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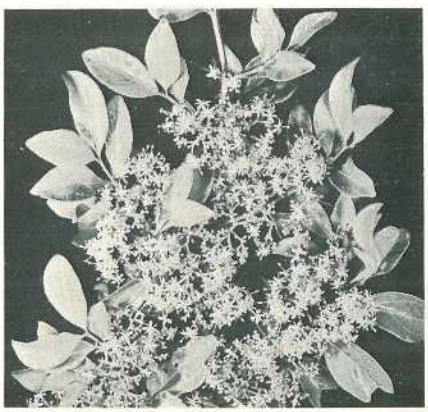

COVER. *Canthium odoratum* is a wildflower native to south-eastern Queensland. See 'The canthiums of south-eastern Queensland' in this issue. Photograph—K. Williams.

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Low cost pasture development

by G. Lambert, Agriculture Branch and
W. Steentsma, Soil Conservation Branch

A low cost method of pasture improvement on steep hillsides has eliminated the need for burning, arrested soil erosion, and trebled animal production.

Keith and Lindsay Chalk's property is situated in the foothills of the McPherson Range, south of Boonah. Average annual rainfall is around 1 000 mm, of which some 70% falls from October to March. Of a total property area of 800 hectares, only 15 hectares of creek flats are suitable for cultivation. The remainder is very steep and only suitable for grazing with careful management.

Soils are of volcanic origin and consist mainly of dark brown loams carrying open eucalypt forest, with patches of red scrub loam occurring at higher elevations.

The forest soils are low in phosphorus while the deeper scrub soils are well supplied with phosphorus and have a better water-holding capacity. The hill country is mainly used for cattle grazing on native, volunteer and sown pastures.

Lindsay Chalk (at right) and a visitor inspect lush growth of siratro and glycine.

replaces burning at Boonah

The farm enterprise

Income from the property comes mainly from grazing cattle, both beef and dairy. The dairy herd averages around 140 head and the Chalks normally run about 700 head of beef cattle—300 head on their own property and 400 head on leased country.

Some lucerne for hay, and irrigated temperate pastures are grown on their 15 hectares of creek flats. All of this is fed to the dairy herd. In recent years, soybeans, barley and potatoes have been grown on the cultivation areas, thereby reducing the area available for lucerne and irrigated pastures. About 90% of the forage for the cattle has come from the 400 hectares of improved pastures as well as from the native pasture areas. The dairy cattle are always grazing improved pastures.

Property development

Previously, the standard management of the forest country was a spring burn to remove the previous season's dead growth and make the new growth accessible to the stock. The drawbacks of this practice were accentuated by the steepness of the country which made the bare soil highly vulnerable to gully erosion from summer storms. Landslips, caused by the removal of deep-rooted vegetation, also occur at the point of change in slope in the steeper areas. The low productivity of this system meant that the Chalks faced the prospect of having to improve the property or go out of dairying.

A young stand of siratro established on a landslip area.

Close-up of siratro colonizing bare soil exposed by the landslip.

During a visit to northern New South Wales in 1969, Keith and Lindsay saw spectacular results from aerial seeding and fertilizing pastures on country which appeared similar to their own. After discussion with local Departmental officers, they worked out a system to improve their steep country.

They planted a mixture of 1 kg per ha of siratro (*Macroptilium atropurpureum*) and 2 kg per ha of Cooper glycine (*Glycine wightii*). The glycine was added because of its longer growing season compared to siratro. The seed mixture was sown from an aircraft, together with 330 kg of Mo 12 superphosphate per ha.

Their strategy was as follows:

- The seed and fertilizer were sown in autumn (the first sowing was in April 1970).
- Stock were allowed to graze the sown paddocks during winter. This removed much of the old grass and possibly trampled some seed into the ground.
- After the first good spring rain, stock were removed until siratro flowers appeared (in 3 to 4 months).
- For the first year, the stocking rate was the same as for native pastures, that is, 1 beast per 3 to 4 hectares.

In the second year, the siratro and glycine became dominant. This allowed the stocking rate to be increased to 1 beast per ha in the third year.

In the fifth year, naturalized improved grasses—paspalum (*Paspalum dilatatum*), Pioneer Rhodes (*Chloris gayana*) and Kazun-

gula setaria (*Setaria anceps*) became noticeable in the pasture. These had obviously resulted from seed brought up from improved pasture areas on the flats. Their vigorous growth was made possible by the nitrogen fixed by the siratro and glycine. In years of favourable winter rain, white clover (*Trifolium repens*) also naturalized and grew well in some heavily grazed areas. This was probably a response to the superphosphate fertilizer.

Costs

The cost per hectare of the improved pasture operation (at 1978 prices) is at follows:

	$	
1 kg siratro	5.10	
2 kg glycine	2.56	
⅓ tonne superphosphate ..	18.67	($56.00/tonne bulk)
Aerial spreading charge ..	5.00	($15.00/tonne aerial spreading)
	31.83 = $32.00	

There has been no maintenance superphosphate applied to the established pasture area because the Chalks feel that it would be better to plant more new areas with the money they have available. To date, they have planted about 400 ha to improved pastures.

On some soils, however, topdressing is necessary. A reasonable annual amount of superphosphate to apply would be 50 kg of superphosphate per ha from the third year onwards. This would cost $3.55 per ha per year.

Returns

Liveweight gain (L.W.G.) of beef cattle on native pastures in south-east Queensland can be taken as 130 kg per head per year.

Assuming a dressing weight gain (D.W.G.) of 55% of liveweight gain, then D.W.G. = 72 kg per head per year. At a stocking rate of 1 beast to 3 ha, D.W.G. is 24 kg per ha.

The improved pastures are stocked at 1 beast per ha. If the cattle on the improved pastures only did as well as those on native pasture, then their D.W.G. per year would be 72 kg per ha. However, from experience with siratro pastures in south-east Queensland, a L.W.G. of 183 kg per head could be expected. This is a D.W.G. of 100 kg per year per ha.

This is an increase of (100 — 24) = 76 kg per year per ha compared to the native pasture.

At a selling price of 48 cents per kg D.W., the value of the increased D.W.G. is $36.48 per year.

Recovery of costs

The 'payback period' method has been used to calculate the time needed to recover the development costs under a beef enterprise. Details are shown in Table 1.

It is assumed that the cost of running one animal is $6 per annum. At a stocking rate of 1 beast to 3 ha, the running cost per ha is $6 ÷ 3 = $2. A stocking rate of 1 beast to 1 ha is $6. Hence the increase in husbandry cost per hectare due to the higher stocking rate is $6 — $2 = $4. This $4 has been included in Table 1.

TABLE 1
COSTS AND RETURNS OF PASTURE DEVELOPMENT* ($)

		Year 1 (low stocking rate)	Year 2 (low stocking rate)	Year 3 (fully stocked)	Year 4 (fully (stocked)	Year 5† (fully stocked)
Establishment and maintenance costs	(a)	32	0	3·55	3·55	3·55
Increased husbandry costs	(b)	0	0	4·00	4·00	4·00
Cash outlay‡ (c=a+b)	(c)	32	0	7·55	7·55	7·55
Cash income‡	(d)	0	0	36·48	36·48	36·48
Cash balance‡ (e=d−c)	(e)	−32	0	+28·93	+28·93	+28·93
Cumulative cash balance		−32	−32	−3·07	+25·86	+54·79

* No interest charges have been included for either development costs or ownership of cattle.
† The length of the payback period depends largely on the price for cattle.
‡ At end of respective year.

It will be seen that the original cost of $32 per hectare rises to $39.55 per hectare as cost of topdressing and additional animal husbandry costs are added. At the end of year 3, the first income of $36.48 resulting from the improvements reduces this cost to $3.07. Continuing in the same way shows that at the end of year 4 all costs have been recovered and a profit of $25.86 per hectare has been made. In subsequent years this profit continues to rise for as long as the pasture is maintained in good condition.

These calculations are based on the assumption that the income from pasture improvement comes solely from extra beef production. In the Chalks' case, the improved pastures are being used for milk production as well as beef. The returns from this would probably be better than those for straight beef.

The fire problem

Keith Chalk claims that his greatest fear is a spring fire. The problem as he sees it is that while the tropical legumes are so dominant there is very little grass left to regenerate quickly after a fire. The legumes are dried off by the winter frosts and they will burn, destroying the creeping stems. Any regrowth of the legumes after being burnt must come from the crown, and this is very slow.

After an accidental fire in the spring of 1976, 4 months elapsed before the burnt area could be restocked. Assuming that one-third of the animal production was lost this represented a potential loss of $12 per hectare. Besides this, severe erosion resulted following the loss of protective plant cover.

Every precaution is taken to prevent fires. Keith says that in future, they will shift as many stock as they can into the most vulnerable paddocks during autumn and winter. This is to reduce to a minimum the material left in spring to carry a fire.

As more grass comes back into the pasture paddocks, the fire problem becomes less severe. This is particularly so if paspalum spreads all over the hillsides as it has done in the oldest established pasture.

The fire in the spring of 1976 burnt out about 100 ha of dense glycine/siratro pasture. Keith used this opportunity to sow green and Gatton panics into the ashes.

By autumn 1977, the legumes had fully recovered. Although they were dominant in the pasture, there was enough panic up and seeding to suggest that it will become a significant component of the pasture in the future.

