipment to artificially inseminate queenbees.

Production and Income

The main source of income is from the sale of honey and beeswax. Some specialists rear colonies and queenbees for sale, and other apiarists provide bees, on a rental basis, as a pollination service for farmers and orchardists. Supporting industries include bee supply and equipment manufacturers, honey packers, dealers and brokers.

A beekeeper's income is not fixed, and fluctuates from season to season. It must be remembered that even in the best districts the honey crop is a failure in some seasons and consequently commercial beekeepers should have sufficient capital to tide them over these

periods. Under Commonwealth taxation laws a beekeeper's income may be averaged on a five year basis.

Annual honey production from well managed apiaries averages 40–90·8 kg of honey per hive over a period of years, though a 227 kg average is not unknown in individual seasons.

The beekeeping industry in Queensland represents a capital investment of about $6 million. Each year about 2·04 million kg of honey, both liquid and comb, 40 000 kg of beeswax, 100 000 queenbees, and 1 000 package bees are produced for sale. The annual income from honey, beeswax, queenbees, package bees, royal jelly and pollination fees and associated industries adds up to more than $2 million each year.

The Chinese Joss houses established during the early history of the State burned propolis as incense. Whilst this product is not now marketed in Queensland, there is some pharmaceutical demand in Europe. The demand for royal jelly, pollen and propolis seems to be increasing.

Beekeeper Organisations

Beekeepers are loosely organised through various associations, the oldest and most important being the Queensland Beekeepers' Association, with branches in Brisbane, Maryborough, Toowoomba and Warwick, and a branch at Woodford called the Stanley River Beekeepers' Association. The present Association was established in 1886. Other semi-professional organisations are the Capricornia Beekeepers' Club at Rockhampton, the Far North Queensland Beekeepers' Association at Atherton and the Southern Beekeepers' Association of Queensland at Toowoomba.

The Queensland Beekeepers' Association started publishing the Queensland Apicultural Journal in 1916, but after a few years this was discontinued.

Marketing

Organised marketing under a State Commodity Marketing Board was tried from 1929 to 1950; it failed, largely because it could not control interstate trade.

Most honey is now sold direct to honey packing organisations in Brisbane, some with beekeeper shareholders. In glut years when prices are low some panic selling and speculative buying occurs.

Marketing of honey overseas is subject to the Australian Honey Board in Sydney (established 1963), which operates under Commonwealth legislation. In this State the Queensland Honey Industry Association (established 1966) is a honey promotional organisation.

Assistance and Control

In 1898 the Government Entomologist reported that his office should handle beekeeping in this State and commenced advisory services. In 1904 he introduced beekeeping as part of the curriculum at the Queensland Agricultural College, Lawes. Early in 1931 there was an outbreak of American foulbrood in an apiary near Brisbane and the Queensland State Government accordingly passed *"The Apiaries Act of* 1931" which gave power to deal promptly and adequately with outbreaks of bee diseases.

The original Act was amended by *"The Apiaries Act of* 1938" which was eventually replaced by the current legislation *"The Apiaries Act of* 1947".

Advisory and research services are maintained today by the Queensland Department of Primary Industries, and Government entomoligical, pathological, botanical, chemical and marketing services are available to assist with problems encountered in the industry. A wide range of beekeeping literature is published through the Queensland Agricultural Journal and is available subsequently as reprints. As part of this service, field days, schools, lectures and film evenings are organised for beekeepers. An annual extension leaflet is published, called "Photo Report".

The Department of Primary Industries and the Queensland Agricultural College at Lawes conduct an annual school at the College, where a beekeeping section is also maintained. Additionally, apiculture is part of Agricultural and Veterinary Science courses at the Queensland University and Queensland Agricultural College.

Nematode control in Bananas

by ROGER A. BROADLEY,
Nematologist, Plant Pathology Branch.

NEMATODES cause decline of banana plantations in many parts of the world.

In Queensland, the burrowing nematode *Radopholus similis* is the most important of these pests, being responsible for a severe root and corm rot, the extent of which is increased when the common soil fungus *Fusarium oxysporum* invades the wounded tissue. The problem is particularly severe in the wet tropical areas of the State.

Red, purple and black lesions in the roots and corm indicate that they are infested with the burrowing nematode. Damaged roots do not function effectively and stools generally lack vigour, produce small bunches and fall in wet, windy, weather. These symptoms are more pronounced in ratoons than plant crops.

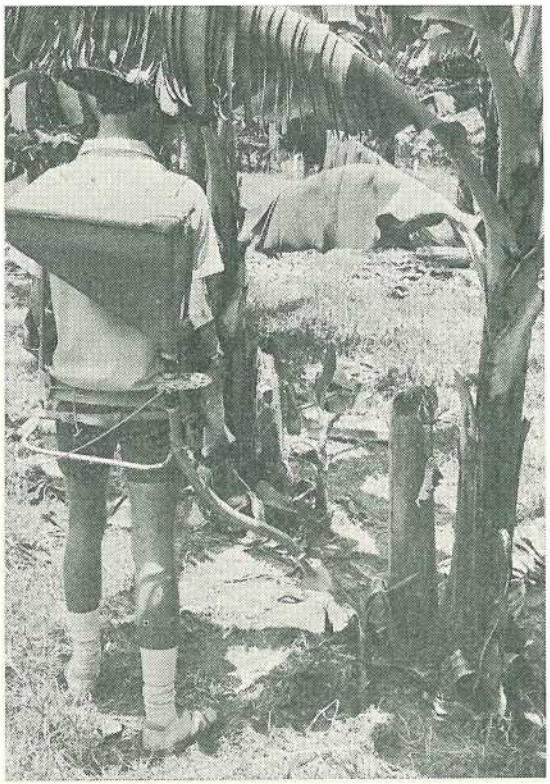
Spiral nematodes, root-knot nematodes and a root-lesion nematode also cause root damage. They are regarded as of lesser importance and are controlled by those measures recommended for the burrowing nematode.

Control

Nematodes must be controlled in the planting material and in the soil.

Select suckers or "bits" from healthy plantations, pare roots and discoloured tissue from the corm and immerse in water at 53°–55°C for 20 minutes. Spread the treated material in a single layer in the shade to cool and plant as soon as practicable because storage reduces germination.

Using a Knapsack Granule Applicator.



Because the burrowing nematode is so common in plantations it is often difficult to secure nematode-free planting material. To overcome this problem, establish nursery areas on virgin land with carefully selected, heat-treated bits or suckers. After 8 to 12 months dig out the stools and divide for planting material.

Control nematodes in the soil before and after planting.

Virgin land is generally free of burrowing nematode whereas old banana land is usually infested and should be spelled for 12 months or longer to allow populations of this nematode to decline before replanting. Eradicate volunteer bananas and do not plant cover crops such as maize, cowpea, sorghum x sudan grass hybrids (e.g. sudax) and stylo as these are alternative hosts.

Before replanting old banana land, provided soil fumigation is practicable, work the soil deeply to a fine tilth and fumigate with EDB15* or DD at 330 litres per hectare. Inject the liquids behind tynes 20–25 cm deep and 30 cm apart. The cost can be reduced by treating a band 2 m wide where the row is to be planted rather than the entire area. All subsequent cultivations should be in the direction of the rows to reduce the rate of reinfestation in the treated strip.

A combination of chemical and cultural control methods gives the best results but will not eradicate nematodes. Chemical control measures should be continued on a regular basis in the established plantation to keep nematode populations low and ensure profitable ratoons.

** Use other formulations of EDB at equivalent rates.*

Applying Granules with a tractor-mounted sprayer.

After planting, apply the non-volatile nematicide phenamiphos ("Nemacur G") in a band 0·5 m wide on either side of the row at 1·25 kg of the 10% granules per 100 m of row (15–20 g per stool) every four months (April, August, December). Rake trash from the area before applying granules by knapsack granule applicator or a tractor-mounted spreader. As the success of the treatment depends on the chemical being washed into the soil around the roots, apply the nematicide when rain is expected or irrigate after treatment.

When bananas are planted in virgin or fumigated soil, start phenamiphos treatment about eight months after planting. On unfumigated replant land commence when the drills have been made for planting.

Some growers have applied the first treatment to ratoon crops but results were inconsistent. Treatment of plant crops prevents high nematode populations becoming established although there will be little if any yield increase in the first crop.

In well-managed plantations, the expense of nematicide treatment is small compared with the increase in production. On the other hand, in poorly-managed plantations, the investment in nematode control may not be worthwhile.

Warning

EDB, DD and phenamiphos are poisonous to humans and domestic animals but are not dangerous when properly handled. Label directions for use and safety precautions must be carried out.

New Tobacco Variety

(Reg. No. 12—Tobacco Variety Register)
(Registered February 1976)

Origin

This cultivar was developed by the CSIRO at the Tobacco Research Institute, Mareeba, for use in bacterial wilt infected areas of North Queensland. CSIRO 3T was developed by crossing the cultivars 16L66 and NC95. Trials were conducted at Ingham (4 Years) Mareeba (2 Years) and Bundaberg (1 Year).

Agronomic Characteristics

CSIRO 3T has good resistance to blue mould (APTI) bacterial wilt and black shank in both seedling and plant stages of growth. Nutritional requirements are similar to Sirone. During the four years that CSIRO 3T was grown in trials at Ingham it was also grown on a semi-commercial scale for comparison with cultivar NC95. In these plantings CSIRO 3T proved to be only marginally more susceptible to bacterial wilt than cultivar NC95. At the same time it showed none of the weaknesses of NC95 in the form of leaf drop or leaf losing colour during maturation.

Cured Leaf Characteristics

CSIRO 3T is very similar to Sirone but when grown in bacterial wilt areas the quality has been shown to be much superior.

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

Boron Deficiency in Tobacco

Boron deficiency has been an increasing problem in the Mareeba – Dimbulah area. Provided the disorder is recognised in the early stages, and remedial treatment immediately applied, economic losses can be prevented.

It is most important to watch for deficiency symptoms throughout the growing period of the tobacco crop. Where the shortage of boron is severe, signs of the deficiency appear suddenly. Irreparable damage results, particularly in young plants, if corrective action is not quickly taken.

SIGNS OF DEFICIENCY

The first sign of deficiency is usually the appearance of broken distorted leaves in the lower plant position. Leaf midribs become extremely brittle and break easily. Under these conditions it is common to find a high number of broken leaves after irrigation or windy weather. Another sign is that the growing point or 'heart' of the young developing plant tends to distort and bend almost at right angles.

The leaf midribs tend to crack at closely spaced intervals along their length. Often they have a bowed appearance. When sliced lengthways a brownish stain shows up in the vascular tissue. This stain is similar to, and should not be confused with, that resulting from systemic blue mould infection.

As the disorder progresses, the growing point or 'hearts' in severely affected young tobacco plants become stained a purplish brown colour. The emerging leaves are also distinctly lighter in colour towards their butts.

In many instances, brown, 'corky' stained areas can be seen at intervals in the exposed pith if the main stems of split lengthways.

In severe cases of deficiency, the growing point quickly dies and the immature plant behaves as if heavily and prematurely topped. Thick, distorted and generally undesirable leaves are produced. A proliferation of sucker growth occurs and, if the plant is not treated with boron, the suckers will also develop deficiency symptoms.

CULTURAL EFFECTS

There have been marked changes in tobacco culture in the Mareeba – Dimbulah area during the last decade. Yields have increased from 1 395 kg per ha in 1955/56 to 1 917 kg per ha in 1971/72. Earlier planting and increased plant populations have increased the usage of both fertiliser and irrigation water. The practice in recent years has been to apply high rates of fertiliser to get maximum leaf development and then ripen the crop by applying heavy waterings through fixed or solid set irrigation. Over-irrigation, particularly with poorly designed fixed irrigation layouts, could contribute to boron deficiency through leaching. The patchy occurrence of the deficiency in some fields is probably due to this.

The type of rotation appears to be of little consequence as boron deficiency in tobacco has shown up following peanut crops, Rhodes grass pasture and volunteer weeds.

The practice of burning off before the wet season could contribute to boron deficiency in wet years. Losses of boron due to erosion and leaching are undoubtedly more severe when the soil is not protected by plant cover.

INFLUENCE OF OTHER NUTRIENTS

The application of luxury rates of nitrogen, potassium, calcium, magnesium and sulphur in tobacco field trials carried out to date have not induced boron deficiency. It appears unlikely that nutrient imbalance is the causal factor in this instance.

REMEDIAL TREATMENT

The application of boron will not restore leaves already thickened and distorted. Where the deficiency has reached the stage where the growing points or 'hearts' have died, spraying alone provides little benefit. In these cases the plants must also be cut or broken back below the affected part and a sucker allowed to grow.

Young, rapidly growing plants show a wider range of symptoms than those approaching harvesting may be one of extreme brittleness with leaves breaking and falling off at the slightest touch, or shedding of their own accord. Flowers develop brown stains around their bases and frequently abort.

FACTORS INFLUENCING BORON DEFICIENCY

As in other tobacco growing areas of the world the reason boron deficiency occurs from time to time is obscure. Boron is a trace or micro element, this means that a plant needs very small quantities for normal growth. Boron levels as low as one part per million (equivalent to 1 kg per ha) in soil may be enough for plant growth. Small changes in soils of low boron content can markedly affect the occurrence of the deficiency. The major factors influencing such changes in the Mareeba – Dimbulah area are climate, soil type and cultural practices.

CLIMATIC EFFECTS

Boron deficiency has shown up in tobacco crops following exceptionally high wet season railfall. It was first recognised

Boron deficiency has shown up in tobacco crops following exceptionally high wet season rainfall. It was first recognised in crops grown after cyclonic rains in 1967. The years 1968 to 1971 were relatively dry and during this period the deficiency was not reported. The problem intensified and became widespread following the heavy wet seasons from 1971. It reached a peak in 1974 when 791 mm of rain fell during January. The rainfall registrations for the Dimbulah area (31 year average 688 mm) from 1966 to 1974 are shown in Table 1.

TABLE 1

Year	Annual Rainfall (mm)
1966	508
*1967	1103
1968	769
1969	445
1970	567
*1971	1019
*1972	1105
*1973	1039
*1974	1843

* Years in which boron deficiency occurred.

DEFICIENT YOUNG PLANT SHOWING TWISTED GROWING POINT AND BROKEN BENT LEAF.

ADVANCED STAGE OF DEFICIENCY GROWING POINT DEAD.

DEFORMED GROWING POINT, DEFORMED LEAVES AND CORKY BROWN STAIN ON OUTSIDE OF STEM.

BROWN EXTERNAL STAINING AND CRACKING ON UNDERSIDE OF AFFECTED LEAF.

STEMS OF DEFICIENT PLANTS SHOWING INTERNAL BROWN STAINING.

AFFECTED LEAVES WITH BIDRIBS

AFFECTED LEAVES WITH MIDRIBS SLICED TO REVEAL INTERNAL BROWNING.

SEVERE BURNING DUE TO THE APPLICATION OF TOO MUCH BORON.

The lexching of boron from surface soils in wet years is likely to be the major cause of deficiency. Experiments have shown that available boron is rapidly leached through coarse, granitic sandy loams. As little as 250 mm of water is able to wash the equivalent of 5 kg per hectare of Borax R below the root zone (60 cm) in this soil type.

SOIL TYPES

Mild symptoms pointing to boron deficiency have been noted on a variety of soil types. The deficiency has been particularly severe on the deep, coarse, sandy loams of granitic origin and deep, sandy loams of mixed granitic/ alluvial origin – particularly in the Dimbulah area.

There appears little likelihood of the deficiency becoming a major problem on the fine-grained shallow soils of metamorphic or basaltic origin. In most cases where it has been suspected on these soil types, plants have generally recovered without the need to add boron.

APPLICATION RATES

Commercially, boron is available as Borax R (11.3% boron) and Solubor R (20.5% boron) and the recommended rates are 4 kg of Borax R or 2 kg of Solubor R to 500 litres of water per hectare, applied as a foliar spray. These recommendations evolved from field trials carried out at Dimbulah. Rates higher than this present insufficient coverage problems with minor leaf burning and lower rates present difficulties in application due to high spray volumes required.

If Borax R is being used, the required quantity should first be mixed in a small quantity of warm water to avoid difficulties in dissolving this material.

NUMBER OF APPLICATIONS

These vary with the degree of severity of the deficiency. As a general rule one foliar application is enough for mild cases and a maximum of three applications at minimum intervals of ten days for severe cases.

On farms with a past history of boron deficiency it is recommended that one application of boron at the recommended rate be carried out at planting out or within the first three weeks after planting out as a precautionary measure, particularly following a heavy wet season.

TOXICITY

It must be remembered that boron at high concentrations is used as a weedicide and soil sterilant. When applying boron to a tobacco crop, care must be exercised in determining the correct quantities both of material and water.

Experience has shown that a 1% solution of Solubor R will cause severe burning and retardation and solutions stronger than 1% have resulted in plant deaths.

R – registered trade marks of Borax Consolidated Ltd.

B.L. BARTHOLOMEW District Adviser in Agriculture and A.J. NICHOLSON Research Scientist, C.S.I.R.O.

Pasture and Fodder crops for Central Queensland Dairy Farms

by T. K. KELLY,
Agriculture Branch.

While improved pastures are the cheapest form of fodder for dairy production, fodder crops are grown on dairy farms to provide quality feed when there is little pasture growth or when pasture quality has declined.

THE profit in dairying can be lifted considerably by the progressive establishment of sown pastures on all land not needed for cropping. Even on crop land a rotation to pastures rejuvenates soil structure and improves crop yields.

Compared with improved pastures, native pastures have a shorter growing period, are inferior in quality and have a lower carrying capacity. In Central Queensland there are also many paddocks of run-down Rhodes grass and low yielding crop land that could be profitably changed to improved legume based pasture.

Establishment of sown pastures is not cheap. The cost involved is the main reason for dairy farmers having lived for years with low-producing native pastures. In recent years the Dairy Pasture Subsidy Scheme has given an impetus to increasing the area of improved pastures on dairy farms at half the normal cost. Progress is being made on most dairy farms but there are still many low-producing hectares which could be converted to improved pastures.