Summing up

Besides the obvious advantages of not having to burn each year, Keith and Lindsay Chalk have done well out of their pasture development. As well as trebling their beef cattle numbers they are producing more and cheaper milk than before because less supplements have to be fed in the bails. Their animals have good paddock feed all year round and they do not have to sell off unfinished cattle in winter.

The only changes that should be made in their planting mixture would be the inclusion of a grass such as green or Gatton panic.

If accidental fire can be avoided, good tropical pastures will provide adequate ground cover to reduce erosion losses to an insignificant level.

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Sheep yards

by P. S. Beasley and D. M. Allison, Sheep and Wool Branch

WELL-DESIGNED and constructed sheep yards make enormous savings in time, effort and tempers.

This article has been written to give guidelines for constructing new yards and for replacing unworkable sections of existing yards.

Siting the yards

Ideally, the main sheep yards should be sited as near as practicable to the centre of the property. The site selected should be well-drained and preferably on a slope. The yards should be sited so that sheep move uphill through forcing pens and races, and from south to north or north to south.

An abundant supply of water handy to the yards is essential both for yard watering and stock water. Suitable holding paddocks are essential adjuncts to any yards. Adequate shade trees on the proposed site are a very real advantage.

Size of yards

Yards should be large enough to handle the largest mob on the property. Yard requirements are usually greatest at crutching time in Queensland. Allow one sheep per square metre in low density yards and three sheep per square metre for forcing pens and work areas.

Shade trees in well-designed yards on a south-west Queensland sheep property.

Holding paddocks will reduce the storage requirements of yards. It must be stressed that management of these holding paddocks is of paramount importance. Feed must be conserved in them at all costs. The temptation to use them between yard workings must be resisted absolutely.

The lower cost of suspension fences and electric fences could make wide laneways (400 m or so) a worthwhile time-saver. By having a series of wide laneways radiating from the yards, paddocks can be mustered with fewer men, sheep can be brought to the yards and yarded easily and can find their own way back to the paddock. Laneways can be used as holding paddocks.

Materials

The choice of building materials for yards is a decision which must be made by the individual owner. Some owners may be prepared to pay relatively high prices for fabricated mesh panels while others may have the time to construct yards from cheaper materials.

The authors favour second-hand galvanized iron for forcing and high density areas of the yards. Sheep work very well through these yards because the only place they can see out is through the gates.

Welded pipe yards look neat and attractive and sheep usually work well in them, but unless large quantities of cheap, second-hand pipe are available the cost of pipe yards is prohibitive.

Fabricated mesh yards are neat, easy and quick to erect and are durable. They are expensive to buy but in many cases the saving in labour for erection makes them the obvious choice. They do have disadvantages in that horns can get caught in them, and broken necks in sheep and broken legs in dogs are more common than with other materials.

Sawn timber and round timber yards are effective but in many cases are more expensive than yards built of other materials.

It must be stressed that materials for forcing and working yards are expensive. Well-designed yards will keep the amount of these materials to a minimum. Use cheaper materials for low density areas such as receiving and holding yards.

Adjustable width is an advantage when the race is used for different tasks and different-sized sheep.

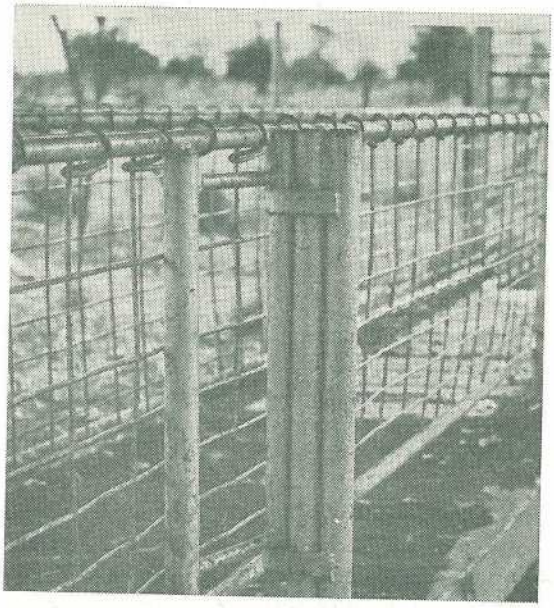
Holding paddocks and watering paddocks around the yards enable sheep to be worked efficiently through relatively small yards.

Designing the yards

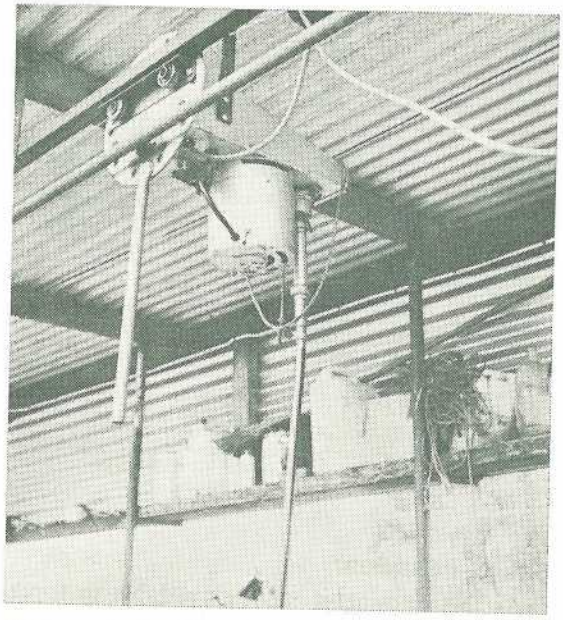
Functions of yards

Facilities are needed to cope with some or all of the operations listed in table 1.

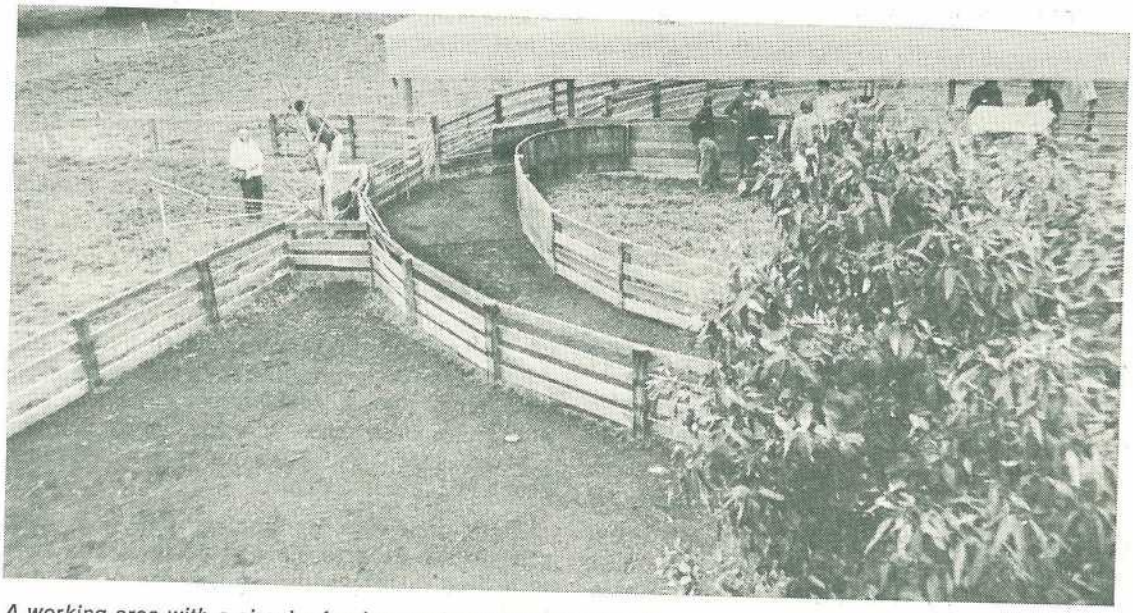
Before making a decision to design the work area, the list of husbandry practices should be examined to see which are essential and which can be discarded—unnecessary work means unnecessary expense. The list should also be examined to determine which practices are performed most often and which operations must be performed quickly.



Hinges on the side of an adjustable race.



Equipment stored on a shelf under the galvanized iron roof of a race.



A working area with a circular forcing yard and a covered drafting race.

TABLF 1

SHEEP YARDS

Production	Disease control	Identification	Selection
Shearing Trucking	Marking* Mulesing* Crutching Jetting Dipping Drenching Inoculaticn Foot trimming Balanitis (pizzle rot) control	Ear tagging Branding	Weighing Condition scoring Classing Mouthing Drafting

* The use of temporary yards for marking and mulesing is encouraged to reduce the risk of post operative infection.

Sheep behaviour

As the amount of labour available to force sheep through yards has declined, greater interest has been shown in the natural instincts and habits of the sheep and how these can be exploited.

The following principles are now well accepted throughout Australia.

- The sheep must not be able to see other sheep behind them.
- They must see the treated sheep escaping—stationary sheep are motivated to move by running sheep.
- Oncoming sheep must not see the operator(s) and the noise of the operation must be minimized.
- The front of the race should be open so that sheep are not expected to approach a dead end.
- Strong contrasts in light should be avoided as these tend to baulk sheep.
- Sheep seem to move more readily around corners than in straight lines.

In addition to these principles, it is the authors' experience that sheep work better when moving away from objects which have caused them trauma in the past (for example, shearing sheds, dips).

Sheep are affected both by their individual natures and by their mob instincts. They may be trained to become accustomed to certain methods of handling and to routes through yards. Any deviation from these can cause stress and confusion.

Important differences exist between breeds:

- Merinos have pronounced gregarious instincts and tend to graze and camp in large mobs.
- British breeds and their crosses are more individualistic and tend not to exhibit this flocking habit to the same extent.

The object should be to control sheep behaviour to the operators' advantage.

Gates and gateways

A set of yards cannot have too many gates. Although gates are expensive, the ability to move sheep in any direction from any yard will more than compensate for the extra cost.

Gates should open and close freely. They should have latches which are quick to open and close and which are absolutely secure.

Gateways should be wide enough to allow sheep to flow through easily. Sizes will range from 2 to 4 m depending on the yard or pen.

Slide/swing gates and lift/swing gates are a real advantage in forcing pens. They can be lifted over the sheep in a full back pen and then lowered and closed forcing sheep up, or can be slid along the fence and closed behind the sheep.

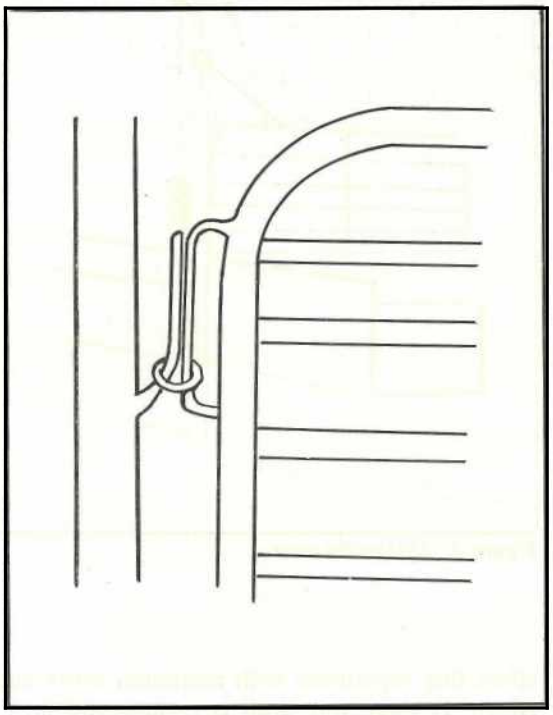
Four-way 'diamond' interchanges in corners of pens add to flexibility of movement.

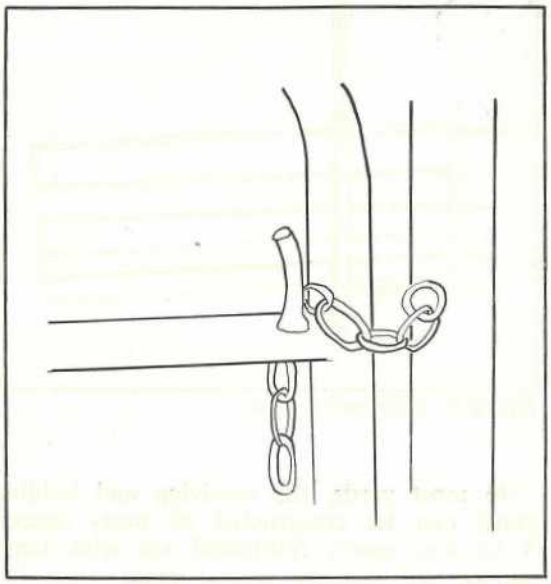
Receiving and holding yards

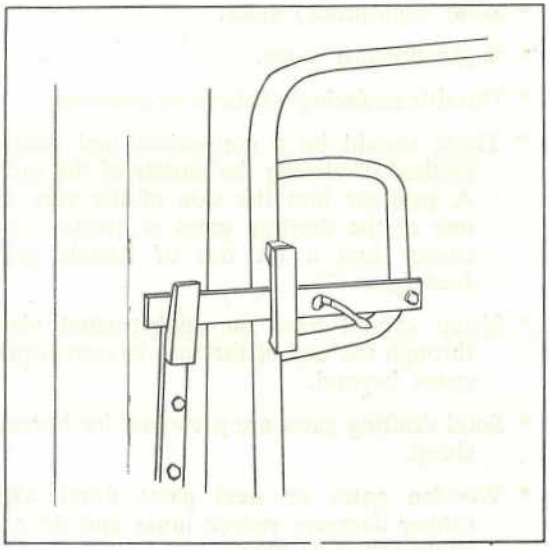
These should be big enough to hold the largest mob on the property relatively loosely. About 1 m^2 or a little more should be allowed per sheep. Good shade trees and water are a definite advantage. If these yards can be grassed, sheep will yard up better and dust problems are overcome.

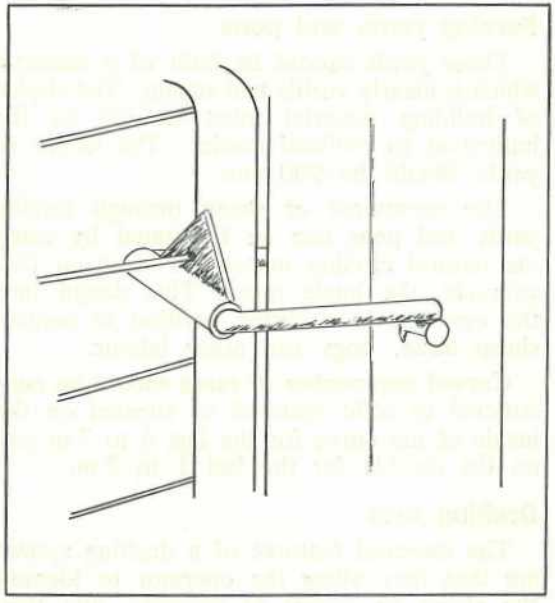
Wide laneways or holding paddocks will obviate the need to store more than one mob at a time thereby reducing the size of holding yards.

Simple gate latches









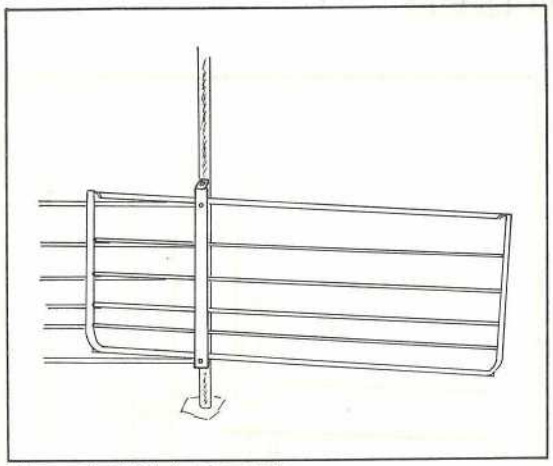


Figure 2. Slide/swing gate.

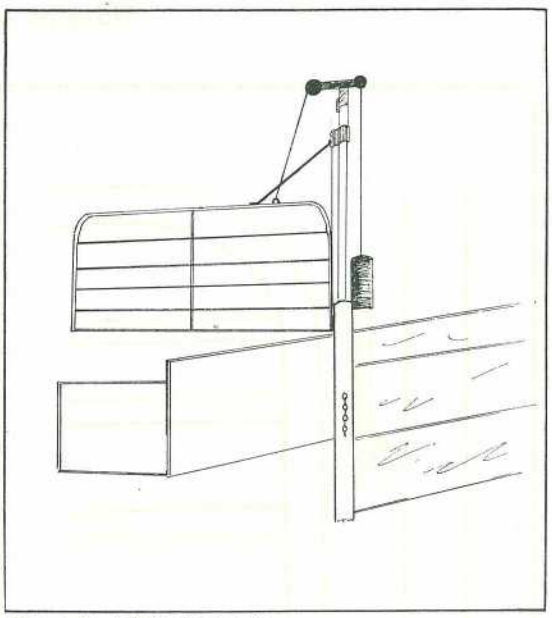


Figure 3. Lift/swing gate.

In most yards, the receiving and holding yards can be constructed of posts spaced 3 to 4 m apart, fabricated six wire lamb netting and suitably spaced plain wires for extra support. A top rail on the fence improves its visibility and stops the sag of wires associated with short strains. A fence height of 1 m will adequately hold all sheep. Entrance gates should be wide enough to allow a good flow of sheep. A double gate, each section 3 m wide, is suggested.

Forcing yards and pens

These yards should be built of a material which is clearly visible and strong. The choice of building material must be left to the individual as outlined earlier. The height of yards should be 900 mm.

The movement of sheep through forcing yards and pens can be facilitated by using the natural circling movement of sheep (for example, the bugle race). This design puts the operator in a better position to control sheep flows, dogs and other labour.

Curved approaches to races should be constructed of solid material or sheeted on the inside of the curve for the last 6 to 7 m and on the outside for the last 1 to 2 m.

Drafting race

The essential features of a drafting system are that they allow the operator to identify the sheep he wishes to separate, and then effect this separation with minimum error and effort. A three way draft is recommended.