Pasture Species

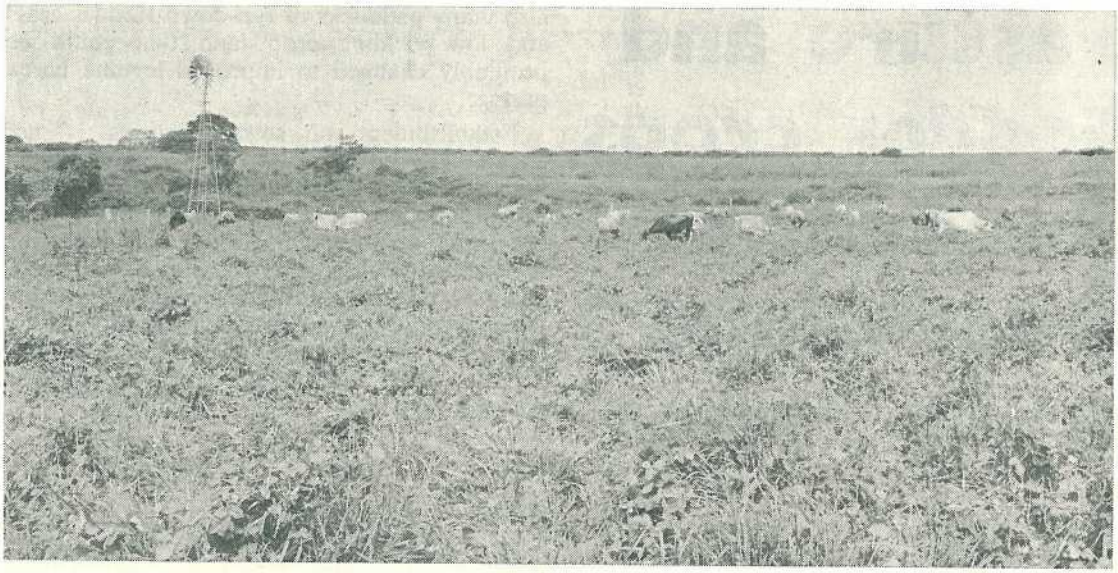
Grasses

A range of suitable and proven grasses—green panic (*Panicum maximum* var. *trichoglume* cv. Petrie), buffel (*Cenchrus ciliaris*) and Rhodes (*Chloris gayana*)—is available to meet most district situations and soil variations on individual farms.

In general, Rhodes grass should be used on heavy, melon-hole brigalow soils. The cultivar Callide is preferred to Pioneer in higher rainfall situations. Green panic is the best grass for well-drained fertile soils such as softwood scrubs, red volcanics and alluvials. Buffel grass may be used on intermediate soil types and can make the best use of sandy soils and soils of low fertility. There is a range of commerical varieties of buffel grass that may be used for specific situations. Gayndah and American buffel colonise freely and are recommended for the sandy loam and shallow soils of forest country. The tall buffels such as Biloela, Nunbank and Tarewinnabar are more productive varieties for the brigalow soils.

In a wet or swampy section of a farm, para grass (*Brachiaria mutica*) will provide valuable grazing in dry periods, and in the winter months if frosts are not severe. In addition para grass can be established on pondage banks which arrest the flow of storm water in suitable catchment areas.

A useful introduced blue grass (*Bothriochloa insculpta*) known as "creeping blue grass" is spreading in the Rockhampton district. This grass is adapted to a wide range of soils but is especially suitable for clay loam



Dairy cows grazing a well managed grass/legume pasture.

A green panic/Siratro pasture established at Marmor under the Dairy Pasture Subsidy Scheme.

to heavy clay soils and can be used as an alternative to Rhodes grass in such situations. Seed is sometimes available from two farmers in The Caves area. It is usually sown by hand broadcasting at 2 kg/ha.

Other grasses such as setaria (*Setaria sphacelata*), paspalum (*Paspalum dilalatum*), plicatulum (*Paspalum plicatulum*), pangola (*Digitaria decumbens*) and signal grass *Brachiaria decumbens*) are only suitable for a restricted higher rainfall area between Yeppoon and Byfield.

There are no suitable winter grasses for our climatic condition but Molopo buffel and Narok setaria have more cold tolerance than the other summer grasses mentioned.

Legumes

Siratro (*Macroptilium atropurpurenum* cv. Siratro) is the best available legume for Central Coast dairy farms. It has proven adaptability to a wide range of soil types and is compatible with the recommended sown grasses. Apart from its direct feed value, it has the ability to "fix" nitrogen better than other tropical legumes and benefit the associated grasses. Siratro's main weakness is susceptibility to frost and it makes little growth during the cooler months.

Farther from the coast, in the drier parts of the Banana Shire, lucerne (*Medicago sativa*) is the only proven legume for a pasture mixture However, its effective life, even with rotational grazing, may not be more than four or five years.

The freely regenerating annual, Townsville stylo (*Stylosanthes humilis*) is used in coastal spear grass country and on sandy ridges carrying timber. The productivity of this legume depends on strategic grass control by grazing, and the use of superphosphate. A new release, Verano stylo (*Stylosanthes hamata*) is now available and is expected to replace Townsville stylo.

Another legume, phasey bean (*Macroptilium lathyroides* cv. Murray), though not wholly reliable in its feed production, is well adapted to the Central Coast and has spread in many areas. Seed is seldom available but the plant volunteers in many pasture sowings. Its usefulness in a pasture mixture is mainly as a support to other legumes or to cope with poorly drained situations.

Leucaena (*Leucaena leucocephala*) is a browse shrub or small tree that could be used for limited periods of controlled grazing on dairy farms. The leaves are palatable and have a high protein content. Production of leafy foliage continues into the winter in frost free coastal situations.

Leucaena can taint milk and should not be fed within two hours of milking. Because of the special aspects of growing leucaena, advice should be sought before deciding to grow this plant.

Pasture Establishment

A fallow period without excessive working, has the advantages of preparing a good seedbed, storing moisture, controlling weeds and increasing available nitrogen. Nitrogen is always needed for good grass establishment.

Superphosphate fertilizer at rates varying from 200 to 500 kg per hectare is required on most Central Coastal soils. On old paddocks with a history of declining crop yields, a complete (NPK) fertilizer or a nitrogen-phosphorus fertilizer will give good results.

Where there is insufficient information available on fertilizer requirements a soil test is recommended.

Superphosphate should be incorporated into the soil at or before planting. In this district, surface applications can be doomed to periods of partial waste on the dried out soil surface.

As pasture seeds are small and must be planted shallow, success or failure is greatly influenced by the weather after sowing. This element of risk can be greatly reduced, but not eliminated, by planting during the wet season.

While the aim is get a good strike after sowing, all is not lost with a poorer strike. If the paddock is closed up for the first summer to permit seeding, germination and early growth, grasses and Siratro can colonize freely and develop into a satisfactory pasture. Slashing of weeds may also be necessary.

Growth Pattern of Pastures

In most years active pasture growth can be expected from early December until March, followed by useful growth until May. A decline in both quality and quantity of mature pastures can then be expected from May until August. This decline is accentuated by frost.

Close-up of a green panic/Siratro pasture.

Para grass established on pondage banks. A good catchment and a wide shallow storage area provide an ideal pondage situation.

TABLE 1

BASIC PASTURE SOWING RECOMMENDATIONS

Soil/Situation	Pasture Species	Seeding Rate* (kg/ha)
Alluvial		
Softwood scrub ..	Green panic	3–6
Brigalow-softwood scrub	Siratro†	1–2
Brigalow	Green panic or buffel	3–6
	Siratro†	1–2
Forest	Buffel	3–6
	Siratro	1–2
Heavy clay	Rhodes	3–6
	Siratro	1–2
Low and swampy areas	Para	1–2 or runners
	Phasey bean	1–2
Sandy forest	native grass	—
Hilly	Verano stylo	2–3

* The range of seeding rates quoted allows for some variation according to seed quality and soil type.

† Lucerne is preferred to Siratro in the drier parts of the Banana Shire. Planting rates for lucerne and grass are similar at 4 kg per hectare. Inoculation of lucerne seed with the specific root nodule bacteria is desirable in all plantings and essential on land which has not previously grown lucerne.

Pasture growth from August to December depends mainly on thunderstorm rain which is more reliable in late October and November. The new season's growth can be wilted and even hayed off during spells of hot dry weather.

There are many variations from this general growth pattern. As one example, green panic can make useful growth during a mild winter when there is good soil moisture.

Management

A new pasture is an investment and should be a source of high production for many years. Pasture management demands a balance between maintaining a vigorous, weed-free sward and providing maximum grazing for the dairy cattle. This is not always easy, but over-grazing of the pasture in dry periods can be minimized on farms that produce fodder crops and conserve fodder. Increasing the area under improved pastures also reduces the pressure on individual paddocks and allows greater flexibility to match consumption with pasture production.

Provision of 1–1½ hectares of improved pasture for each cow or cow equivalent will avoid excessive grazing and provide scope for high production.

To retain a viny legume such as Siratro in the pasture, grazing should not continue below 8 cm above ground level.

Maintaining a desirable legume/grass balance is a key part of management. It is not only associated with degree and timing of grazing pressure but also with the maintenance of balanced soil fertility. On many coastal dairy farms annual applications of superphosphate are required. Potash may also be needed on some soil types.

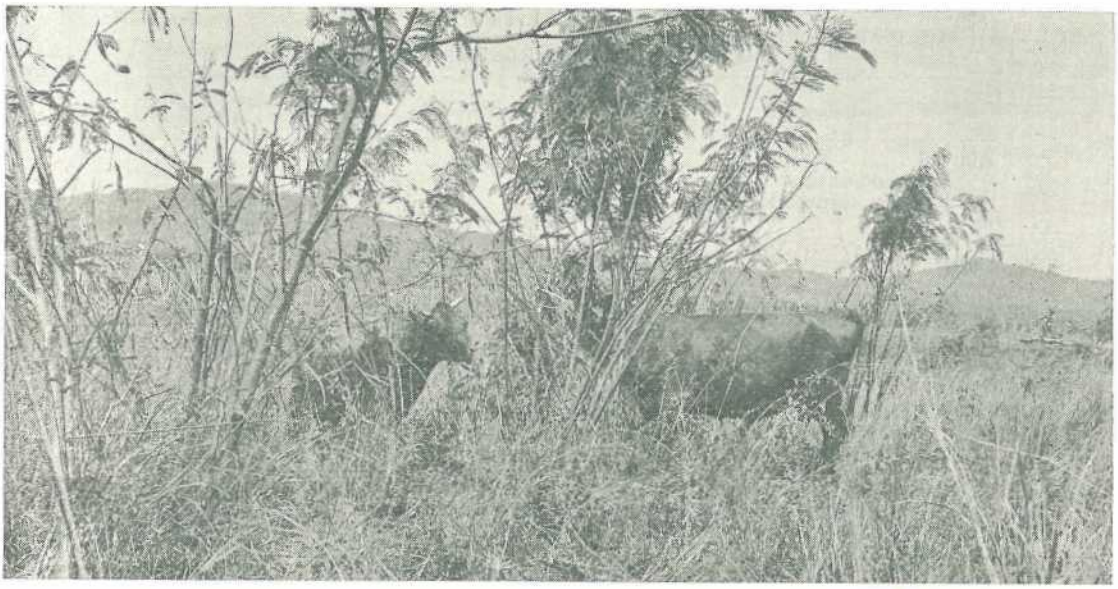
Use of surplus growth

There should be no concern about an excess of improved pastures in a good season. Surplus growth can be converted to good quality hay and where frost is not severe a closed up paddock provides useful standover feed. Since mowing gives a setback to viny legumes, making hay from a Siratro based pasture should be restricted to opportune occasions when Siratro is dominant.

Irrigation

Irrigation on dairy farms is usually for lucerne growing and to a lesser extent for oats.

There is scope on some farms to irrigate an area of improved pasture such as green panic and Siratro. Active growth of green panic can then occur from early spring right through until early winter, and the growing period of Siratro is also lengthened.



Dairy cattle eating the leaves of the browse shrub leucaena at Bouldercombe.

A pasture of creeping blue grass and siratro on a dairy farm at Alton Downs.

Fodder Crops

On dairy farms fodder crops are grown to provide quality feed in periods when there is little pasture growth or when pasture quality has declined. Besides this, growing crops for one or preferably two years, especially with a legume as the second crop, provides the best land preparation when converting old grassland to improved pasture.

Summer Crops

Grain Sorghum

This is the most widely grown grain crop and after the grain harvest the stubble provides roughage in the feed gap between summer and winter-crops.

The crop is well suited to the climatic conditions of Central Queensland and grain yields of 2·5 tonnes per hectare can be expected in most years.

Stubble and associated ratoon growth will be available during the period from June to August and can carry one to two cows per hectare for a period of two months. The quality and quantity of stubble vary according to grain yield and seasonal conditions.

Grain growing in association with dairying is not practicable on all dairy farms but is more prevalent in the Banana and Fitzroy Shires than in Calliope and Livingstone.

Hybrids such as E57 can outyield the open pollinated Alpha but the latter is still grown on dairy farms because of better stubble and suitability of the grain for hammer-milling.

Forage Sorghum

This is the highest yielding forage crop. There are several types including hybrid forage sorghum, sweet sorghum, sudan and sudan hybrids.

A number of hybrid forage sorghums are available such as Sudax, Zulu, Forager, Bonanza and Sordan. Trials have indicated that there is not a wide difference in the total dry matter yield between the hybrids but there could be some variation in palatability. In a good season on fertile soils, they are capable of making early growth at the rate of 30 cm per week. For best results graze a forage sorghum crop down quickly before it reaches 90 cm in height; spell it and repeat the process. A grazing rate of two to four cows per hectare may be required to control growth.

Growth may get out of control and be wasted in a wet season. However, this excess growth can be made into silage as an insurance against dry periods and droughts which are a normal variation in the pattern of seasons.

Of the sweet sorghums, Sugardrip is the main variety but a hybrid is also available. Because of the sweet succulent stem they are superior to forage sorghums as stand-over fodder for the autumn and winter months.

Sudan and sudan grass hybrids have fine stems. While the total yield may be less than that from other forage sorghums, they can be made into hay if not needed for green feed.

Because there is a risk of prussic acid poisoning when grazing all forage sorghums, it is not advisable to graze hungry cattle on short ratoon growth, particularly after a dry period or frosting.

Millets

The grazing millets, with the exception of pearl millet, are capable of providing very quick grazing but do not have the same capacity as sorghums to ratoon for subsequent use. They have value for quick, short term grazing between other crops and are also useful as hay crops.

Legumes

Of the summer annual legumes, lablab bean has to a large extent superseded velvet beans, mung beans and cowpeas.

The outstanding merit of lablab bean is a long production season, late maturity, and cold tolerance during the autumn and early winter. Grazing management should be directed towards stripping the leaves from the plant without cutting back too much of the stem. This allows quick recovery.

A new variety Highworth was recently released to complement the existing Rongai. Its main differences are upright growth, and earlier flowering and seed maturity.

The use of lablab bean or other legumes in a crop rotation also maintains soil fertility.

Lucerne is an extremely valuable high protein and reliable fodder where irrigation is available. It is mainly grown for hay, but as the crop thins out after a few years, with consequent grass invasion, short periods of strip grazing may be practicable. Lucerne is also capable of making fair growth during a mild winter.

Winter Crops

These are less reliable than late sown summer crops. They include oats, safflower, barley, wheat and rape.

Barley and wheat do not make regrowth following grazing as well as oats or safflower. Rape is susceptible to insect attack.

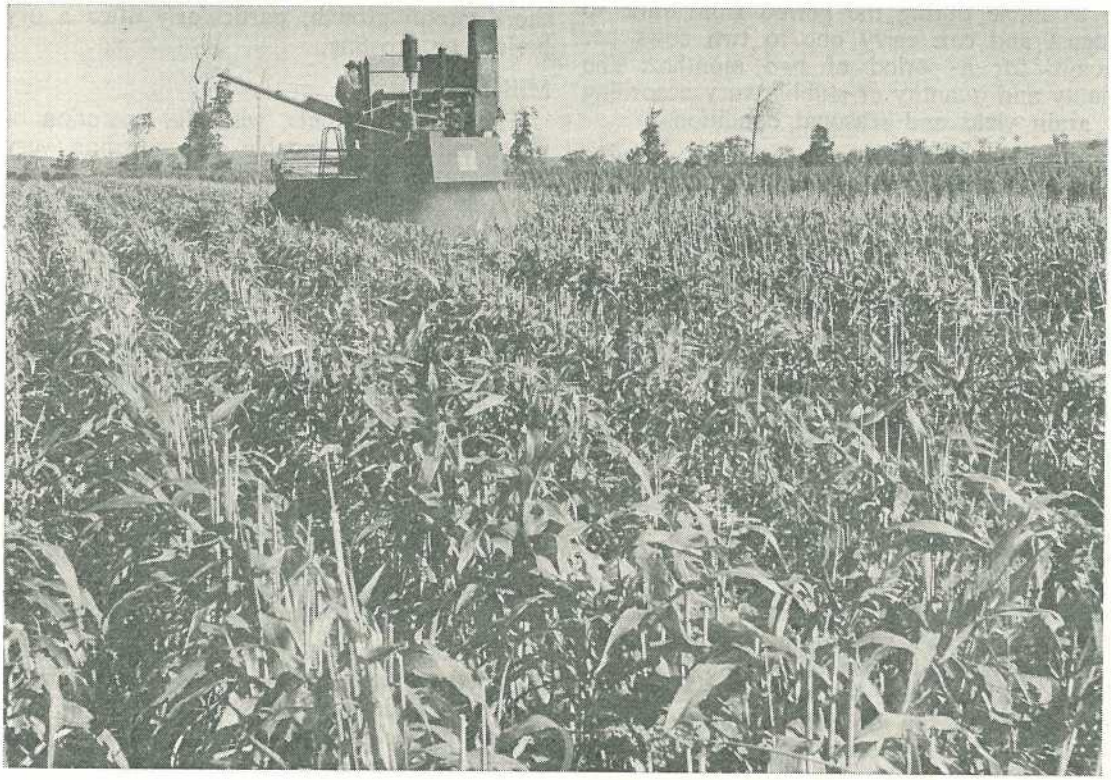
Oats is the traditional winter crop for the region but, because of the lower winter rainfall, it has not the same degree of reliability as in southern areas. Apart from rain for sowing, follow-up rain is essential to promote secondary root development. For this reason sow in late February or early March, and only use varieties which have resistance or at least tolerance to leaf rust. Currently recommended varieties are Minhafer, Camellia and Bentland. Where irrigation is available a succession of sowings may be made during autumn and winter.