The following points will help in planning the race:

- Tapered sides (see figure 6).
- Solid (lightproof) sides.
- Slight upward slope.
- Durable surfacing—battens or concrete.
- There should be a convenient and secure method of closing the outlets of the race. A gate set into the side of the race or one of the drafting gates is quicker and easier than a lift out or tumble gate (see figure 7).
- Sheep should have an unobstructed view through the end of the race to some open space beyond.
- Solid drafting gates are preferred for horned sheep.
- Wooden gates or steel gates fitted with rubber dampers reduce noise and do not baulk sheep as much.

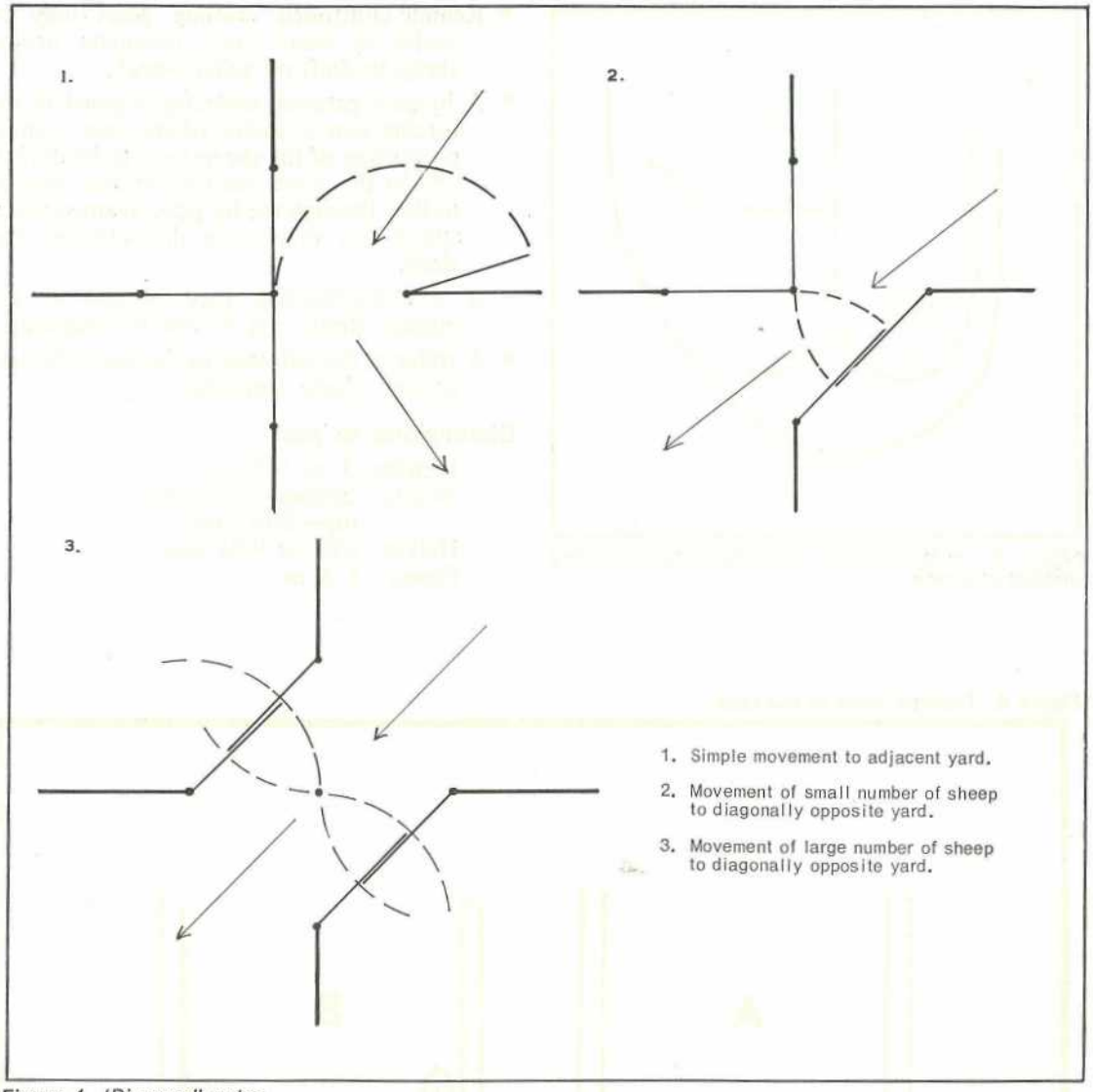


Figure 4. 'Diamond' gates.

- The direction of the drafting race should minimize the effect of sun and shadows on the operator and sheep—south to north is preferable.
- The race should run away from or parallel to the shearing shed, dip and any other structure which has painful memories for sheep.
- Roofing the race, forcing pen and check pens eliminates contrasts of light and shadows. Sheep will run better and operator comfort is improved. Fluorescent lights over the race and check pens mean that drafting can be done in the cool of the evening. Sheep run well towards these lights at night.

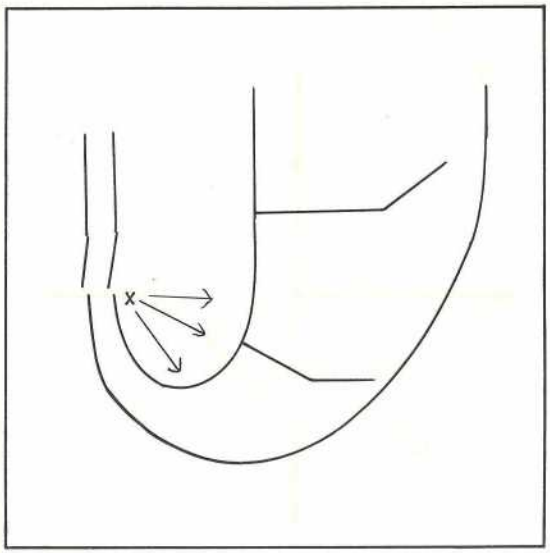


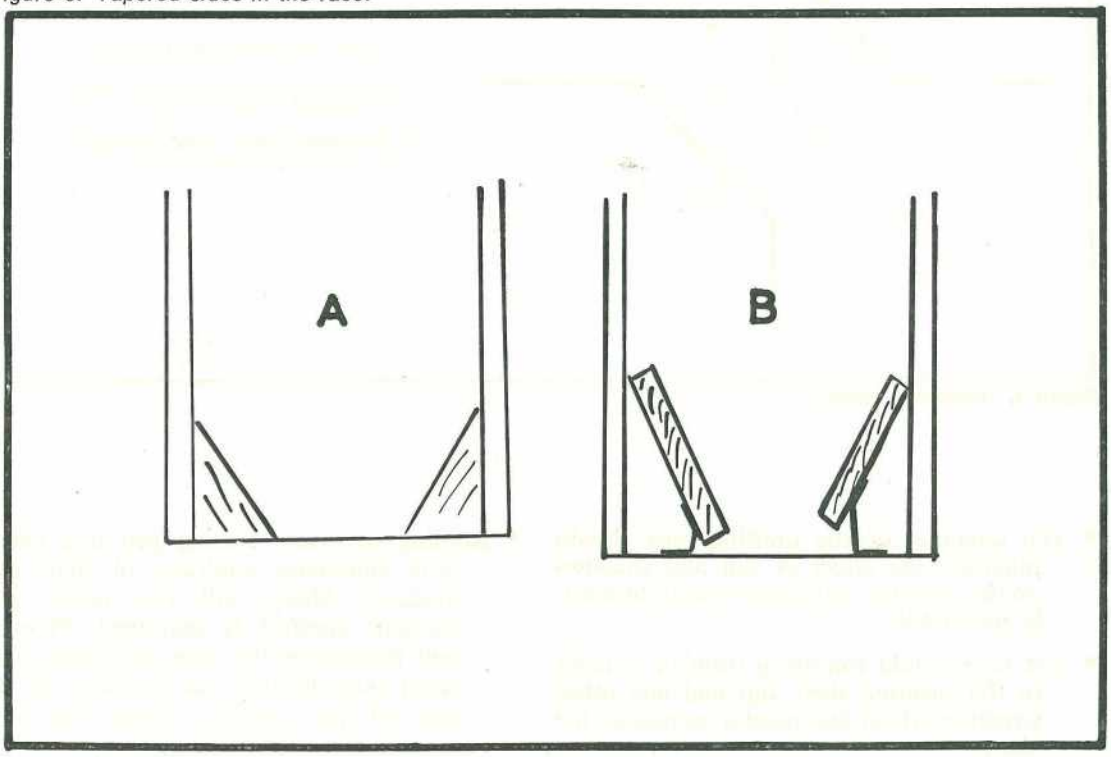
Figure 5. 'Bulge' design uses the natural circling instinct of sheep.

- Remote-controlled drafting gates may be useful in some cases (standing behind sheep to draft off soiled ones).
- A by-pass gateway replacing a panel of the forcing pen is useful where only a small proportion of the sheep have to be drafted off. In this case, most sheep are allowed to flow through the by-pass. Wanted sheep and a few others are diverted into the draft.
- A working/classing race instead of the middle check pen is not recommended.
- A roller at the entrance to the race will help prevent sheep jamming.

Dimensions of race

Length: 3 to 3·5 m
Width: bottom—280 mm
top—550 mm
Height: 850 to 900 mm
Gates: 1·3 m

Figure 6. Tapered sides in the race.