If oats is the main winter fodder, aim to grow at least 1 hectare for every 5 cows. Best value from oats is obtained by strip grazing.

Safflower is grown to a lesser extent than oats. As it has a tap root it can cope better than oats with drier conditions after sowing but is not as easy to manage. Plant a non-spiny variety such as Horowitz and maintain a grazing pressure sufficient to prevent flowering and seed development.

Soils and Land Preparation

The most important aspect of soils used for cropping is their moisture holding capacity. A reserve of moisture will carry an estab-



Grain sorghum stubble at Etna Creek which will provide valuable grazing during winter.

lished crop through a period of dry weather. Such periods can be expected from late autumn through to early summer.

The moisture holding capacity of a soil is governed by depth and texture. Alluvials and the deeper loams and clay loams are best. A clay loam can store 50 mm of water per 30 cm of depth.

With all grain and fodder crops land preparation should allow for a fallow period to control weeds and build up subsoil moisture.

Annual summer forage crops are less demanding than grain and winter forage crops. They can be used in a cropping phase for one or two seasons when changing over from native to sown pastures.

Fertilizer

Phosphorus may be deficient in some localities. Applications of from 100 to 300 kg/ha, according to the degree of deficiency, may be required at sowing. With irrigated crops potash may also be required.

Nitrogen is an important element for all fodder crops but its economic use requires adequate rainfall or irrigation. On moderately fertile soil nitrogen can build up during the fallow. For irrigated crops the normal application rate is 100 kg/ha of urea or its equivalent in nitrogen. Close contact between seed and urea will reduce germination.

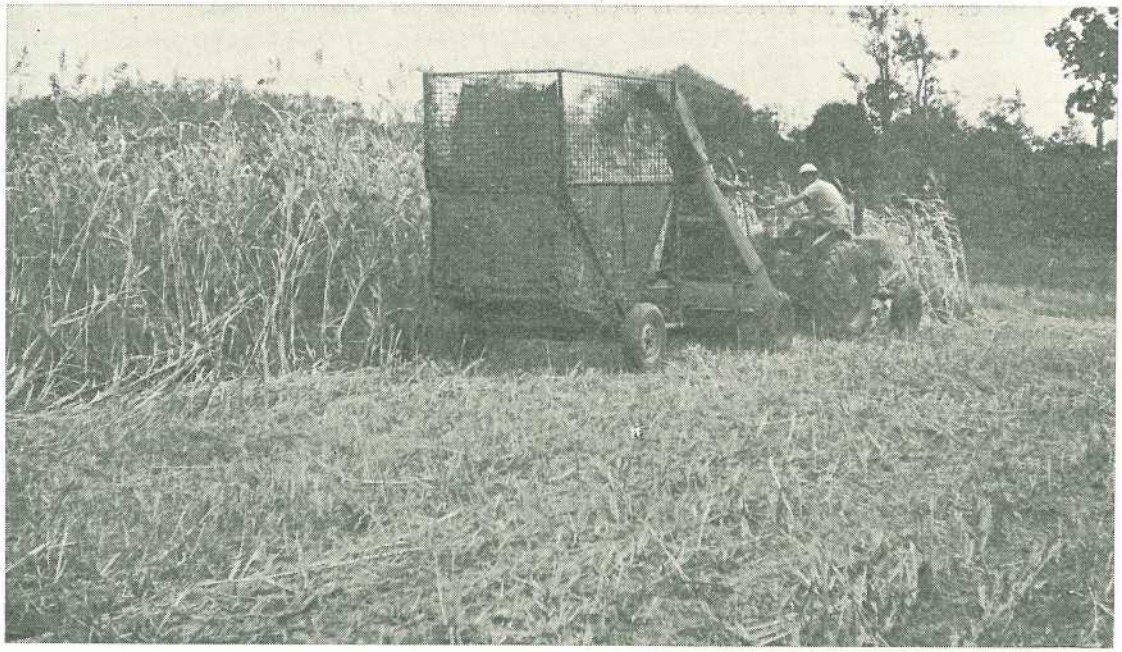
Local recommendations for the different soil types are available.

Suggested Cropping Programme

(Dryland)

Sow hybrid forage sorghum early, lablab bean in mid season and sweet sorghum late to spread out the availability of summer forage. An alternative is to sow lablab with sweet sorghum in the late crop, thus enhancing the feed value of the sorghum.

When there is good subsoil moisture, sow an early autumn crop of oats to lift the protein level of winter feed. With oats it should be realized that the winter rainfall may not be sufficient in some years to provide satisfactory regrowth after the first grazing.



Harvesting a crop of hybrid forage sorghum at Raglan.

Lablab bean can produce an abundance of high protein forage for autumn grazing.

TABLE II

SOWING RATES AND TIMES, AND PERIOD OF FODDER AVAILABILITY

Crops	Sowing		Fodder Availability
	Rate (kg/ha)	Time	
Grain sorghum	2–5	Dec.–Jan.	May–Dec. (grain) Jun.–Aug. (stubble)
Hybrid forage sorghum	8–10	Late Aug.–Oct.	Oct.–May
Sudan	6–8	Late Aug.–Oct.	Oct.–May
Sweet sorghum	8–10	Late Jan.–Early Mar.	May–Jul.
Millets	8–10	Late Aug.–Oct.	Oct.–Jan.
Lablab bean* (rows)	12–15	Dec.–Jan.	Mar.–Jul.
Lucerne* (irrigated)	10–15	Apr.–May	Jan.–Dec.
Oats	30–40	Late Feb.–Mar.	Apr.–Aug.
Safflower	10–12	Late Feb.–Mar.	Apr.–Aug.

* Inoculation of lucerne and lablab seed with the specific root nodule bacteria is desirable for all plantings and essential on land which has not previously grown the particular crop.

The success of an early (spring) sown forage sorghum crop depends on planting rain supported by conserved subsoil moisture. The benefits are quick feed during spring, and early summer spelling of pastures which may have been overgrazed during the winter, and the provision of a large bulk of fodder on a small area.

As the area of improved pastures increases and available cropping land decreases, it may be necessary to reduce the area of early sown summer fodder crops, or eliminate them in favour of late sown summer crops. This is practicable when the area of improved pasture is extensive and well managed to provide spelled reserve paddocks and farm saved quality hay. Few dairy farms have reached such an advanced stage of development.

Table II shows sowing rate and time and period of availability of fodder for the crops discussed.

The sowing periods suggested are for the use of the crop to obtain a balanced distribution of fodder in relation to pasture growth and other crops.

Varieties

Crop varietal recommendations can vary from year to year as better varieties become available or established varieties decline owing to factors such as disease susceptibility. Check with local advisory officers before sowing or refer to the annual recommendations in the *Queensland Agricultural Journal* for crops such as grain sorghum and oats.

Pasture—fodder crop combination

This combination is an essential part of dairying in the region. Used effectively, it considerably reduces the amount of bought fodder and concentrates required.

Although it is possible and advisable to plan fodder cropping, such planning needs to be flexible by providing for alternatives to allow for the uncertainty of seasonal conditions and fit in with pasture availability.

Best value from oats is obtained by strip grazing.

Identifying insects

GRASSHOPPERS, LOCUSTS & CRICKETS
(Order *Orthoptera*)

by I. D. GALLOWAY, Entomology Branch.

Locusts and grasshoppers are agricultural pests of great antiquity being recorded as devastating crops during the 6th dynasty in Egypt (2625-2475 B.C.). Throughout history, when the probability of locust and grasshopper plagues arose, the immediate reaction of most farmers has been the fear of devastation.

VIRTUALLY every farm in Queensland supports a regular though small population of the pests, and almost everyone associated with the land would on sight be able to identify one of these insects as a "grasshopper". It is, however, only when massive numbers, swarms or plagues of the pest occur that they become pests of real economic significance.

In any discussion therefore, it is important that the meaning of terms such as plagues, swarms and non-swarming populations, and in fact locusts and grasshoppers be clearly understood.

Locusts and grasshoppers are very similar in appearance and habits, except that locusts are capable of migrating considerable distances away from the areas in which they developed. Such migrations may occur when the pests are present in very large numbers and when certain ecological conditions tend to mass the insects together into swarms.

Grasshoppers, on the other hand, no matter how numerous they become, never form into true swarms. On occasions, large numbers may be present as a population aggregation but each individual is independent of the others and there is no tendency towards the development of a migratory habit. Vague "swarms" of this nature at most do not move beyond a few miles from the areas in which they developed. Grasshoppers therefore may constitute problems of local or even district significance while locusts may breed in one district and ravage crops over much wider and distant areas.

The habits of locust species, however, are frequently the same as those of grasshoppers. The essential difference between a swarming and a non-swarming population of locusts is that the insects of a swarming population move together more or less as a unit. This can happen with the nymphs as well as the adults. They tend to keep together, move in the same direction and rest together. The non-swarming populations however act as individuals.

Life history

The life history of most locust and grasshopper species is broadly similar. The adult female deposits eggs in holes which she cuts into the soil by means of two curved processes at the end of the abdomen. The sites which the females choose for egg laying are usually open, relatively devoid of vegetation and in areas of fairly compacted soil. The eggs hatch after periods which may vary from a few weeks to some months. The hoppers are similar to the adults except that they are smaller, devoid of wings and, of course, sexually immature. They grow quite rapidly, shedding their skins several times as they develop.

In some species, a number of generations may occur each year while in others only one generation is the rule. In the prominent pest species found in Queensland, however, more than one generation per year is usual, with the eggs hatching within a few weeks and the hoppers completing their development in about two months.

Classification

Grasshoppers, locusts and crickets are regarded as members of the order *Orthoptera* and as such have a number of essential features in common. Briefly these features are:—

- the possession of biting and chewing mouthparts.
- locomotion frequently provided by two pair of wings and a pair of hind legs adapted for jumping; the forewings are modified to form leathery wing covers while the hind pair are membranous and fan-like.
- the wingless immature stages or nymphs resemble the adult in both appearance and habits, and finally reach maturity through a succession of moults.

Major pest species

Of the numerous species of locusts and grasshoppers which occur in Australia only five can be considered as pests of real economic significance in Queensland. These are the Australian plague locust, the yellow-winged locust, the spur-throated locust, the migratory locust and the wingless grasshopper.

Australian Plague Locust

The Australian plague locust is probably the best known of all the Australian locusts and grasshoppers. Scattered individuals of the species may be found over the greater part of Queensland and swarms have occurred over portions of the State on one or another occasion during the present century.

The mature insect measures from 30–42 mm in the female and 25–30 mm in the male. The forewings are narrow and semi-transparent with several large dark coloured bands and spots. The hind wings are transparent and colourless except for a large black spot at the tip of each wing. The shanks of the hind legs are a bright scarlet and the usual body colour is brown, but grey and green specimens are not uncommon. The body colour of the pest is not a reliable characteristic upon which to base a casual identification. The black spot at the tip of each hind wing and the red shanks of the hind legs constitute more reliable characters.

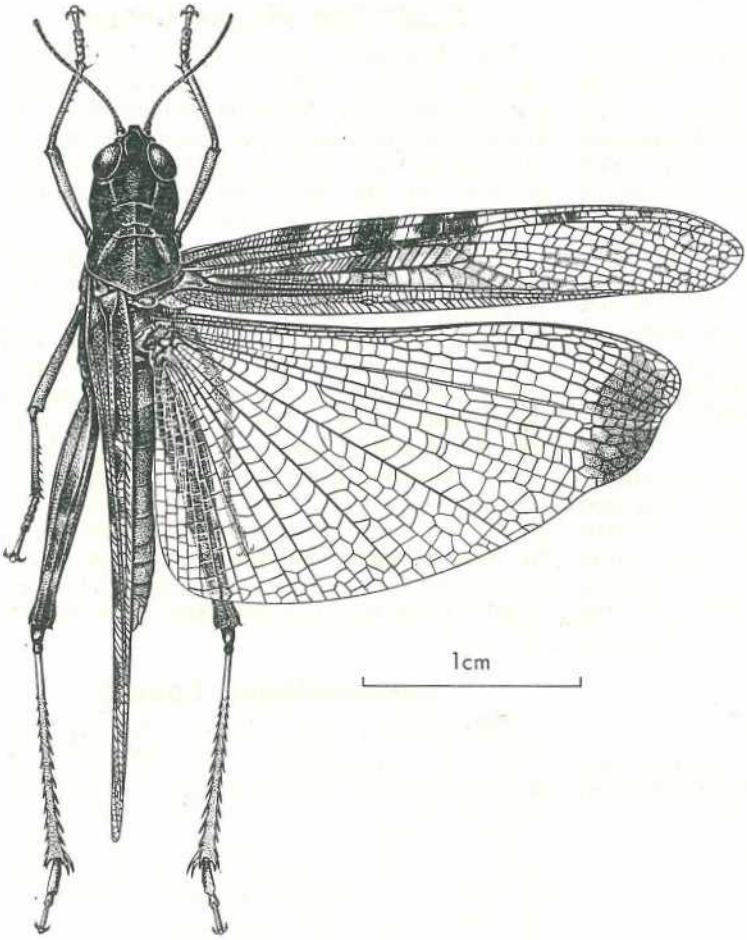
Yellow-winged Locust

The yellow-winged locust showing the habits of a grasshopper may be found in isolated numbers in most parts of Queensland. Only in the drier regions of the central and northern districts of Queensland are plagues of the pest experienced. Economic losses from the insect are largely confined to pastures, sorghum, maize and sugar-cane. The adult may measure from 45–55 mm in the female and 35–45 mm in the male.

Characteristically there is a large bright area of yellow colour on the basal region of each hind wing, while the central part of the hind wing carries a broad, curved band of black. The general body colour of the yellow-winged locust is brown in swarming populations. In addition to the characteristic yellow wing colour, the pests make a distinctive loud clicking noise in flight.

Spur-throated Locust

The spur-throated locust is a large distinctive species which is commonly found in association with dense, tall grass. The mature female insect may measure as much as 70 to 80 mm in length and up to 130 mm across the outspread wings.



AUSTRALIAN PLAGUE LOCUST
(Chortoicetes terminifera (Walker))

(Illustration reproduced with the kind permission of CSIRO Division of Entomology and Melbourne University Press)

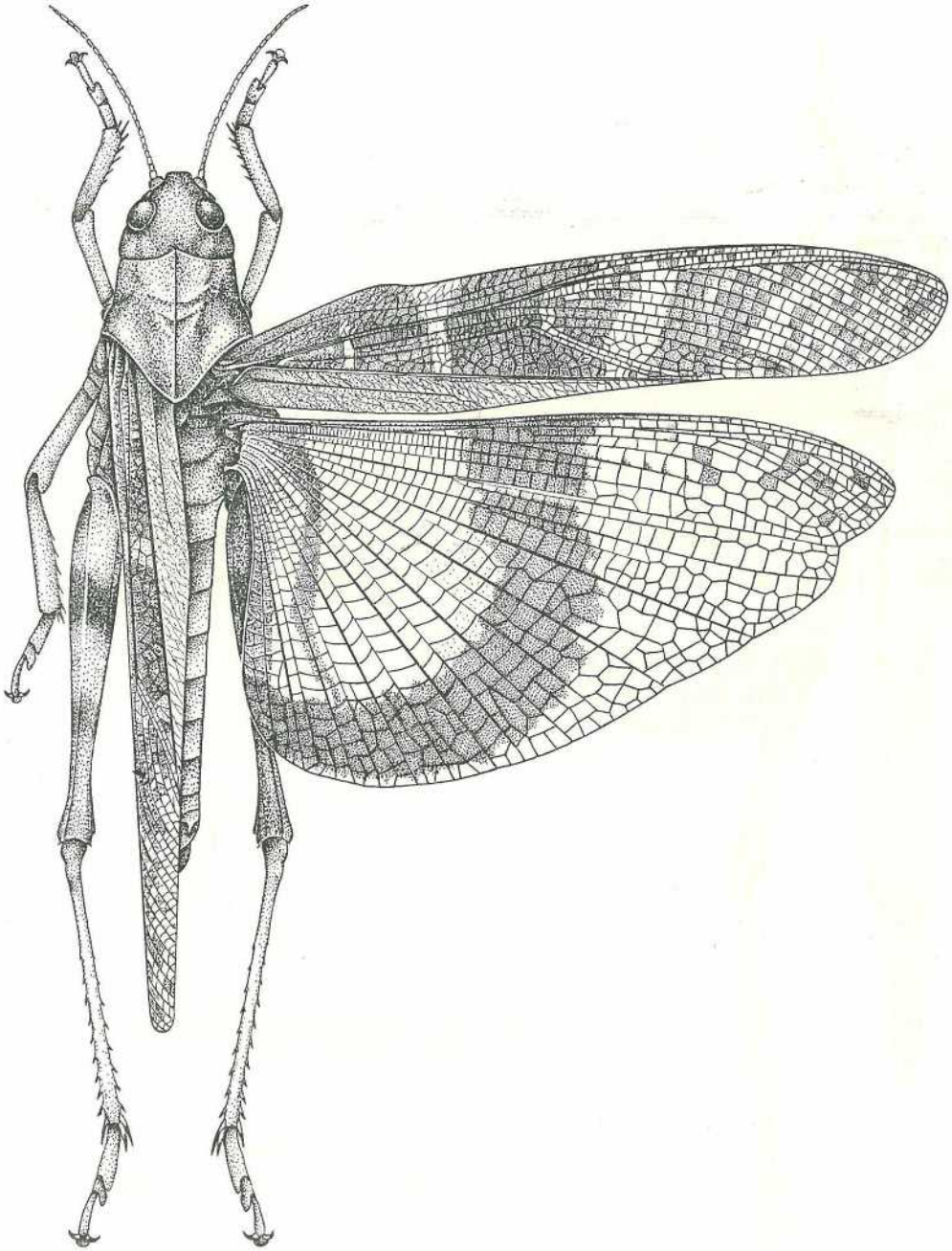
The forewings are semi-transparent with many dark spots and the hind wings are transparent and colourless. This species carries a large spine or spur on the underside of the neck, projecting backwards between the first pair of legs. This spur distinguishes the species from each of the other locust and grasshopper pests.