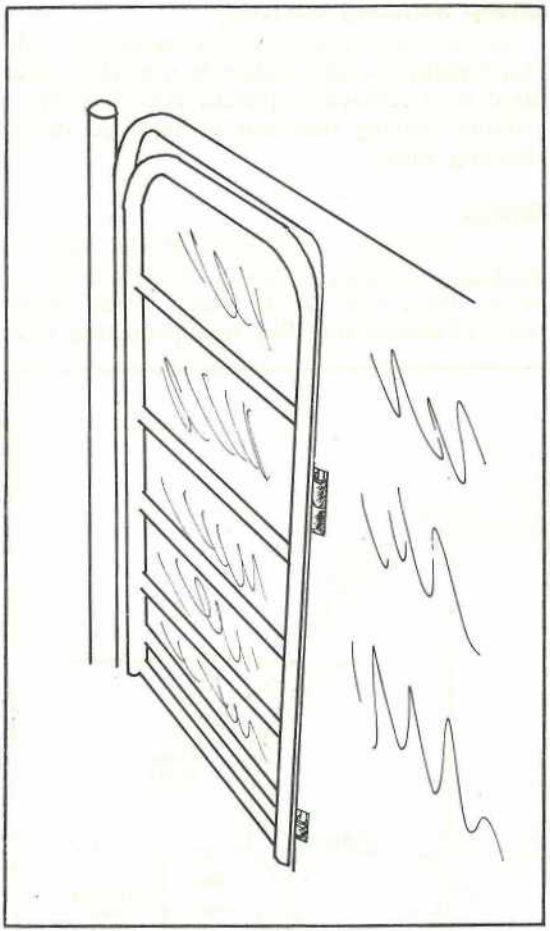


Figure 7. Gate set into side of the race.

Dip

Because of the high cost of separate yards, most dips are included in the main yards.

The dip should be placed as an appendage to the main sheep pathway, so that sheep can be conveniently diverted into it. It should, however, be located as far as practicable from main working areas (drafting race, entry to shearing shed, working race). Sheep will not willingly work towards dips.

The dip sump should be constructed of strong, reinforced concrete so that it can be readily cleaned and can be left empty between use. Sunlight in a dry sump is the best insurance against infection.

Plunge dips are very effective but the labour required to put sheep through them is prohibitive.

Shower dips are more convenient to load and give good control of lice. They should be installed so that the constant replenishment system as outlined in the instructions supplied by manufacturers can be used.

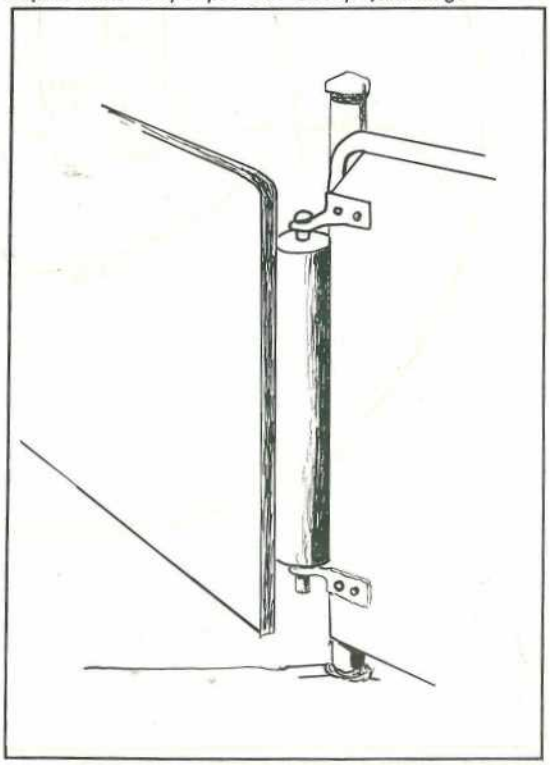
The authors have seen shower dips which are fed out of the shearing shed. These work well but management at shearing time may have to be altered on some properties.

Walk through off shears spray races are effective but the difficulty in getting sheep to flow slowly and evenly through these machines makes them inadequate on most properties.

Loading ramp

Raised shearing sheds in many cases double as excellent loading ramps. Elsewhere like dips they should be added as appendages to the main sheep pathways.

Figure 8. A 75 to 100 mm roller at the entrance to the race helps prevent sheep jamming.



If separate structures are built they can be built up with stone and rubble to truck height. An adjustable end which is raised with a windlass can be added to load double and triple-decked trucks.

A wide loading ramp (approximately 1 m) with adequate block off gates works better than a single sheep ramp.

The loading ramp should run as nearly as possible to north-south. Loading sheep on to top decks into a rising or setting sun is impossible.

Sheep handling devices

These can be placed as appendages to main sheep pathways or installed in a working race fitted with removable panels. Alternatively, a portable forcing race can be installed in the shearing shed.

Shade

As previously mentioned, shade trees in yards are a distinct advantage. Some established native trees will die in sheep yards. Athel trees (*Tamarix aphylla*) and pepperina trees

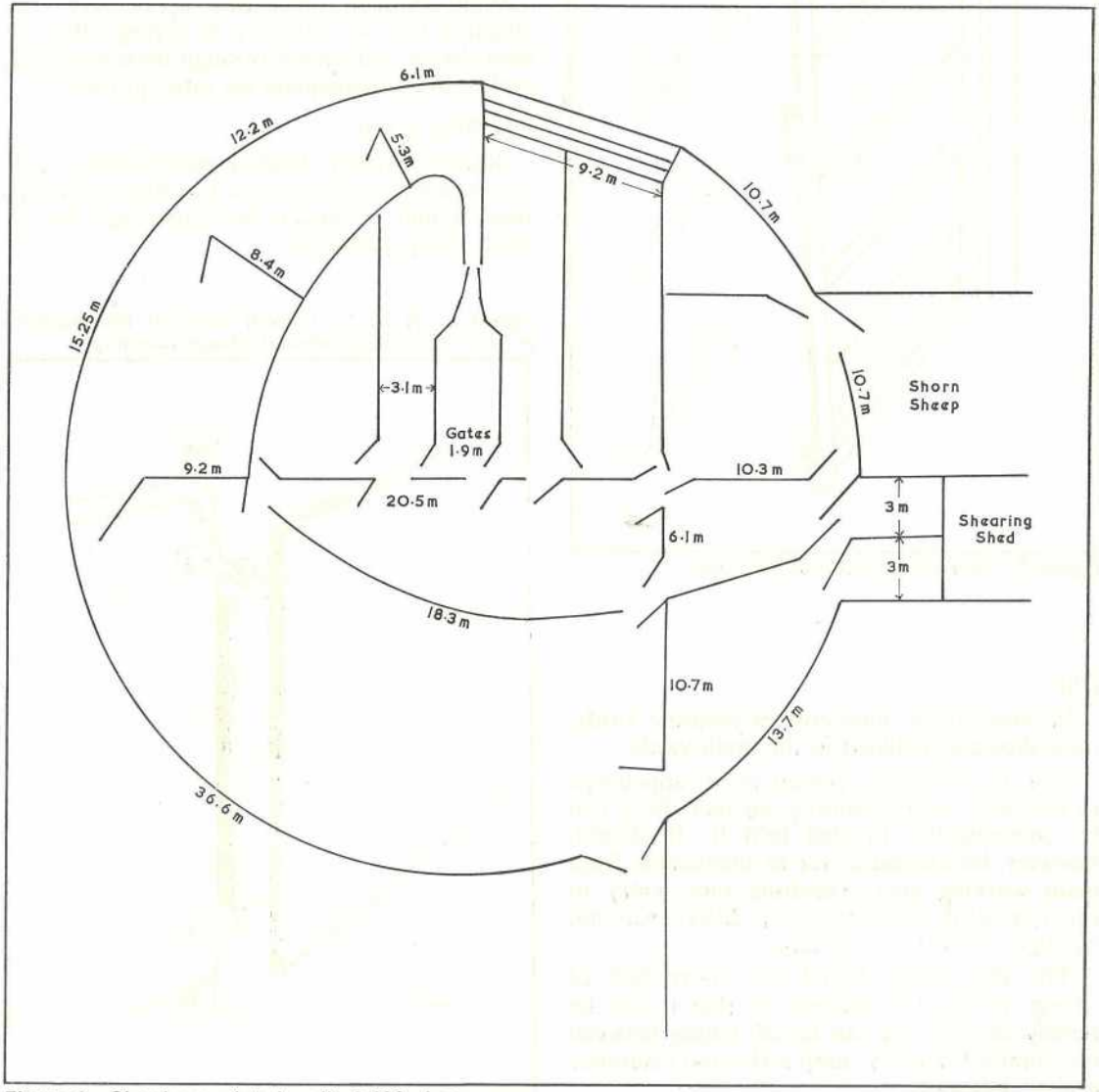


Figure 9. Circular yard to handle 2 000 sheep.

(*Schinus molle*) will thrive and produce good shade. Young trees planted in yards must be protected with suitable guards until they are well above the reach of sheep.

Artificial shade over working areas (drafting race, working race, lamb marking pen) takes a lot of the drudgery from sheep work. Men, dogs and sheep are cooler and all will work better. Bough sheds are quick, easy and inexpensive to erect. More substantial structures with a galvanized iron roof have the advantage that drenching guns, raddle and other equipment can be conveniently stored on shelves adjacent to working races. Lights can be installed if desired.