Migratory Locust

The migratory locust is the only locust species that occurs both in Australia and in areas outside the Australian continent and surrounding islands. In size, it is larger than the Australian plague locust but it does not have a black area on the tip of the hind wings. It is a serious pest in many parts of the world including Europe, Africa and Asia. In Queensland, it is mainly coastal in distribution and sugar-cane is the major host to which economic damage is caused.

Wingless Grasshopper

The wingless grasshopper is a pest in southern Australia but it extends into the southern inland part of Queensland where it occasionally causes damage to fruit trees, tobacco, vegetables and garden plants, thus showing a preference for broad-leafed plant species. This pest is a small grasshopper, never more than 20 mm long.



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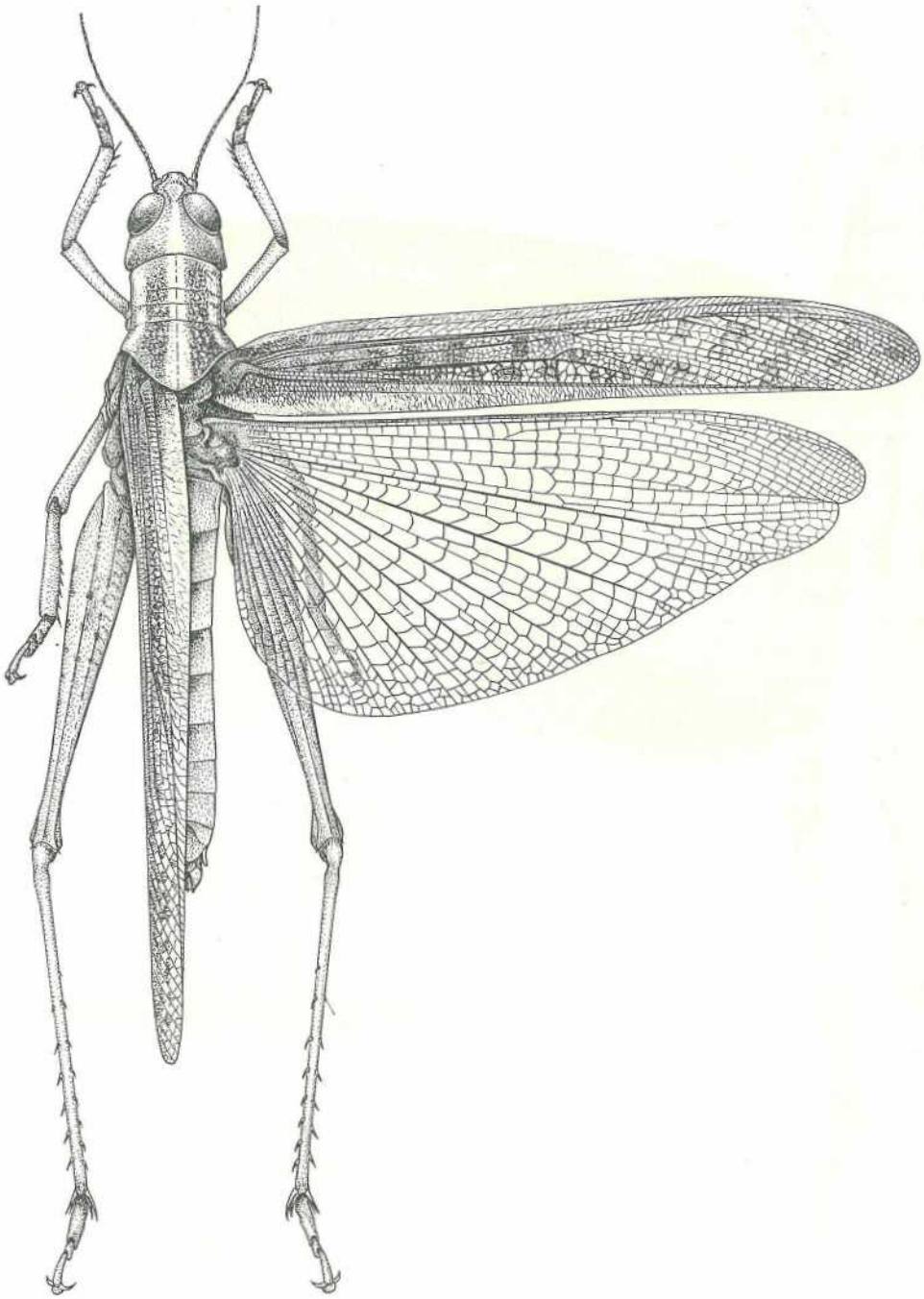
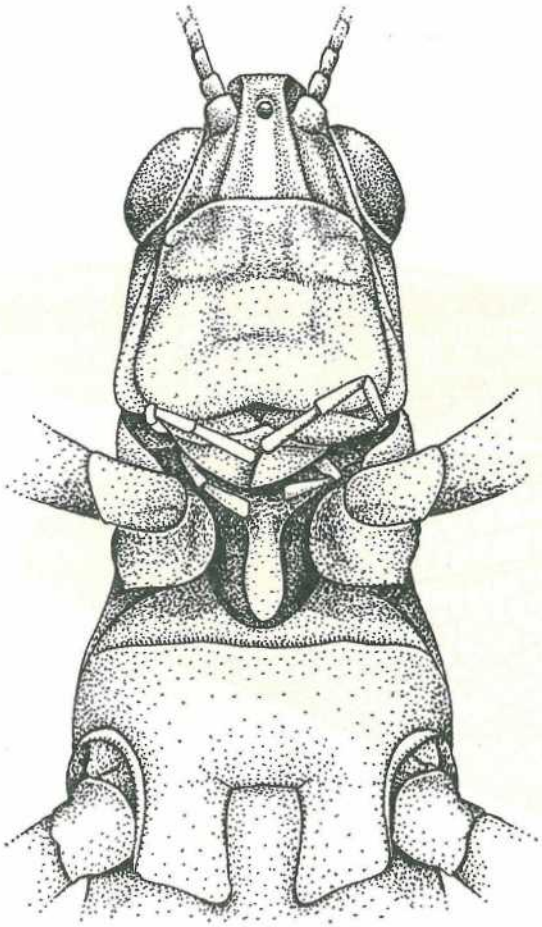
YELLOW-WINGED LOCUST (*Gastrimargus musicus* (Fabricius)). *(Illustration by R. Kohout)*



SPUR-THROATED LOCUST (*Austracris guttulosa* (Walker)) *dorsal view.* *(Illustration by R. Kohout)*



1 cm

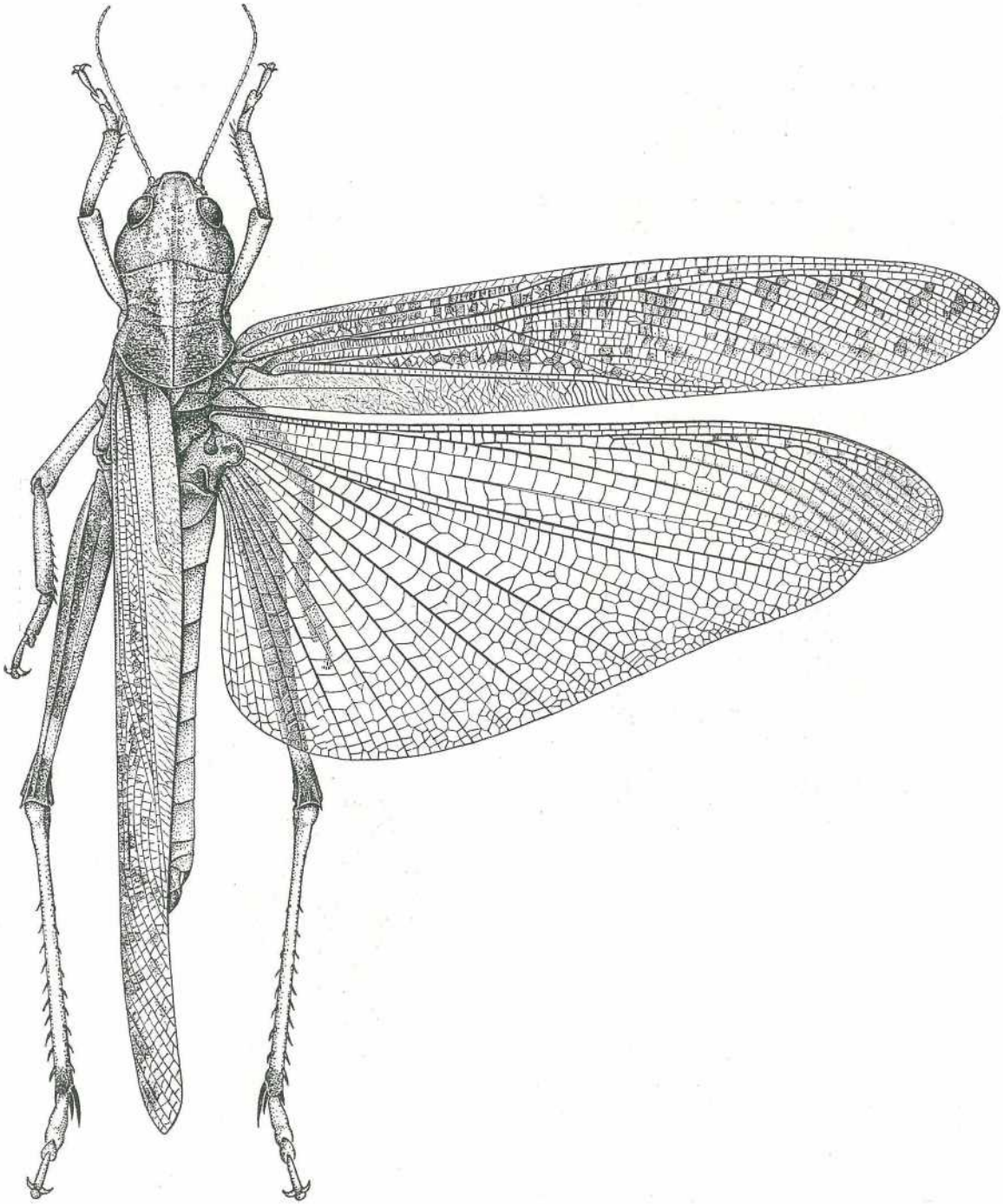
1 cm

SPUR-THROATED LOCUST *(Austracris guttulosa* (Walker)).

Above: ventral view.

Right: lateral view.

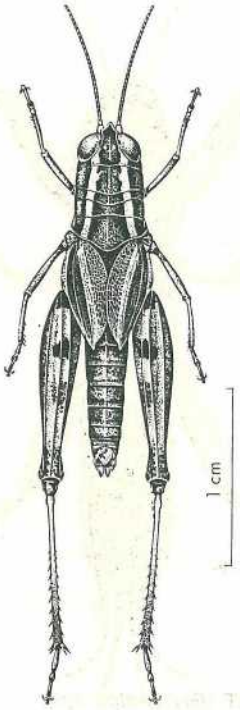
(Illustrations by R. Kohout)



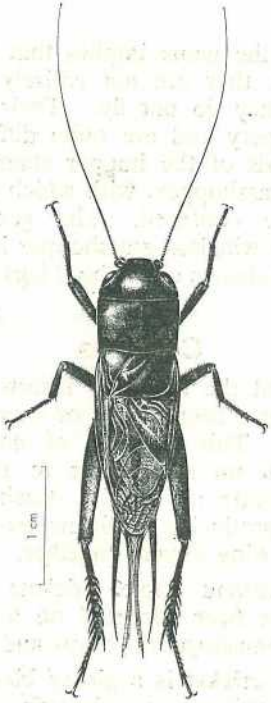
MIGRATORY LOCUST (*Locusta migratoria* (Linnaeus)) *dorsal view.* *(Illustration by R. Kohout)*

MIGRATORY LOCUST (*Locusta migratoria* (Linnaeus)) *lateral view.*

(Illustration by R. Kohout)

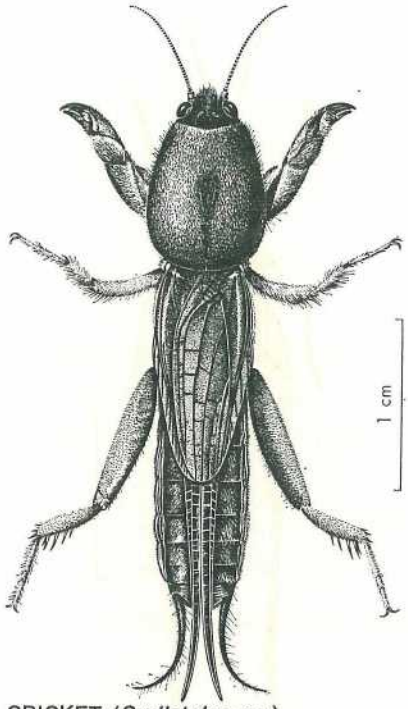


WINGLESS GRASSHOPPER *(Phaulacridium vittatum* (Sjost)).



FIELD CRICKET (*Teleogryllus commodus* (Walker)).

(Illustrations reproduced with the kind permission of CSIRO Division of Entomology and Melbourne University Press)



MOLE CRICKET (*Gryllotalpa* sp.).

(Illustration reproduced with the kind permission of CSIRO Division of Entomology and Melbourne University Press)

Although the name implies that the insects are wingless, they are not entirely devoid of wings, but they do not fly. Their wings are thin and papery and are quite different from the wing buds of the hopper stages of other locusts or grasshoppers with which they might otherwise be confused. The general body colour of the wingless grasshopper is brown or grey and the shanks of the hind legs are usually red.

Crickets

Throughout the ages few insects have provoked the same fascinations or superstitions as the cricket. This measure of notoriety has been due in no small part to the crickets ability to create a "song". Each species is capable of producing a distinctive melody by rubbing its wing covers together.

In Queensland mole crickets and field crickets have been reported on a number of occasions damaging field crops and vegetables.

The **field cricket** is a glossy black, thickset insect measuring approximately 25 mm in length. The head is large and broad and is surmounted by a pair of long thread-like antennae. The female is distinguished from the male by the possession of a slender ovipositor projecting from the extremity of the abdomen. Both sexes have powerful hind legs modified for jumping.

During the day field crickets remain hidden in burrows in the soil or under stones, emerging only at dusk to engage in an active life and partake of a mixed diet of vegetable and animal matter. The female cricket deposits her eggs in the soil by means of the elongate ovipositor. From the eggs hatch small wingless replicas of the parents which grow by a series of moults, until with the final moult the mature fully winged cricket is formed.

Mole crickets are easily distinguished from their field cricket relative. They are brown coloured, somewhat velvety looking insects whose length varies from 25–40 mm. The wings of mole crickets appear short and stumpy but this is because the extensive hind wings used in flight are neatly folded under the short forewings when the insect is at rest. The most distinctive feature of the mole cricket is however the remarkably strong forelegs which have been adapted for burrowing. The lower portion of the limb is flattened and expanded to form a broad shovel, while the lower edge is serrated into a number of tooth-like projections. The effectiveness of this foreleg adaptation is evidenced by the ease with which mole crickets drive their tunnels through hard ground.

Mole crickets are omnivorous, feeding upon insects and plants. In field and vegetable crops, damage is caused by the crickets burrowing just below the surface of the soil and disturbing the roots. They have also been known to attack turnips and carrots and to feed on the roots of various plants. The female mole cricket lays her eggs in a chamber at the end of a tunnel in the soil. Upon hatching, the young though incapable of flight, are able to take part in burrowing through the soil. Growth occurs through a series of moults until the winged adult is formed.

The scientific names of insects in order of appearance in the text are:—

Australian plague locust	*Chortoicetes terminifera* (Walk.)
Yellow-winged locust	*Gastrimargus musicus* (F.)
Spur-throated locust	*Austracris guttulosa* (Walk.)
Migratory locust ..	*Locusta migratoria* (L.)
Wingless grasshopper	*Phaulacridium vittatum* (Sjost.)
Field cricket	*Teleogryllus commodus* (Walk.)
Mole crickets ..	*Gryllotalpa* spp.

Part 4

Guide to Soils and Plant Nutrition

by N. G. CASSIDY

In this Section

Leaching of nutrients
pH and its uses
Organic matter

Leaching of Nutrients

IT has been seen that the salts (such as sodium chloride) which accumulate in watered soils are the most soluble substances to be met with in soils. Under good natural rainfall there is little salt in, say, the top 50 cm of a soil.

The most soluble substances are then likely to be residual fertilizer. Of these, ammonium cations and (more especially) nitrate anions are likely to be found in greatest quantity. Common values for a fertile soil which has not been very heavily fertilized are 10–100 parts per million of nitrogen (N) in the nitrate form and 0–5 parts per million in the ammonium form.

When organic matter decomposes, in a well-aerated soil, ammonium N is formed first and this soon oxidizes to nitrate N. At the same time any sulphur is converted to sulphate. The changes in nitrogen and sulphur are brought about by micro-organisms.

Of the other major nutrients there are likely to be about 100 ppm of replaceable potassium (cation) and 100 ppm available phosphorus (H_2PO_4' anion) in a fertile soil. These are of course not in solution, but are combined with the fine soil fractions.

Leaching

The question of the leaching away of nutriants by heavy rain is of great importance, particularly in sub-tropical and tropical zones. The essence of this problem is 'how much', as concerns each plant-food. The most common mistake is to assume that all plant-foods are washed away to the same extent, by heavy rainfall.

An examination of losses of the anions sulphate and phosphate from a krasnozem soil in Queensland (soil which receives a 2 000 mm rainfall) was made under laboratory conditions.

It was demonstrated that at soil-saturation, one change of soil water removed no sulphate; but at eight changes a top-dressing of 75 kg sulphate/ha had been substantially removed from the upper 6 cm soil.

With ammonium sulphate, 90% of the top-dressing was recovered in the drainage; and with calcium sulphate 70% of the sulphate was recovered.

The case for phosphate was completely different. No appreciable amount of phosphate was removed in the drainage at all.

The soil was very porous, and an infiltration rate of over 10 cm per hour was achieved.