Reducing the dust problem

Abundant water adjacent to sheep yards is essential. Piping should be laid so that all yards can be watered with relatively short hoses.

Dust cannot be controlled adequately with low pressure systems.

A suitable pump, large diameter hose and fire fighting nozzle will allow sheepmen to water yards quickly and effectively.

Stands fitted with irrigation type sprinklers and supplied by a pump of sufficient capacity do a good job and save time and labour. However, they are more expensive to install.

Well-grassed receiving and holding yards are a real asset on any property and could be well worth the time taken to maintain them.

Working race

When designing the working race, it is important to make a list of all the operations which will be carried out in it. The common ones in Queensland are listed in table 2.

TABLE 2

Disease control	Identification	Selection
Jetting Drenching Crutching* Foot Trimming* Mulesing*	Ear Tagging Branding	Weighing Condition Scoring Classing Mouthing

* These operations can be carried out in the race if a sheep handling device is incorporated.

Decide which operation(s) you do most in the race and design it accordingly.

- WIDTH OF RACE. The race should be no wider than 770 mm and no narrower than 660 mm. Below 660 mm, sheep will turn around in the race and not turn back. If the race is too wide, sheep cannot be controlled without getting in with them.

If the most common operations in the race are jetting and drenching, the narrower width should be chosen. If classing and branding are the main uses, a wider race can be built. The sides of a race should be open.

- LENGTH. Over-long races are difficult to fill tightly and races which are too short do not hold enough sheep. They should be between 9 m and 12 m long. A block-off gate in the middle of the race is a definite advantage for some operations.
- FLOORING. A raised grating floor is the cleanest and most convenient. Removable grating makes cleaning out under the race easier. Grating should run across the race.

Concrete flooring can be used. It must be well-sloped to allow excess jetting fluid to drain away.

- MULTIPLE RACES. Double races are tiring. The operator must climb fences all day. Triple races are more convenient. The outside races are filled with sheep and the operator works in the middle race.
- ADJUSTABLE WIDTH RACES. These are a decided advantage when using the race for different tasks and different-sized sheep.
- ROOF. A roof over the race means cooler working conditions for men, sheep and dogs.
- GATES. Gates which slide vertically have several advantages—they can be counterweighted and remote-controlled. This saves a lot of walking up and down the race. A drafting gate at the end of the race is useful for classing.
- SHEEP HANDLING DEVICES. Removable panels at the end of the race will allow sheep handling devices to be installed and removed easily.

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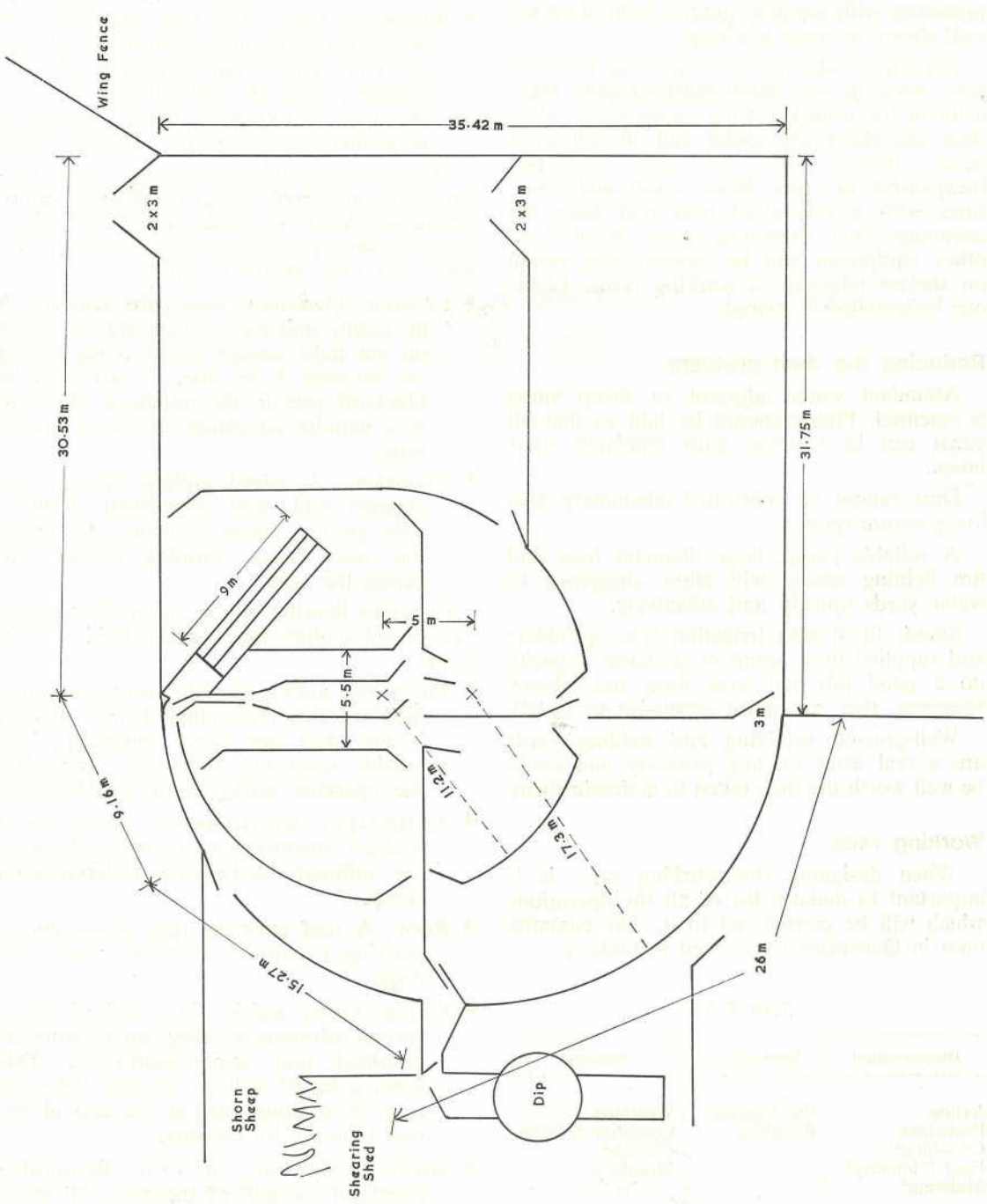


Figure 10. Bugle yard to handle 2 000 to 3 000 sheep.

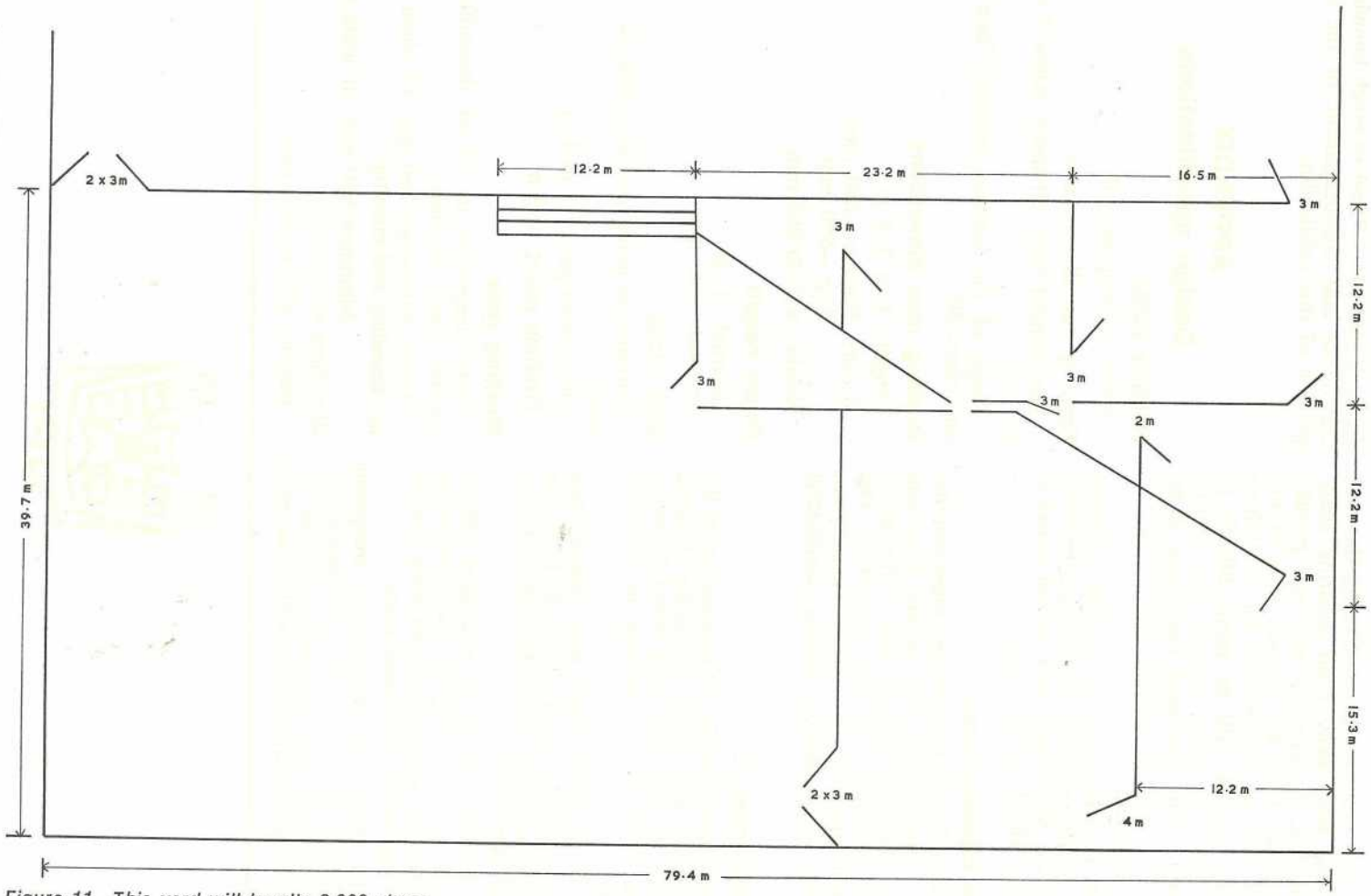


Figure 11. This yard will handle 3 000 sheep.