Further Experiments

Similar experiments with another krasnozem were carried out. Ammonium sulphate and potassium sulphate each at 600 kg/ha, and superphosphate at 1 200 kg/ha were applied to the surface of the soil. Leaching amounted to 30 cm of water, intermittently, over a period of a fortnight.

The drainage contained 78% of the applied nitrogen, half as ammonia and half oxidised to nitrate; it contained only 1·5% of the potassium. Phosphate could scarcely be detected in the drainage; and it was no higher for the fertilized soil than for an unfertilized sample.

Another similar experiment was made on a latosol in Fiji. Here 91% of the nitrogen fertilizer was washed through the soil, 79% of it as ammonium salt. When urea was used instead of ammonium sulphate, 53% of the nitrogen (mainly converted to ammonium ion) appeared in the drainage. About 13% of the potassium appeared in the drainage: but as usual the loss of phosphate was scarcely measureable.

It is normally difficult to detect soluble P in the soil at all: as little as 0·01 ppm may be present in water-soluble form.

Only with some very sandy soils is phosphate lost by the leaching process. Some potassium may be removed from the surface soil, but nitrogen is the plant food which is most vulnerable.

Ammonium salts can be held firmly on the clay particles by cation exchange: nitrates are not firmly held by anion exchange, and are the most easily lost of all plant foods.

In rice culture the nitrogen is often added as ammonium salt, deep in the saturated soil. The ANAEROBIC conditions prevent oxidation to nitrate, and this allows the rice (one of the few plants to accept ammonium ions directly) to obtain its nitrogen continuously, as required.

Shortage

A chronic shortage of nitrogen exists in tropical plants during the wet season and has given rise to the expression "a green desert". It is only abundant rain which can maintain a greenness in plants whilst the foodstuff necessary for growth and yield is missing.

In drier climates, as in dry-farming, nitrates are washed down some distance into the soil, but are still within reach of the subsequent crop. The generation of nitrates from soil organic matter, under these aerobic conditions, is one of the benefits of dry-farming.

The leaching of trace elements is a subject without an extensive literature and will not be dealt with here.

To sum up, 75% of the nitrogen salts, 10% of the potassium salts, but less than 1% of soluble phosphate ("super") can be expected to be removed by intensive leaching with water.

pH and its uses

What is pH? It is a number, in a scale going up to 14, that gives a measure of acidity in the lower half of the scale and of alkalinity in the upper half. At 7 lies the neutral point; here, there is neither acidity nor alkalinity.

pH thus allows us to be precise about the acidity of, say, orange juice (4·5) or the alkalinity of a soap lather (9·0). Pure water is neutral, with a theoretical value of 7·0. In fact, though, even water free of mineral matter will contain dissolved carbon dioxide gas. This gives rise to carbonic acid, so the water will be slightly acid, having a pH value of about 6·4.

By means of an electrical meter, or more simply by indicator papers, any solution containing acid can be given its appropriate value below 7. Notice that the stronger the acid, the lower will be this figure. Similarly an alkaline solution may be given its appropriate value. Alkaline solutions will have a value greater than 7, with a maximum of 14 for strong caustic soda. Some pH values of common substances are shown below.

APPROXIMATE pH OF COMMON SUBSTANCES

Vinegar	2·5
Orange, tomato juice	3·5
Prunes, banana, papaw	5·0
Plant sap (commonly)	5·5
Milk	6·5
Limestone, chalk	7·0
Blood	7·4
Eggs	7·8
Urea	8·0
Soap lather	9·0
Borax	9·7
Washing Soda	10

pH is important because it affects a multitude of things. At low pH (i.e. strong acidity) certain bacteria will not thrive. The Rhizobia bacteria needed by leguminous plants (peas, lucerne, beans, etc.) will not thrive in acid soils, so the host plant will not thrive either. The exception is provided by tropical legumes which have evolved in the acidic soils of warm high-rainfall areas.

The question of whether to plant a certain crop on a particular soil is a subject of primary concern. Some plant species have definite preferences, although the majority can accommodate to a range of pH values.

In extreme cases, where the actual soil pH is completely different from the crop-preference, it is best to change to another crop. Pineapples are subject to iron deficiency, and potatoes are subject to scab, if grown on alkaline soils: similarly azaleas and rhododendrons are most unhappy in such soils. On the other hand, lucerne, beet and cucumber will not do well on acid soils.

When the soil pH is not too far from the optimum, it is customary and perhaps economic to change an acid pH, at least for the currency of the growing season, by applying limestone.

As a rule the pH value after liming tends to revert slowly to the original value. Thus, coral-sand limestone with a particle size of about 1 mm was applied at 5 000 kilograms per hectare to an alluvial soil of pH 5·6 in Fiji. At the end of two years the applied limestone could not be detected chemically, in the soil; the pH of the (0–20) cm layer was still 0·27 units higher than its original value, but in the (20–60) cm layer there was scarcely a detectible difference.

Under moist tropical conditions the effect of liming had therefore practically been lost after two years.

The Table shows the effect of limestone in raising the pH of different kinds of soil, and of the reverse effect produced by flowers of sulphur.

CHANGING THE pH OF A SOIL

"Lime requirement" Fine limestone, in metric tons per hectare

pH change	4·5 to 5·5	5·5 to 6·5
	t/ha	t/ha
Loam	1·7	2·2
Silt loam	2·6	3·2
Clay loam	3·4	4·3
Krasnozem	..	3·9

"Sulphur requirement" Fine sulphur, in kilograms per hectare

pH change	8·5 to 7·5	7·5 to 6·5
	kg/ha	kg/ha
Approx. dosage ..	1 200	700

The action with sulphur depends on the presence of certain bacteria to effect the oxidation of sulphur to sulphuric acid, and so the dosage is less precise.

The continuous use of ammonium sulphate fertilizer can acidify a soil. A decrease of one or two units of pH has frequently been observed under these conditions.

pH also influences the availability of plant foods already present in the soil. A wide band means a favourable condition. The chart does not show what nutrients are present in a soil at a given pH. It merely shows how a certain pH affects their availability. Also, some species will always be more capable of getting their requirements than others.

Looking at pH 6·5 on the chart, all elements show a fairly good band-width. At pH 8·5, copper, zinc, boron, manganese, iron (and even phosphorus) will tend to be insoluble and therefore may be in short supply. One might well consider altering the 8·5 soil pH towards 7·0; but any change for a 6·5 soil would only be justified if the intended crop had a strong pH-preference.

The uptake of calcium is shown to be inhibited by an acid reaction. This is well illustrated by a case where 20 ppm calcium in solution was found to be sufficient at pH 6, but 280 ppm was required at pH 4.

Finally, for the mathematically minded—

$$pH = -\log_{10} \text{(hydrogen ion concentration)}.$$

$$= -\log_{10} [H^+]$$ where concentration is in moles per litre. The minus sign is simply a device to make the pH scale a series of positive numbers instead of negative ones.

In pure water at 25°C, hydrogen ions and hydroxyl ions are each present to the extremely small extent of 10^{-7} moles per litre. At equilibrium:—

$$H^+ + OH' \rightleftharpoons H_2O$$

$$[H^+] \times [OH'] = k \times [H_2O]$$

On the right hand side, the reaction constant k and the essentially constant amount of molecular water give a constant product. If hydrogen ion (acid) is added, the hydroxyl ion is therefore correspondingly decreased. The reverse holds for addition of hydroxyl ion. For convenience a scale of H ion is used for all cases, and not one for H^+ and one for OH'. At neutrality, i.e. only pure water present, the pH value must be 7.

Although some plant species have a definite pH = $-\log_{10}$ (hydrogen ion concentration. accommodate themselves to a fair range of pH values. It will therefore be simplest to mention those species which need a definite limited range of pH.

ACID CONDITIONS REQUIRED

Cotton
Cowpea
Millet
Pineapple
Peanut
Rice
Tropical Legumes
Azalea
Cineraria
Camellia
Gardenia
Ferns
Heaths
Hydrangea (blue)
Lupin
Magnolia
Orchids
Pine Trees
Rhododendron

SLIGHTLY ACID

Asparagus
Cabbage
Cauliflower
Celery
Egg Plant
Raspberry
Spinach
Sweet Potato
Tomato
Water Cress
Strawberry
Aster
Chrysanthemum
Daffodil
Dahlia
Daisy
Jonquil
Larkspur
Petunia
Primrose
Rose
Snapdragon
Tulip
Viola

SLIGHTLY ACID TO ALKALINE

Broccoli
Brussels Sprouts
Carrot
Cucumber
Endive
Lettuce
Mushroom
Canna
Gladiolus
Sweet Pea
Ranunculus
May
Stock
Violet

SLIGHTLY ACID TO ALKALINE—continued

Onion
Parsley
Parsnip
Radish
Passion Fruit
Papaw

WIDE RANGE TOLERATED

PREFERRING ACID

Flax
Vetches

PREFERRING ALKALINE

Barley
Lucerne
Passion Fruit
Canna
Gladiolus

PREFERRING NEUTRAL

Maize
Tobacco
Wheat
Sweet Corn

MOST TOLERANT OF ALL

Grasses
Oats
Rye
Sugar Cane

Grasses are the most tolerant plants of all. They will grow at an acidity represented by pH 4, if soluble nitrogen is plentiful. They will also grow in alkaline soil.

Tropical Legumes are more tolerant to low pH and soluble aluminium than are temperate-climate legumes.

The tropical legumes (excepting Desmodium species) will grow and nodulate freely at pH 4. Glycine will do well at pH 5·5 provided calcium is abundant.

Organic Matter

IN most soils organic matter makes up a fairly small portion of the whole soil. Exceptions are peaty soils, in which there is very little mineral matter, and some A_0 horizons as in the podzol soil type. Otherwise organic matter would seldom amount to more than 10% of the total.

In spite of this, organic matter may have a considerable influence on the soil. Some of the reasons will be considered in their possible order of importance.

(1) Organic matter in the surface soil has a favourable influence on the infiltration of water, into a soil. This is important in preventing run-off and reducing erosion.

(2) The compaction of soils is reduced as organic matter increases.

(3) Organic matter combines with iron in the soil and this reduces the "fixation" of phosphate.

(4) The water-holding capacity of a soil may be increased by raising the organic matter content: but this effect is often exaggerated.

The difficulty of increasing the organic-matter content is seldom realized. At Rothamsted it took 56 years with an annual addition of 15 metric tons of farmyard manure per hectare to increase the organic matter by 50% of its original value.

There is sometimes an emotional approach to the use of natural manures and compost, which attributes to them almost magical properties. More than a century of field trials at Rothamsted has failed to show any higher yield from manure than from an equivalent amount of artificial fertilizer.

Similarly, there is no evidence that the quality of produce derived from compost or manure is any better than that derived from artificial fertilizers. Research workers have for many decades been producing perfectly healthy plants in water and sand with inorganic chemicals. This, of course, requires great expertise and in normal situations is neither practicable nor economic.

The wise farmer, horticulturalist or gardener will have the best of both worlds—the organic and the inorganic. Sometimes the easiest way to assure the presence of organic matter in the soil is to grow good crops with the use of inorganic fertilizers!

The Queensland sugar industry survives regular burning of cane trash because the crop is a "giant pasture". The roots alone return to the soil about 2½ tons dry weight of organic matter per hectare per crop.

Decomposition

Organic matter in abundance acts as a stimulant to soil micro-organisms. When the organic matter decomposes in the soil, ammonia is first formed and the NH_4 ions are then oxidised to NO_3.

Fungi attack the cellulose under well-aerated conditions, and they greatly increase in numbers because of the plentiful food supply. They also cause separation of ammonia from proteins. The ammonia is later converted to nitrate by bacterial action.

The ratio of carbon to nitrogen gives a guide to the progress of decomposition. Crop residues such as wheat straw, cane trash etc. contain little nitrogen and so have a high C/N ratio (100). The final product by decomposition, i.e. soil humus, has a C/N ratio of about 10, and this is the value that is attained by a soil in equilibrium with its organic-matter content.

Intermediate values of C/N are shown by leguminous plant tissue and farmyard manure.

During the process of decomposition most of the important plantfood nitrogen is retained in the bodies of the micro organisms. At this stage plants may look yellow for lack of nitrogen. It is only when nitrification is attained that plants can thrive again. For this reason raw organic matter should not be mixed into soil that has plants growing in it. The only alternative is to see that the organic matter has mixed with it 2% of nitrogen from a high-nitrogen source such as urea, dried blood etc.

APPROXIMATE CARBON/NITROGEN VALUES

Straw, cane trash, millet	100
Manure, cane roots	25
Compost (organic matter decomposition-heap). Lucerne	12
Soil in equilibrium with its organic matter	10
Seed-meals (5). Animal products, dried blood	4
Urea	0·4

When a substance has a C/N value less than about 25 it is capable of decomposing with the liberation of nitrogen available to plants.

After three weeks of incubation, with adequate moisture and warmth, most of the nitrogen in dried blood might be converted to nitrate, where as nitrification in straw under the same conditions could be negligible.

It will be seen in a later chapter that farmyard manure is a good potential source of trace elements for plant nutrition, and these must be included in any assessment of the true value of manure. The same applies to compost.

These facts help to emphasize that it is only by decomposing that organic matter can help in the nutrition of plants. Plants are unable to absorb organic matter directly as plant food: they absorb nitrate, sulphate, potassium, calcium and other decomposition products from the organic matter.

Run-off and Soil Erosion

WHEN heavy rain falls on any piece of land there is always a danger that some of the water will not be absorbed quickly enough and will flow away as "run-off". This is the most important cause of soil-erosion, though in very dry areas erosion by wind may be equally as important.

The best counters to erosion are:—

(1) A soil surface that contains the stubble from a previous crop, or supports a thick pasture.

(2) A soil surface that consists of large clods from a prior ploughing.

(3) A system of working the soil across the slope ("along the contours") so that water cannot readily find the steepest descent to lower levels.

Contour lines are lines joining points of equal elevation. If a small bank of soil is formed along a contour line, water that reaches the bank will not flow appreciably to right or to left, but will gradually sink into the soil.

A contour bank may be replaced by a level terrace, so that more water can then be contained.

Erosion of soil may start as a small rill but eventually end as a gulley so deep that a man standing in it would be hidden from sight.

At other times sheet erosion takes place, and because a little soil is lost from the whole surface, this may not be noticed at first. Wind erosion acts in this way.

Erosion always takes the richest and the most protective layer—the surface soil. Here organic matter and all plant nutrients are in highest concentration. The soil that is lost by erosion has in most cases taken thousands of years to form, and in a human life-time is irreplaceable.

Heavy rainfall naturally causes the greatest erosion, because the run-off water is then moving fast. Even a very porous soil—the krasnozem—can suffer in a special way. Air is trapped in the soil crumbs by the sudden wetting, and it may escape by tiny explosions, which cause erosion in an otherwise stable soil.

Soil aggregates that will not collapse in any way when wet, are the basis of resistance to erosion.

It will be clear that the amount of run-off depends not only on the intensity of rainfall but also on the nature of the receiving surface.

Studies have been made of rainfall-intensity in various regions, and of the effect of soil surface conditions. The Institution of Engineers, Australia has estimated that in the semi-arid region between Cloncurry and Windorah, from a total rain of 60 mm in a day, there is a two-thirds chance that 27 mm will be lost as run-off. Observers in the St. George area estimate that on hard Mulga ridges, run-off can amount to 60–75% of the total rain. In a country of low rainfall the loss of up to three-quarters of the rainfall without any advantage to the area on which it falls, is phenomenal.

It has been asserted that this water could be transferred to safe storage underground in old dry stream-beds which underlie western Queensland. The conserved water could then be used as supplementary irrigation to produce grain sorghum. This proposal has never been tried.

Although run-off is necessary to maintain surface streams and rivers, the run-off that only fills temporary lakes is almost entirely a wasted resource.

Colluvial soil

On a natural landscape unaltered by man, run-off and its associated erosion of soil, can result in the formation of a special type of soil, the colluvial soil. This is the soil that is formed when earth from the higher slopes gradually moves downward under the influence of heavy rain. When soil is transported in flood water and then deposited later on, it is alluvial soil. Alluvial soil shows the layering due to its origin. At increasing distance from its place of origin it becomes more and more clayey because smaller particles are carried further.

By the time run-off water has got into a river or stream it has often lost most of its suspended particles and contains mostly dissolved substances. The soluble salts are related to the soils and (ultimately) to the rocks of the water catchment.

TABLE 2

ANALYSES OF STREAMS FROM CATCHMENTS OF DIFFERENT GEOLOGICAL ORIGIN

Stream and Site	HCO_3	Cl	SO_4	Ca	Mg	Na	K
	(Milliequivalents per litre)						
Sampled in flood time							
Mellum Creek (Sandstone) No. 1	0·77	0·94	0·12	0·75	1·25	0·93	0·04
Mooloolah River (Mixed) No. 2	0·42	0·53	0·07	0·35	0·70	0·48	0·04
Obi Obi Creek (Basalt) No. 3	0·35	0·31	0·05	0·30	0·25	0·26	0·02
Sampled in dry weather							
Mellum Creek No. 1	2·27	4·90	0·14	1·35	2·48	3·8	0·05
Mooloolah River No. 2	1·12	2·47	0·08	0·76	1·12	2·0	0·04
Obi Obi Creek No. 3	0·42	0·43	0·04	0·13	0·35	0·4	0·02
Sampled in protracted dry period							
Mellum Creek No. 1	1·81	..	0·13	3·95	7·05	..	..
Mooloolah River No. 2	1·18	..	0·10	2·24	3·76	..	..
Obi Obi Creek No. 3	0·47	..	0·03	0·45	0·83	..	..

Table 2 gives the composition of streams derived either from sandstone, basalt, or from a mixture of the two. Although the catchments are near the sea it was concluded that the main influence on composition was the country rock. The stream (No. 1) from sandstone always had the highest composition of mineral matter: No. 3 from basalt had the lowest composition and No. 2, of mixed origin, had an intermediate composition. It appears that the sandstone can release soluble matter at a greater rate than basalt, even though basalts contain more calcium, magnesium, sodium and potassium than sandstones. (See table below.)

An examination of the composition of streams can also show if excess of fertilizers or insecticides is contaminating the environment.

Earlier the leaching away of plant nutrients was considered. When possible loss by erosion of soil is included, a more stringent testing takes place. This was done to check the Fijian system of shifting cultivation. Here there were three categories, the rainfall being 3 000 mm per annum.

(1) Land that was ready for clearing after 30–50 years without cultivation. (Virgin land).

(2) Land that had been under cultivation for 4–10 years. (Cultivated land).

(3) Land that was reverting to jungle: resting for 8–25 years. (Reverted land).

Both cultivated land and reverted land contained as much or more nitrogen, available phosphate and available potassium as the virgin soil. The system is therefore very effective in conserving soil resources. It is in marked contrast to the deterioration of the extremely fertile land on Pitcairn Island, where plant nutrients have been reduced to as little as 10% of their original value under exploitation, not based on an ancient culture.

MEDIAN VALUES FOR A NUMBER OF SANDSTONES AND OLIVINE BASALTS

—	Calcium	Magnesium	Sodium	Potassium
	%	%	%	%
Sandstones	2·7	1·2	1·0	1·1
Basalts	7·1	4·3	1·8	0·7

GLOSSARY

(of words in capitals)

ANAEROBIC: Without air, and therefore short of oxygen.

The opposite is aerobic.

Aotus in south-east Queensland

by BERYL A. LEBLER, Senior Botanist.

THE British botanist, Sir James Edward Smith, who named and described the first wedge pea and bitter pea, described seven shrubby pea-flowers at about the same time. They included *Pultenaea* and *Aotus*.

The generic name Aotus is a combination of two Greek words, *a* meaning without, and *otos* meaning an ear. It refers to the absence of barcteoles on the calyx tube. *Pultenaea,* which was named and described twelve years before *Aotus,* has two persistent bracteoles either close under the calyx or attached to it.

The species of *Aotus* are always woody shrubs with simple leaves. These may be alternate and scattered along the branches or arranged in whorls of three or more. Their margins are recurved or revolute. Hairs are usually present to some degree on the stems, and they can be almost glabrous, softly villose or velvety tomentose.

The flowers are either solitary in the leaf axils, or in clusters of up to three flowers, and often form showy terminal leafy racemes. The flower is a typical pea flower with the five sepals joined together to form a calyx tube in which the two upper lobes are broader than the lower lobes and are united into a lip. The corolla is always some shade of yellow and some species have purple or red-black keels. Dark red markings are often found at the base of the standard. This is reflexed but usually folded rather than spreading widely. The ten stamens are quite free from one another and the pod is ovate to obovate and can be flat or swollen.

These plants are found only in Australia. In south-eastern Queensland there are three species: *Aotus ericoides, A. subglauca* and *A. lanigera.*

Common Aotus

(*Aotus ericoides*)

This was the first species described. The specific epithet means resembling *Erica* or heath.

DISTINGUISHING CHARACTERS. The size and habit of the plant, the habitat in which it grows, and the yellow keel is enough to distinguish this shrub.

DESCRIPTION. This is a variable plant. In some situations it develops into a much-branched shrub of very open habit, about 1·5 m high with many drooping slender branches. In others, it is an erect, much smaller and more compact plant. Short, closely appressed brown hairs give the slender stems a dusty appearance. In some plants a cluster of up to ten lateral stems develop near the ends of the branches. The leaves are alternate, 1 cm long, 0·1 cm wide, and are dark green on the upper surface. The margins are recurved with little of the lower surface exposed except the raised midrib. The leaf tip is pointed and curves downwards abruptly.

The flowers are axillary, forming leafy racemes. At the base of the inflorescence the flowers are solitary and at the top of the stems they are in pairs, on short pedicels which curve out on each side of the leaf. The calyx is covered by appressed hairs similar to those on the stems. The tube is 0·2 cm long and ends in five pointed teeth almost as long as the tube. The flower is less than 1 cm long and the reflexed portion of the standard is over 0·5 cm long, a little broader and is slightly emarginate at the tip. The petals are deep lemon yellow and at the base of the standard there is an arc of red lines. On the outer surface this colouration is darker and wider. The wings and keel are yellow. On the islands in Moreton Bay, many of the plants do not have any red marking on the standards and the flowers are completely yellow.

In a freshly opened flower the standard is folded down on either side of the central line. As the flower ages the standard becomes reflexed and spreads, although never as widely as in many of the other pea flowers. The flowers in the middle of the inflorescence usually open first, with buds above and below.

FLOWERING TIME. On the islands in Moreton Bay these plants flower in autumn and again in late winter. On the mainland the main flowering period is from late winter to spring.

HABITAT. This plant grows in wallum sand in mixed open forest on the mainland, and on sand dunes and on the edges of fresh water swamps on the islands.

DISTRIBUTION. It is common on the coastal lowlands in all the eastern States, Tasmania and South Australia.

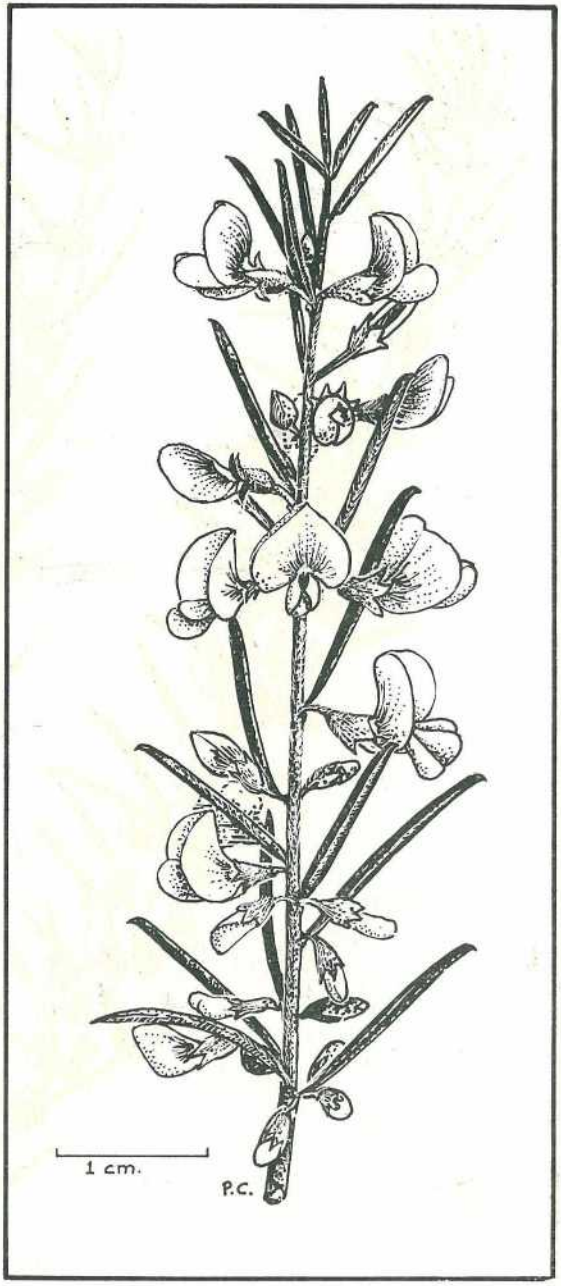
Aotus subglauca

The specific epithet for this plant means somewhat bluish-green or grey-green and describes the appearance of the stems and the lower surfaces of the leaves.

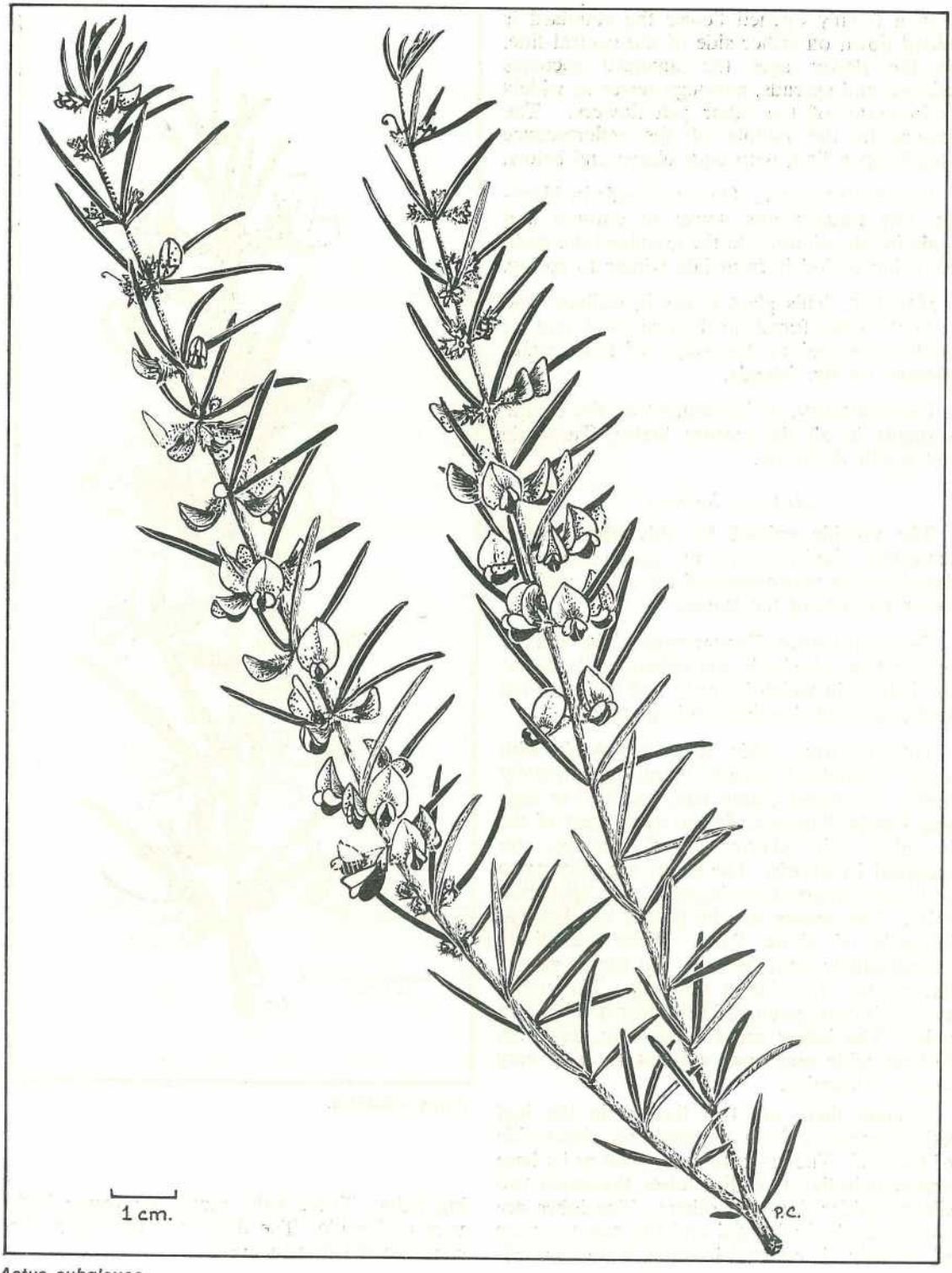
DISTINGUISHING CHARACTERS. The smaller size of this sub-shrub, the colour of its stems, the habitat in which it grows and the wine-red keel readily distinguishes this plant.

DESCRIPTION. This is a sub-shrub with many decumbent branches and it frequently forms a rounded clump less than 0·5 m high and 1 m in diameter. In the upper part of the branches, thin, shorter lateral branches are arranged in whorls. The stems are grey-green and have a sparse covering of minute appressed hairs. The leaves are in whorls of three at intervals of about 2 cm. They sometimes spread widely from the stem, but can lie almost flat against it, pointing upwards. The upper surface is dark green and the lower one is much paler. The leaves are 1·5 cm long, less than 0·2 cm wide and have a blunt tip and very recurved margins.

Usually there are two flowers in the leaf axils, spreading from the stem on either side of the leaf. The calyx tube is green at its base and ends in five spreading lobes, the upper two slightly wider than the others. The lobes are usually flushed with red and the outer surface of the calyx is covered by long, white, spreading hairs. These hairs make the young buds very noticeable. The flowers at the top of the stem are the first to open.



Aotus ericoides.



Aotus subglauca.

The conspicuous standard curves upward, and is folded down, or reflexed and spreading, depending on the age of the flower. It is just under 1 cm long, and as broad and is slightly emarginate. On the outer surface, a wedge shaped wine-red blotch at the base is bordered by a deep gold band. Dark red lines spread from the edge of this blotch towards the margin and at least half the standard is dark red. This colour on the inner surface is restricted to a narrow band of lines. The wings are yellow, have a blunt tip and curve in towards the keel which is dark purple.

HABITAT. It is common on sandstone or granite hills in open eucalyptus forest.

DISTRIBUTION. It is found only in New South Wales and Queensland. In Queensland it has a patchy distribution. It grows in the Stanthorpe district (Girraween National Park) on the sandstone hills north of Helidon, and in central Queensland on the Blackdown Tableland and the Isla Gorge.

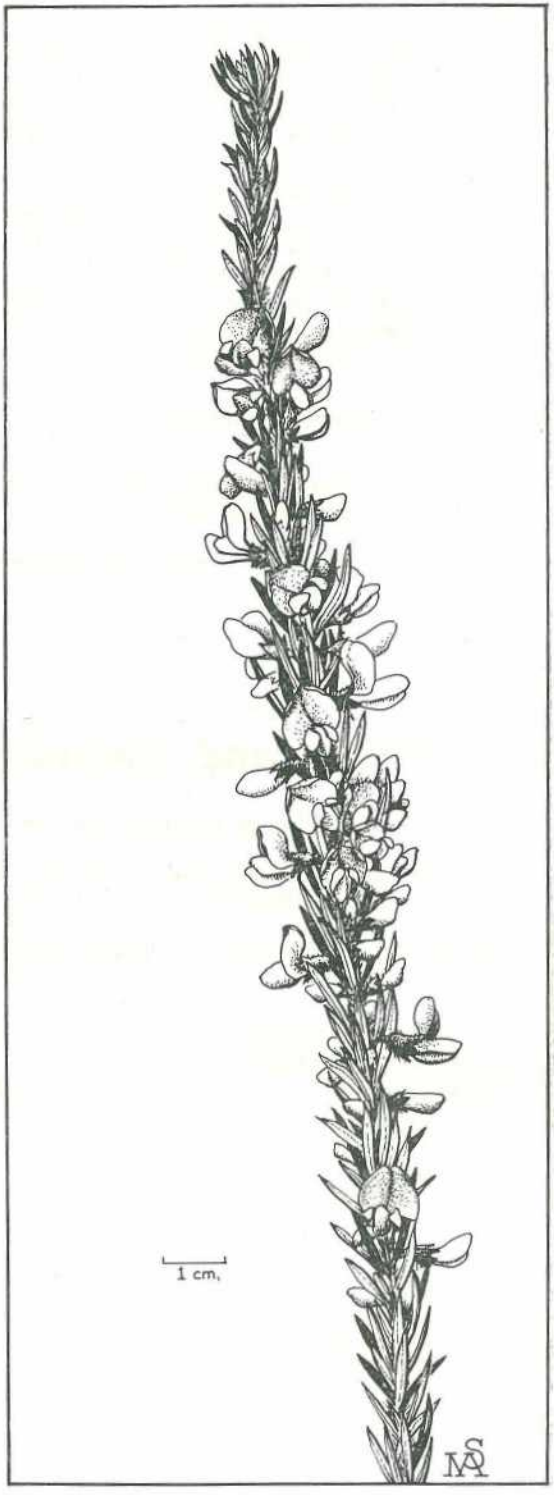
Woolly Aotus

(*Aotus lanigera*)

The Latin adjective meaning woolly, is the specific epithet for this plant. It describes the long, soft and spreading hairs found on the plant.

DISTINGUISHING CHARACTERS. The hairs which give the plant its name are sufficient to distinguish this plant, but the manner in which the leaves lie along the stem with the lower surfaces exposed is also characteristic of this species.

DESCRIPTION. This is a much branched shrub which can reach a height of 2 m. Long, soft, spreading hairs which are usually dark in colour, form a dense covering on the stems and are most noticeable in the young growing tips. The leaves are alternate and arranged in a very tight spiral so that the tip of each leaf overlaps the leaf above. The leaves are lanceolate and 2·5 cm long, 0·2 cm wide and end in a pointed tip. The upper surface is bright green, smooth and shining, the margins are recurved and the lower surface is paler with long hairs scattered on the midribs.



Aotus lanigera.

The flowers are axillary and usually solitary, and form leafy racemes at or near the ends of the branches. These inflorescences can be up to 12 cm long. Often the flowers in the middle of the inflorescence open first. The pedicels are short and the pale green calyx is covered with spreading hairs like those on the stems. The calyx lobes are almost identical in size and shape. The corolla is golden yellow and the standard is 0·8 cm long and as broad. It is almost entire and depending on the age of the flower, is folded or reflexed, but not spreading. The wings curve out at an angle to the keel.

FLOWERING TIME. Spring time.

HABITAT. It is very common on wallum flats where it often forms dense thickets.

DISTRIBUTION. It is found as far south in New South Wales as Port Macquarie to as far north as Byfield in Queensland and as far west as Wyberba on the Darling Downs.

Field Key to Aotus in south-eastern Queensland

1.	Stems and calyces covered with long, soft hairs, leaves alternate	*Aotus lanigera*
	Stems pubescent but hairs appressed, leaves alternate or in whorls	2
2.	Leaves in whorls of three, keel dark purple	*Aotus subglauca*
	Leaves alternate, keel yellow	*Aotus ericoides*

Trying to probe the future for beef

IT'S a frustrating and intensely difficult job to forecast market prospects for the Australian beef industry, but that's not stopping research workers from learning all they can, in the hope that future predictions will be better than those of the past.

Life would be a lot easier for the Australian beef producer if he could predict the market for the future. As events of the last few years have shown, this is not easy.

But that is no excuse for not trying, and at the Bureau of Agricultural Economics in Canberra, research workers are using Australian Meat Research Committee funds to grapple with this difficult task.

Dr. Alan Hayman, Assistant Director of the Livestock Commodities Branch, describes their work as firstly, analysing what's happened in the past, and secondly, trying to extend these developments to get an inkling of the future.