- THE SITE FOR THE RACE. Ideally, the race should feed away from shearing sheds and dips. At worst, it may run parallel to these. It is not a good idea to use the race as a substitute for a drafting check pen. It will be more difficult to get sheep to work through the drafting race. It will also mean that shorn sheep must be put through the drafting race to be branded.

If the race is not to be roofed it should run on a north-south axis to minimize the effect of shadows. Sheep will tend to run better if there is a slight up-hill slope.

Special classing races

Elevated single width classing races give the classer a good overall view of the sheep and eliminate the need to bend over. They are a definite advantage on stud properties. The additional expense of these races is usually not warranted on properties running commercial flocks.

Acknowledgements

Material contained in the proceedings of the 1976 Sheep and Wool Refresher Course, sponsored by the Australian Wool Corporation, has been used extensively in this publication.

Several diagrams have been taken from Extension Bulletin No. 11.74 by A. L. Brown and published by the South Australian Department of Agriculture.

Our thanks must go to the other officers of Sheep and Wool Branch for contributing plans, designs, photographs and ideas backed by their experience over many years.

Special thanks are due to the sheepmen who allowed us to measure and photograph their yards; who were prepared to discuss the shortcomings of their yards as well as the good features; and who offered so much knowledge, experience and encouragement in the compilation of this publication.

APPENDIX
Design specifications

Holding yards

Allow 1 sheep per m^2.

Forcing pen dimensions

Should hold 30 to 50 sheep. Allow 3 sheep per m^2.

Angle of the junction between force pen and race=30°.

Drafting race dimensions

Length: 3 to 3·5 m

Width: Bottom—280 mm
Top—550 mm

Height: 850 to 900 mm

Fence height

External: 1 m
Internal: 900 mm

Gate sizes

Entrance to main receiving yards: 2 x 3 m gates.

Other main gates: 2 to 4 m

Drafting gates: 1·3 m

Working race

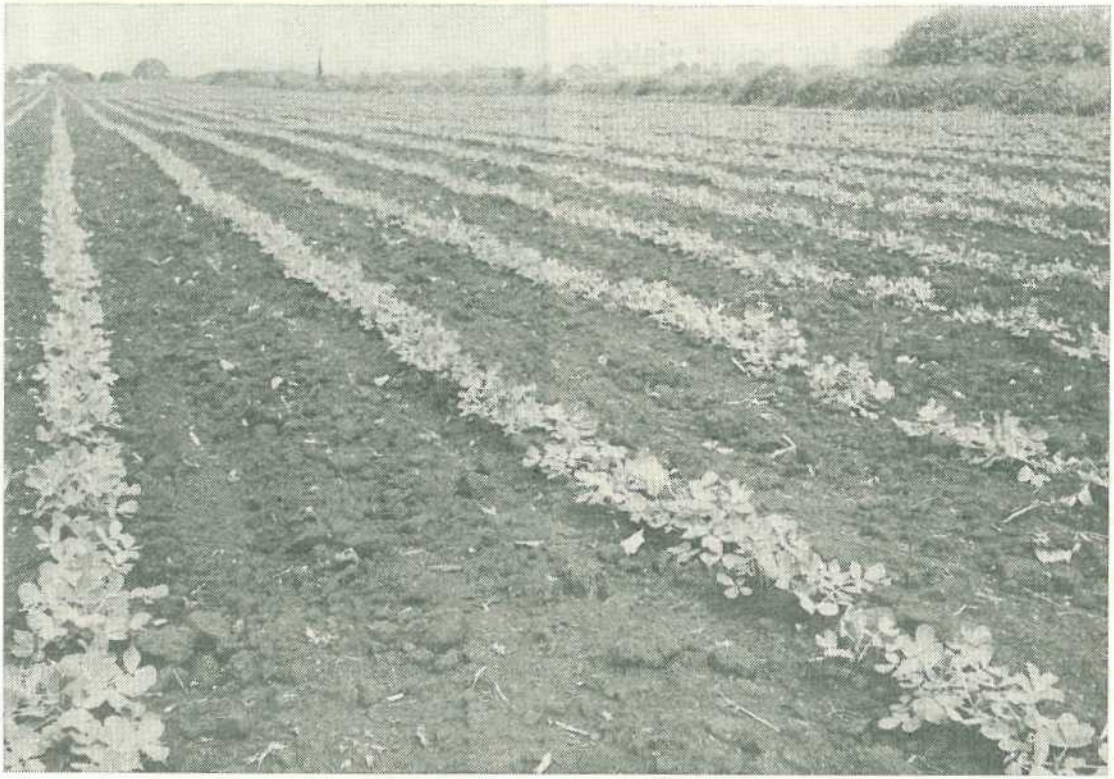
Total length=9 to 15 m depending on whether single or triple.

Width: Maximum 760 mm (if main tasks are branding and classing).

Minimum 660 mm (if main use is drenching and jetting).

Height: 850 to 900 mm.

Growing peanuts in North Queensland



by J. Kilpatrick and I. C. Crosthwaite, Agriculture Branch.

Care at planting will provide an even emergence and regular plant spacing.

THE peanut industry in North Queensland has gone through a rapid growth period over the last 3 years.

The crop is now being grown in areas other than the traditional Atherton Tableland and on soils other than red basalts.

During the 1977-78 season, significant plantings of peanuts were made on the red and white sandy soils of the Dimbulah area, the sandy red earths of the Mount Garnet district and the red basalts of Lakeland in the Cape York Peninsula. All of these crops produced satisfactory and profitable yields of peanuts.

Four factors which influence the peanut expansion in North Queensland are:

- The light-textured, free-draining and friable soils which will not set hard at harvesting.
- The suitable rainfall and temperatures of much of North Queensland which are satisfactory for peanuts.
- The strong demand for top quality peanut kernels which marketing authorities believe will continue. The returns to the grower are expected to remain attractive.
- The Peanut Marketing Board facilities which are established in the district at Tolga.

The peanut industry will continue to expand in North Queensland, and more growers will be planting in these newer production areas. The industry will also continue to grow on a limited extent on the Atherton Tableland.

A five point plan for better yields

A combination of research and commercial experience has shown that five factors are critical in getting the best out of a peanut crop in North Queensland. These are:

- Ground preparation and crop rotation.
- Planting, seed rate and plant population.
- Weed control.
- Disease control.
- Harvesting and curing.

Each factor is equally important. By neglecting any one, a potentially good crop could result in an economic failure.

Crop rotation and ground preparation

Peanuts should be grown on different ground each year. They must be part of a well-planned crop rotation.

Each piece of ground should have at least a one-year break between peanut plantings. However, a two-year rest is preferable.

Where peanuts are grown on the same ground in successive years, yields are nearly always lower in the second year, disease incidence is higher, soil structure is poorer and soil compaction is usually greater.

On the red basalt soils of the Atherton Tableland, maize is an ideal summer crop to rotate with peanuts. A stable maize industry exists and markets are established. Maize agronomy is of a high standard and financial losses from maize are most unlikely.

Maize could have a place in the new and expanding peanut-growing areas. Grain sorghum could also be used. However, if sufficient land is available, a legume pasture phase should be considered.

The short-term economics of a pasture break in the peanut rotation are poor but the other benefits obtained are of tremendous value in any agricultural situation in North Queensland. The benefits include improved soil structure, increased soil organic matter and the elimination of self sown peanuts thereby reducing disease build-up. Subsequent maize and grain sorghum crops also benefit.

Peanuts will tolerate small clods. Very fine seedbeds can lead to costly erosion.

Land preparation is also important. All operations should aim at preparing a deep, firm and weed-free seedbed.

The initial land break-up should be completed as early as possible. The use of cutter bars or deep rippers is increasing in the established peanut-growing districts and these are best used as soon as the crop preceeding peanuts is harvested. Regardless of which implements are used, all hardpans must be eliminated.

All organic matter is of value and should be returned to the soil. Surface trash must be either turned under or well worked into the seedbed and again the sooner the better. Crop residues should not be burnt.

Excessive working of the seedbed can damage the crumb structure of the soil and increase the erosion risk. Clods of soil up to 5 cm are not a problem in a peanut seedbed.

NUTRITION. Many experiments have failed to show any yield responses following direct applications of fertilizers on red basalt soils.