"The first aim essentially is to try to understand why demand for beef changes over time, and why different supply patterns develop in supplying countries," he explains.

"We must first identify the causes for such changes, and then study the factors which influence them."

In the 'old days', Australia used to eat most of her beef and export the rest. These days, exports have dominated the overall market, and have the major effect on what the Australian beef producer gets for his stock.

Dr. Hayman points out, however, that while supply levels on the world beef market are vital to major exporting countries like Australia, they are much less important to the major importing countries, like the United States, the E.E.C. and Japan.

"Only about 10% of world beef production enters world trade, and for the major importing countries, the volume of imports only represents a very small part of their total market requirements," he reports.

"Even a small change in their levels of production or consumption can have a major effect on the world beef market."

For example, beef production in the E.E.C. is about six million tonnes a year. A 5% change in this production would be about 300 000 tonnes. If reflected on the world market as greater or lesser demand, it would be equivalent to about half Australia's exports. A ripple over there represents a tidal wave over here, as we've learned to our cost over the past two years.

According to Dr. Hayman, the main reasons for changes in demand from the major importing countries are:—

- Economic prosperity—better standards of living usually bring more demand for beef.
- Grain prices—which markedly effect the prosperity and production of beef producers in countries which do a great deal of grain feeding of stock.
- Government policies—which may control levels of imports irrespective of normal supply and demand.

Fluctuations in consumer purchasing power is understandably, and to some extent predictably, a very real factor in changing demand, but it is difficult to forecast events like the recent oil crisis, and the subsequent effects on the economics of many countries, Dr. Hayman explains.

Dr. Robert Bain, who has recently returned from extended studies in the United States, our major beef market, emphasises the watch we must keep on world grain supplies and prices. For most Australian beef producers, changing grain prices may not directly affect production or prosperity, but in other countries it is very different.

In the United States, most beef production is geared to lot feeding, which in the early 1970's turned off almost 95% of steers and heifers slaughtered.

With rising grain prices, this level has fallen off considerably, with eventual effects on prices to Australian beef producers.

"The prosperity of the feedlot industry greatly influences the prosperity of the breeders, and this in turn affects the rate of culling of cows from the breeding herds," explains Dr. Bain.

"It is into this cow beef market that we have to sell our supplies of manufacturing type beef.

"A fall in cow beef prices also produces internal pressures on the United States Government for it to limit our access into that market."

But according to Dr. Hayman, probably the most significant and the most unpredictable factor is Government policy in the main importing countries like the United States, the E.E.C. and Japan.

"The virtual bans on imports by the E.E.C. and Japan during the last two or three years were unprecedented, and we as forecasters had no way of predicting them," he reports.

"Governments may, to protect their own livestock producers, or by balance of payments to protect their economies, suddenly restrict imports, but it is the exporting countries like Australia that pay the price for these protective measures, and as I mentioned before, relatively minor changes over there can have big repercussions here.

"At times, sudden and unpredictable controls of imports by some countries make the world market potentially unstable, but this is probably one of the inevitable difficulties of any form of world market forecasting. We just can't avoid this sort of situation."

Is it an impossible task to predict future market trends?

According to Dr. Hayman, the more we learn of the factors influencing supply and demand, the better chance we have.

At the same time, he warns, we have to be realistic and recognise the difficulties in making market outlook forecasts.

"I believe we've come a long way in understanding causes for change, and this is the first essential step in analysing the future", he reports.

"At the same time, events over the past two or three years, particularly the unpredictable political decisions, have shown we can never be too certain about what might happen in the future."

Issued by Australian Meat Research Committee.

Gardening notes

Growing chokos in the home garden

by officers of Horticulture Branch.

THE choko *(Sechium edule)* can be grown in any odd corner of the garden, and the vine is relatively free from pests and diseases.

The plant differs somewhat from other cucurbits such as cucumbers, rockmelons and watermelons in that the vine is perennial in habit and is usually grown on a trellis or frame.

Climate

The plant is deciduous and will tolerate lower temperatures than other cucurbits, but severe frosts will kill the entire vine.

Soils

Almost any reasonably good soil will grow chokos, but the site must be well drained. If the soil is only marginally drained, it would be better to grow the plant on a bed built up well above the surrounding garden.

Because of the perennial habit of the choko, the soil should be thoroughly prepared before planting if profitable crops are to be produced.

The soil should be dug to the full depth of the spade or fork within a circle of about 1 metre in diameter around the spot where the seed is to be planted. Well rotted animal or poultry manure or home made compost, if available, is very beneficial, and should be incorporated during the preparation of the bed.

Fertilising

A pre-plant application of 200 g of a complete fertilizer mixture with an analysis of approximately 5% nitrogen, 6% phosphorus and 4% potash (5–6–4 NPK) is usually necessary on most soils. The fertilizer is best incorporated into the soil several weeks before planting.

The vine will benefit from a light soil dressing of a 5–6–4 fertilizer mixture in midsummer when the main crop is setting.

When the plant is being ratooned or grown on for a second year, a further light side dressing of the same fertilizer is given in early spring, just as the plant moves into growth after its winter dormancy.

The side dressing should be spread very evenly over the ground within a radius of 0·5 metre from the plant and watered in immediately.

Varieties

Smooth Green is the main variety grown, but the cream variety is preferred by some home gardeners.

Planting Time

Chokos are usually planted between spring and midsummer. When the seed is mature, the fruit sends out a 'shoot' (the primary root) at its basal end, and planting begins as soon as this shoot appears.

Planting

A whole fruit is planted alongside a support post. If more than one seed is to be planted, allow about 3 metres between plants. The fruit is placed about 100 mm deep in the ground at an angle of about 45 degrees with the 'shoot' downwards. The stem end of the fruit is then at ground level or slightly exposed.

Trellising

In commercial plantings, substantial trellises capable of standing for several years are erected.

In the home garden, however, the vine may be trained along a dividing fence or, better still, over a simply constructed timber arch with plain wire stretched across it at about 150 mm spacings in both directions.

Cultivation and Watering

Cultivation should be shallow and frequent enough to keep weeds under control.

When growth has ceased in the winter, the vine may be cut back and the soil covered with a mulch to avoid frost damage at ground level. In the spring, the tuberous root will throw out new shoots for the ratoon crop.

As the choko has a high water requirement, frequent waterings are necessary during the growing and cropping period each year.

Harvesting

When the vine is well established, two crops will be produced each season; a light crop from late spring to early summer and the main crop in autumn. A small number of fruit will also mature in midsummer. Chokos are best harvested as soon as they are fully developed and must not be allowed to become too old and seedy.

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 school project feature

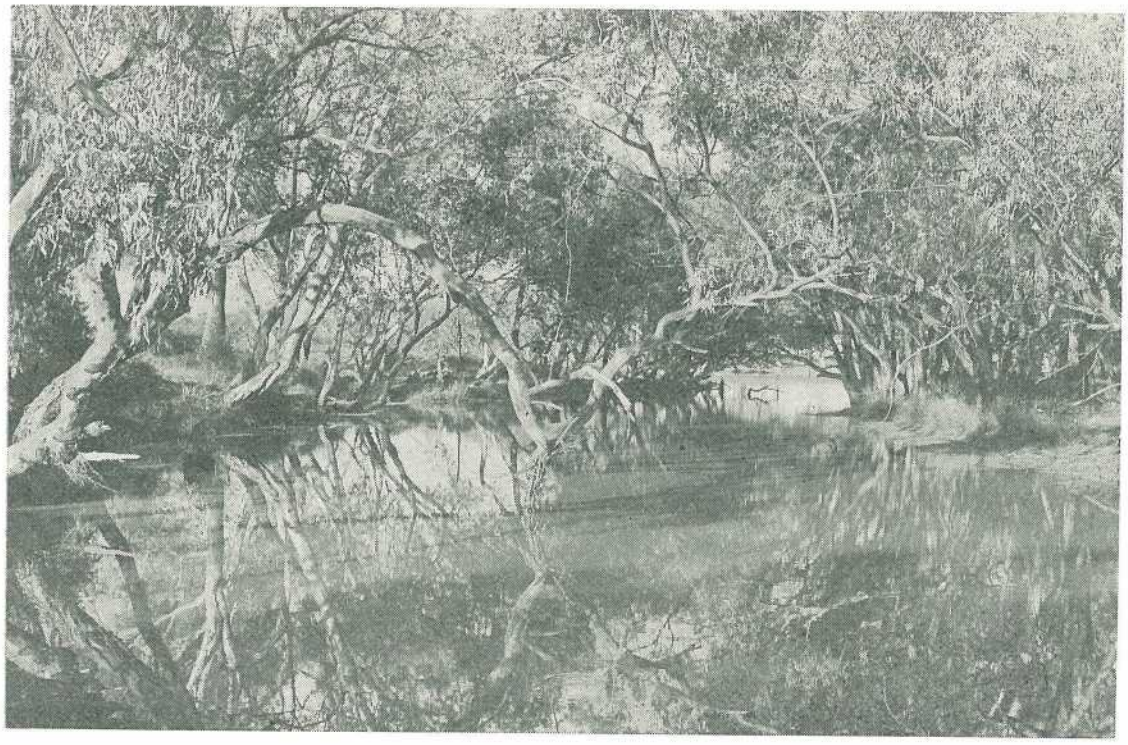
Man and his environment

by FLORA SMITH (Agriculture Branch).

Summarised from a talk given over the School of the Air, at Charleville.

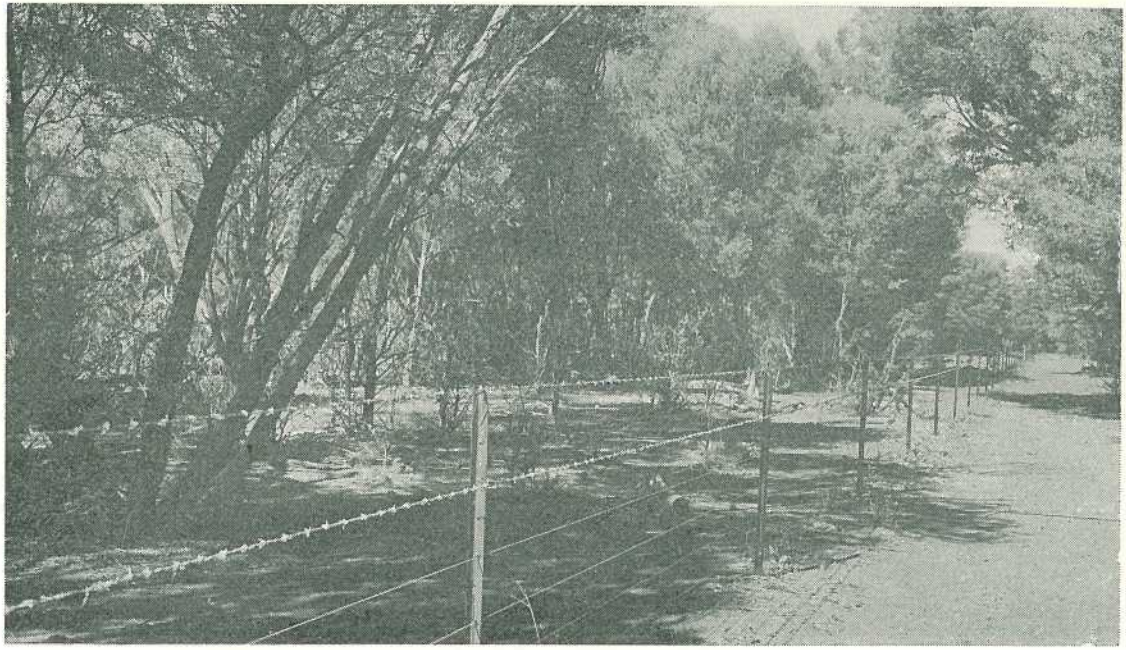
DURING the last few years, more and more people have become aware of what man has done to his environment. They have realized that if we are to maintain our present standard of living we will need to conserve our natural resources.

River gums and coolibahs on Burenda Creek near Augathella.



Mulga is Australia's most important fodder tree and the mainstay of sheep during droughts in south-west Queensland.

A dense stand of mulga near Charleville. Grasses and herbage are almost non-existent and stock have already eaten the lower leaves of large trees and completely stripped the small bushes.



One has only to turn on the radio, or pick up almost any newspaper or magazine, to become aware of the interest in conservation at present. Who has not heard of the sand-mining on Fraser Island? Should controlled mining continue, or should the island be declared a national park? Is pollution killing the fish in our rivers and in the ocean? Is the clearing of timber leading to the siltation of our water supply dams? Is the quality of our pasture deteriorating? Is soil erosion becoming a serious problem in our district?

In the year 1800 there were 50 cities in the world which had populations of over 100 000. Now there are 900 such cities. In 1800, 6% of the people in the United States of America lived in the cities. Now 70% of American people are city dwellers. Every year, as the world's population increases and as the cities grow larger, 312 000 square kilometres of agricultural land is lost. Each person in the world needs what is produced from 1 hectare of arable land to support him. The average amount of arable land in the world is now less than half a hectare per person. So, there must be quite a number of people in the world who do not have enough to eat.

If man is to survive, he must start *right now* to manage his natural resources so production causes a minimum of damage. We cannot afford to lose even one hectare of producing land because of mismanagement. Indeed, we need to learn to manage so that we can produce more, and if possible, improve our natural resources.

We should use modern technology to help us produce more from our land, but we must be very careful that the methods which help us to produce more in the short term, do not cause a depletion in the resource over a long period. A knowledge of ecology, which is the study of the relations between living things and their environment will help avoid this deterioration of our resources.

Now, let's look at our environment in south-west Queensland. What are our natural resources? Firstly, climate is the main factor governing production. It is characterized by very large changes. The rainfall is low, the yearly average varying from 400 mm in the Blackall area to less than 170 mm in the Birdsville area. Quilpie has an average annual rainfall of 344 mm, while Mt. Margaret receives 275 mm and Nappamerrie receives only 160 mm. Most of this rain falls during the summer months when temperatures are very high.

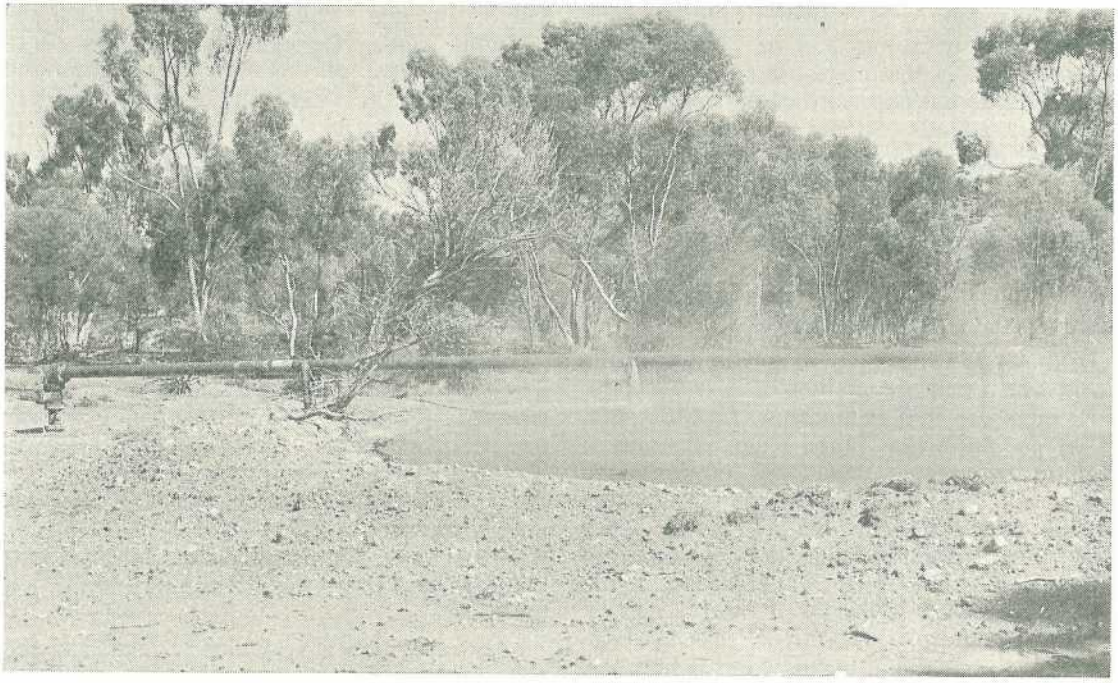
In contrast, winters are usually dry and can be cold, with severe frosts in some places. Of course, there are some years when the rainfall is far above average, as it was in 1973, when we experienced severe flooding. And sometimes it is far below average and we then have to contend with drought.

Next, let's look at our soils. We have such a variety. Along the flood plains of major streams such as the Paroo and Bulloo Rivers and Coopers Creek, there are grey cracking clay soils, while brown clays predominate on the tributaries of these streams. There are undulating stony downs like those between Arrabury and Windorah, sand dunes, rocky outcrops, and large areas of red earth on which mulga grows.

Our vegetation is very closely related to the soil types, and can change just as abruptly from one type to another. Did you know that, in south-west Queensland, we have 615 different species of plants? Mulga grows on the red earths while on the clay soils along the streams we have river gum and coolibah. We find bloodwood trees on the stony outcrops and on the stony and sandy soils we can find beautiful wildflowers. The Cooper clover of the Channel Country is wonderful for fattening cattle. But, perhaps our most important plants are our grasses.

Think of our Mitchell grass plains, and some of our mulga grasses such as kangaroo grass and mulga oats. Did you know that 23% of the world's vegetation is made up of grasses? As well as being a most important source of food for our animals, grasses provide a protective cover for the soil.

Our resources also include minerals. The only mineral which has been of commercial importance so far is opal. There are small mines, such as those at Yowah and Duck Creek, scattered throughout the area. Oil exploration so far has been unsuccessful. Natural gas occurs in some places, but not in commercial quantities. We are lucky to have artesian bores without which it would be impossible to run stock in much of this country.



A flowing bore in south-west Queensland.

Testing the viability of pasture seeds under different temperatures at the Charleville Pastoral Laboratory.

What of our wildlife resources? You will all be familiar with the wildlife of the area. I was lucky enough to see about 20 brolgas and a number of water hens near Adavale recently. Our animals all have their place in nature, for instance birds can help to control plagues of grasshoppers. Many people believe that dingoes used to kill a lot of young pigs, and since 1080 has been used against dingoes the pig population has increased tremendously. Perhaps we must now decide how often or where baiting should be carried out in order to maintain a reasonable balance between the two species.

Now let's look at what's been happening to our environment as a whole. Have these natural resources changed since settlement by white man over a century ago? There is strong evidence to suggest that considerable changes have taken place and this is only to be expected. One such change in the vegetation is that, even in good seasons, there is now far less kangaroo grass. Indeed, there has been a decrease in the number of most perennial grasses except perhaps Mitchell grass, and an increase in annual herbage.

Annual plants can be quite good while they last, but when they are dry and blow away there is nothing left to protect the soil surface from erosion. On the whole, the plant cover has become thinner and more soil has been exposed. Weeds such as turkey bushes, sandalwood and wiregrass have increased. Areas of scalded ground have increased, or developed, and silting-up of waterholes has occurred.

Some species of animals and birds which were once abundant, such as the plain turkey, have decreased in number. The flow of artesian water has decreased and in many cases it is now necessary to pump water to the surface of the ground.

I think you will all agree that these changes have been for the worse. So let us now think about the reasons for these changes.

In the opinion of many experienced landholders and scientists, the main reason for the changes in the plant communities has been continuous grazing by sheep. When stock are in paddocks where there is a variety of plants, they will naturally select the better species for their diet. If they are allowed to graze the same land continually, they will repeatedly graze the same plants, thus preventing them from seeding.

At the same time, the plants which they do not like are being left to grow and produce seeds. I think this points strongly to the need for the occasional spelling or resting of each paddock to allow the better plant species to set seed. If stock numbers are high, or the season is dry, a serious decrease in ground cover can occur and lead to erosion by wind and water. As the surface erodes, scalded patches form, and the soil which is removed is blown up against logs or fences, or is washed into the waterholes, causing them to silt up.

Some of our wildlife species have become scarce because we have hunted them, while others have moved away, or perhaps perished, because we have changed their environment by practices like clearing scrub. Man has also interferred with nature's balance by introducing animals other than sheep and cattle. Foxes have caused the numbers of small animals and ground-dwelling birds to decrease. Before the introduction of myxomatosis, rabbits caused severe damage to pastures.

We now come to the activities of the Department of Primary Industries in south-west Queensland. This Department has about 30 officers in the region, whose job is to assist graziers. There are two main sections of our Department here, made up of people who do research to gain a better understanding of our environment, and others who act as advisers to landholders.

Research is usually a long term project. In most cases it takes several years before we can say confidently that what we think happens is really so. Some of the things which have been studied are:—the effect of thinning on mulga communities, long-term vegetation changes, soil fertility, the conditions which are necessary for seedling establishment, and plant introduction from overseas. Other studies have included the effects of supplements on sheep which are being fed on mulga, phosphate supplements for cattle, and general animal management. In the advisory section there are those who provide veterinary services to the community and give advice on the control of diseases and pests in stock, and on

stock management. Stock inspectors issue stock movement permits and regulate stock movement to minimise the spread of pests and diseases. Economists are able to give advice on financial matters.

What can we do to protect our environment in south-west Queensland? I think the first thing for us all to realize is that, because of the sensitive balance of nature in an arid area, it is very easy to change the environment for the worse, and very difficult to reverse this process of deterioration. Once we accept this, we can learn to watch for little changes and learn to look for the causes. When we know what to look for, we will have a greater understanding of our environment and will know better what to do to preserve it.

For many years, all over the world, man has been trying to impose his needs upon nature—and this just doesn't work. We must learn to work with nature and accept our responsibility to conserve the basic resources which we need to survive. Otherwise, in the not too distant future, perhaps during your lifetime, nature will no longer be able to cope and mankind will starve.

So let's start to put nature first for a change, so that there will be plenty of good food and water for our animals— and for ourselves—not just next year, or in ten or twelve years' time when you are grown up and managing your own properties, but when your grandchildren and their grandchildren are living here.

1976 National Elanco Rural Youth Award

The aim of the 1976 National Elanco–Rural Youth Award is to encourage young Australians involved in rural industry to continue their studies and expand their experience.

The award also provides the winner with the opportunity to make a contribution to Australian rural industry and the rural community by passing on knowledge and information gained through his participation in the award project and subsequent use of the award.

All young Australians under the age of 30, who are engaged principally in rural industry, are eligible to enter the award contest.

The award is a joint project by the Australian Council of Rural Youth and the Elanco Products Company.

The Elanco Products Company will provide the principal prize of $3,000 and individual prizes of $200 to State winners.

Elanco will provide facilities for a one week visit to the Companies Greenfield Research Facility in Indiana, U.S.A., and will provide free accommodation and transportation for the winner for this period.

The Elanco Products Company will also pay the cost of transporting and accommodating National Finalists and judges from their home districts to the National Finals in September 1976.

Any Australian under the age of 30 who is directly or principally engaged in a rural industry, or an industry directly supporting a rural industry is eligible to enter the contest.

Further details and entry application forms are available from:—

The Rural Youth Organisation of Qld.,
P.O. Box 151,
North Brisbane, Qld. 4000.
Telephone: (Brisbane) 224 6930.

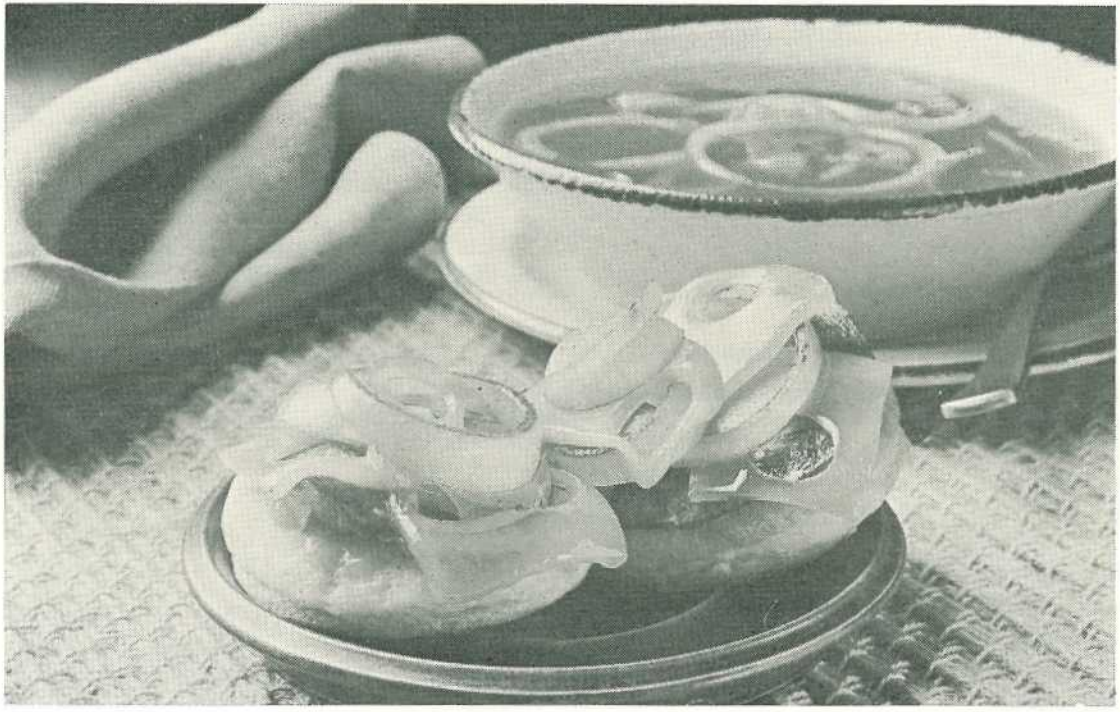
Piping Hot Soups with Cheesy Snacks

Bowls of Creamy Corn Chowder; Chicken Noodle with a distinctive curry flavour; an unusual variation to canned beef consomme with liverwurst paste, mustard and frankfurters; and a version of French onion soup. All are piping hot, warming and flavourful soups—and to complement each one a hot, cheesy bread, scone or biscuit snack.

They're four super hot, weekend soup and snack meal makers for you to enjoy.

In all recipes a standard 250 ml measuring cup and 20 ml tablespoon are used. All measurements are level.

Onion Ring Soup.



Onion Ring Soup

3 tablespoons butter.
4 medium onions, cut into rings.
1 clove garlic, crushed.
2 beef stock cubes.
4 cups water.

Melt butter in a saucepan. Saute onion and garlic till onions are browned. Add remaining ingredients. Simmer for 20 minutes. Season with freshly ground pepper if necessary. Serve accompanied with hot Salami Pickelloes. Serves 4–6.

The Salami Pickelloes

1, 226 g (8 oz.) packet scone mix, made up as directed.
1 tablespoon spreadable sweet mustard pickle.
10, 6 cm (2½″) wide sliced salami.
1, 125 g (4 oz.) packet sliced Australian Swiss cheese, cut into 1″–2″ pieces.
1 onion, sliced and broken into rings, ground black pepper.

Roll kneaded dough out lightly to 1 cm (½″) thickness. Cut into 12 scones using a 6 cm (2½″) diameter cutter. Place on buttered oven tray. Spread each with mustard pickle then top with salami, cheese, onion rings and a sprinkling of black pepper. Bake at 230°C (450°F) for 10 minutes. Makes 10.

★ ★

Creamy Corn Chowder

1 packet white sauce mix, blended with 1½ cups milk.
1½ cups water.
2, 455 g (15 oz.) cans creamed sweetcorn.
1, 250 g (8 oz.) packet frozen mixed vegetables.
1 medium potato, cut into 1 cm (½″) dice.
½ red pepper, cut into 1 cm (½″) dice.
2 teaspoons sweet paprika.
½ teaspoon salt.
pepper to taste.

Combine all ingredients in a large saucepan. Stir constantly till just boiling. Simmer gently for 15 minutes. Serve accompanied with Tuna Crusties. Serves 8.

The Tuna Crusties

8 slices stale bread, crusts removed.
3 tablespoons butter, softened.
½ cup grated Australian Matured Cheddar cheese.
1, approximately 185 g (6½ oz.) can tuna.
2 teaspoons gherkin relish.
2 tablespoons smoked almonds, chopped.

Spread butter on each side of bread slices. Press firmly into deep patty pans. Combine other ingredients and press into bread cases. Brush with a little extra butter to moisten. Bake at 200°C (400°F) for 15–20 minutes until bread is browned and crisp.

★ ★

Beef "N" Pate Potage

2 tablespoons butter.
2 tablespoons flour.
1 tablespoon dry mustard.
half of 127 g (4½ oz.) can liverwurst spread, remainder reserved.
1, 425 g (15 oz.) can beef consomme.
1½ cups water.
125 g (4 oz.) thick frankfurters, cut into 5 mm (¼″) slices.

Melt butter in a saucepan. Blend in flour and mustard away from heat. Cook 1 minute. Cool. Blend in spread then consomme and water. Bring to simmering point stirring constantly. Cook for a few minutes. Blanch frankfurters in boiling water for 1–2 minutes then add to soup. Serve accompanied by Cheddarwurst Stacks. Serves 4–6.

Cheddarwurst Stacks

12 slices bread, crusts removed.

The Filling

Combine: 1 cup grated Australian Matured Cheddar cheese reserved liverwurst spread. 2 tablespoons chopped dill cucumbers.

The Savoury Butter

Combine: 125 g (4 oz.) butter, melted, 2 tablespoons dry mustard, ⅛–¼ teaspoon cayenne pepper.

Spread filling over one side of eight slices of bread. Place four filled slices on the other four with spread side uppermost. Press the third layer of plain bread slices firmly on top. Cut each bread stack in half, making eight fingers. Brush the top and bottom of each generously with savoury butter. Place on a baking tray. Bake at 200°C (400°F) for 10 minutes until brown and crisp.

★ ★

Curried Noodles

1 tablespoon butter.
2 teaspoons mild curry powder.
1 packet chicken noodle soup.
4 cups water.
¼ cup sultanas.
60 g (2 oz.) sliced ham, cut into strips.
1 cooking apple, peeled, cored and grated.
½ cup grated carrot.
1 teaspoon chopped parsley.

Fry curry powder in butter for 1 minute. Add soup, water and sultanas. Cook for 5 minutes. Add remaining ingredients. Simmer gently for further 2-3 minutes. Accompany with Coconut Cheese Snaps. Serves 6-8.

The Coconut Cheese Snaps

¾ cup grated Australian Matured Cheddar cheese.
½ cup desiccated coconut.
2 tablespoons self raising flour.
1 tablespoon butter.

Combine ingredients and rub together firmly with fingers to form one lump. Divide and roll mixture into 8 balls. Place on a buttered oven tray allowing room for spreading. Flatten each to 8 cm (3″) diameter with fingertips. Bake at 200°C (400°F) for 10 minutes until golden brown. Remove from tray immediately with a spatula. Cool on a wire rack until crisp. Makes 8.

TAKE A HINT

This time, some tips for knitters:

*If plastic knitting needle points become rough, paint one or two coats of colourless nail varnish over them.

*Use plastic clothes pegs to hold the edges of a knitted garment together while you are sewing the seams. Unlike steel pins, they don't get lost.

*Keep a pipe-cleaner handy when knitting your winter garments. It is useful for holding stitches that have to be picked up later. The stitches don't slip off or tighten, and the pipe-cleaner can be bent into any position.

*When a right-handed mother is teaching her left-handed daughter to knit, it is easier if mother sits in front of a mirror and lets her daughter follow the actions of the mirror image.

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Diseases of Bananas

PANAMA disease of bananas, caused by the fungus *Fusarium oxysporum* f. sp. *cubense* is widely distributed throughout the world. It affects only the tall-growing cultivars such as Lady Finger, Sugar and Gros Michel. The Cavendish cultivars and Mons Mari are immune.

The first indication of the disease is a marginal yellowing of the older leaves which later turn brown and dry out. Affected leaves die back from the tips and eventually collapse at some point along the leaf stalk or at the junction of the leaf stalk and pseudostem, leaving a skirt of dead leaves around the plant. Death of the parent pseudostem generally follows but suckers may not necessarily die.

Panama disease may be recognized by cutting through the pseudostem of an affected plant near the ground where a characteristic dark brown or black discoloration of the water conducting tissues will be seen. This is also evident in corms where the brown or black lines are found running in all directions through the tissues.

Spread

The Panama disease fungus gains entry to the plant through the roots. It then invades the water conducting tissues of the corm and pseudostem reducing their efficiency and producing the symptoms already described. The fungus may grow out from the diseased parent into surrounding suckers, and the planting of this infected material is the main way in which spread from one plantation to another occurs. Once established in an area, the fungus may persist in the soil for many years.

Control

The best means of preventing losses from this disease is to exclude it from the plantation. Susceptible cultivars should be planted only on land on which the disease has never occurred and planting material should be obtained from a disease-free plantation. To assist in this, the Banana Industry Protection Board arranges inspections of plantations of Lady Finger and Sugar bananas from which planting material is likely to be available. Plantations which are apparently free of Panama are classified as 'Approved' sources of supply of planting material.

According to the current Banana Planting Policy approved by the Minister, an 'Approved' plantation must satisfy the following conditions:

1. It has no previous record of the occurrence of Panama disease.
2. It is apparently free from Panama disease when subjected to the following row to row inspections after it is at least 18 months old:
   (a) In autumn of the current year; and
   (b) In the following spring not more than three (3) months prior to the removal of planting material.
3. It complies with all other requirements of the Banana Planting Policy.

All new plantations should be planted with material from an 'Approved' source.

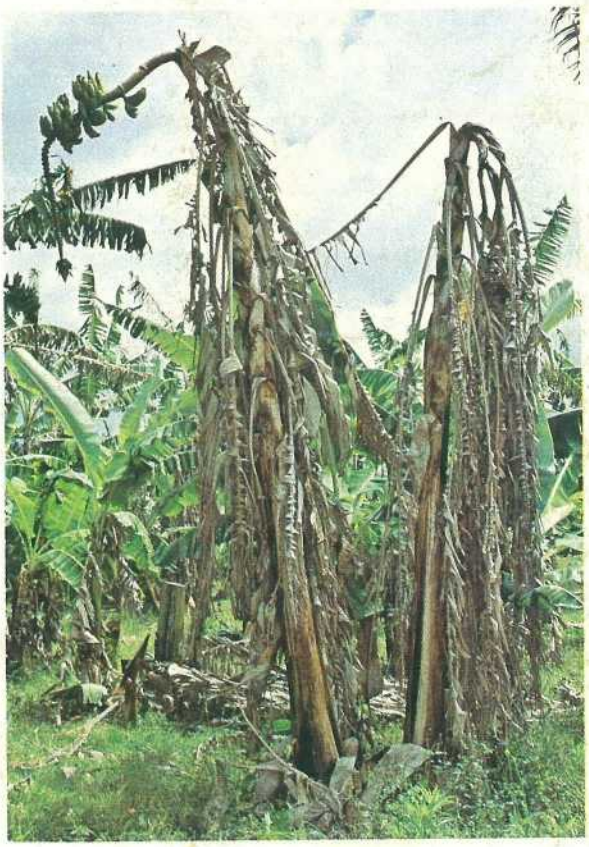
If Panama disease does appear in a plantation, it is best to cease cultivation and grow a permanent cover crop which can be mown when necessary. This practice often prolongs the life of a plantation considerably but needs to be implemented before the disease has spread to any extent.

Poorly drained soils increase the severity of the disease and should be avoided wherever possible.

Compiled by N.T. Vock, Plant Pathology Branch.

(Further information on the disease may be obtained from your nearest Plant Pathology Branch office or by writing to the Director, Plant Pathology Branch, Department of Primary Industries, Meiers Road, Indooroopilly, Q. 4068. For further information regarding 'Approved' sources of supply of Lady Finger planting material contact your local banana Inspector).

Diseases of Bananas - 1



PANAMA DISEASE
Top left: diseased plants showing the characteristic breakdown of the leaves.
Top right: cut section of pseudostem showing discoloration of water conducting tissues.
Bottom right: leaf yellowing and dieback – an early symptom of the disease.