However, if the land has a history of cropping or if the soil is low in phosphorus then a response to phosphorus may be obtained. It should be applied to the previous crop or spread on to the ground and worked into the soil during land preparation for the peanut crop.

Direct applications of D.A.P. at planting have helped provide large and vigorous seedlings early in the crop life. These have obvious advantages, but no final yield increases have been shown on red basalts.

On sandy or light-coloured soils, phosphorus will usually be required. Often, other nutrients may be required. A soil test will allow a recommendation to be made.

Planting, seed rates and plant populations

The best time to plant peanuts in North Queensland is in the second half of December and the first half of January. This reduces the risk of weather problems during the harvest about 4 to 5 months later.

The correct population plays a very important part in getting maximum yields from a peanut crop. If careless planting results in a poor plant population, there is little that can be done later to improve the reduced yield potential.

There are a number of ways to ensure that a good stand is obtained.

Two peanut crops in a row can lead to problems with volunteer peanuts. These clods are also much too large.

- CALIBRATE THE PLANTER CAREFULLY BEFORE STARTING TO PLANT. Test the planter units individually to make sure all have the same output. Check the machine for any breakages or loose and worn parts in the planter mechanism.
- DO NOT TRAVEL TOO QUICKLY WHEN PLANTING. Peanut seed is very easily damaged during the planting operation. The two halves of a peanut seed are very easily separated, and once this happens it will not germinate and grow.
- HANDLE SEED VERY GENTLY AT ALL TIMES. Do not bump or throw bags of peanut seed. Tests have shown that up to 12% of seed can be damaged in the bag prior to planting. Other research has shown that germination losses of up to 25% can be caused as seed passes through a slightly faulty planter unit.
- DO NOT PLANT SEED TOO DEEP. In a well-prepared seedbed with ample moisture, seed planted at a depth of 5 cm emerges quickly and evenly. Even if the soil surface is a little dry, there should be no reason to plant peanut seed deeper than 8 cm.

How much seed will be needed? What plant spacing is required? What row spacing should be used? Table 1 gives this information on planting rates and plant populations for different locations in North Queensland.

TABLE 1
RECOMMENDED PLANTING RATES AND PLANT POPULATIONS

Situation	Variety	Planting rate (kg/ha)	Seed spacing (cm)	Plant spacing (cm)
Tableland red soils or Irrigated crops on any soil	Virginia Bunch	110–120 .. .. VBA 80– 90 .. .. VBB	8	10
	Red Spanish	80– 90 .. .. RSA 70– 80 .. .. RSB	6	7·5
Sandy soils or lower rainfall areas	Virginia Bunch	90–100 .. .. VBA 70– 80 .. .. VBB	10	12
	Red Spanish	60– 70 .. .. RSA 50– 60 .. .. RSB	8	10

The inter-row spacing used is 90 cm. Peanut machinery is designed and built to fit this row spacing.

However, experimental work has shown that narrower row spacing significantly increases peanut yields. At present, farm machinery has not been modified to take advantage of this yield advantage.

Weed control

Every effort should be made to minimize weed competition. Weeds cause economic losses, and in extreme cases, complete crop failure.

A successful weed control campaign begins with the initial land preparation. Each stage of cultivation should aim at maximum reduction of weed seedlings.

The weed control programme must remain flexible and a combination of mechanical and chemical control methods used. Mechanical cultivation is still important but herbicide usage is almost essential unless peanuts are being grown on new ground which is being cropped for the first time.

A good guide is to control the weeds between the rows by inter-row cultivation, and the weeds between the peanut plants down the row by herbicides.

When cultivating, care must be taken not to throw soil into the centre of the peanut plant during inter-row cultivation. Soil may be moved up to, but not on to, the plant. Attacks from fungal diseases are more likely if soil covers any part of the plant.

ABOVE. Calibrate the boom spray before starting and use the correct nozzles. Apply herbicides to the crop at the right time and beware of spray drift damage to other crops. Always wear protective clothing.

BELOW. The desiccated weeds are shown after the use of dinoseb. The peanuts soon recover from the slight amount of phytotoxic burn of the leaves.

A satisfactory herbicide to control both broad-leaved and grassy weeds is not available. Often applications of different chemicals at different times are needed if both types of weeds are present.

The performance of preplant herbicides to control grassy weeds can be no better than their uniformity of application and incorporation.

Disease control is essential. Inspect the whole crop regularly for disease.

Broad-leaved weeds are best controlled after the crop has emerged. Again, careful and correct use of the chemicals is necessary.

Because the range of chemicals for use in peanuts is changing each year and practical experience is continually adding to our knowledge of their uses, a detailed list of herbicides, application rates and methods, weeds controlled and other relevant information is not included in this article.

Up-to-date information will be available each year from the local D.P.I. office in the peanut-growing areas.

Disease control

The most important peanut diseases in North Queensland are leaf spot and rust.

Both diseases can be controlled with fungicides. These fungicides only protect the leaf, they do not cure or eradicate infection already established in the leaf. Crop rotation and early land preparation are also important in disease control. Yields of crops protected by fungicide have been up to 50% higher than those from unprotected crops.

Full details of recommended fungicides, application techniques and times of spraying are given in 'Peanut leaf spot and rust control on the Atherton Tableland', which was published in the March–April 1977 issue of the *Queensland Agricultural Journal*. This is available from local D.P.I. offices.

The main points to remember are:

- Inspect your peanut crop regularly!
- Make the first application of fungicide when either disease is first observed or the crop is 6 weeks old. In a 'bad disease season', spraying may have to commence when the crop is only 3-weeks-old.

Spraying with fungicide for disease control. Note the extra nozzles on droppers for better coverage.

- The programme must be flexible so that during times of heavy disease incidence and high rainfall, increased fungicidal dosage and/or reduced spray interval can be introduced.
- Make sure that a good cover of all peanut foliage is obtained. Some boom sprays do not give a good cover and extra nozzles are needed.

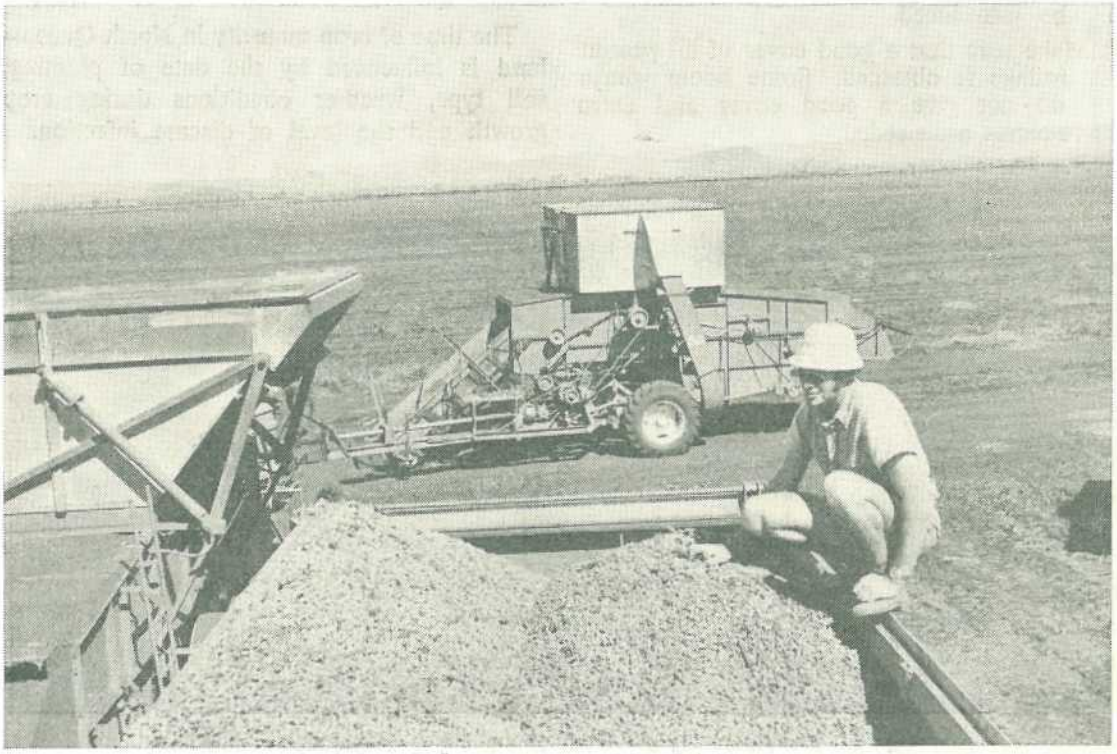
Harvesting and curing

This is where much of the final yield, quality and total value of the crop is determined.

The time of crop maturity in North Queensland is influenced by the date of planting, soil type, weather conditions during crop growth and the level of disease infection.

Peanuts that have been cut and pulled are left in the paddock 3 to 4 days before threshing.

Regular adjustments are necessary during the threshing operation. Changes in harvesting conditions require changes in machinery adjustments.



Growing peanuts does not end when the peanuts have been threshed and loaded into the truck. Correct curing is essential to obtain the premiums paid for top quality peanuts.

However, Virginia Bunch peanuts will normally mature between 20 and 22 weeks after planting. Red Spanish peanuts are usually about 2 weeks earlier.

There is no hard and fast rule to indicate when to cut and pull peanuts. However, it is wise to wait until at least 70% of the peanuts are mature.

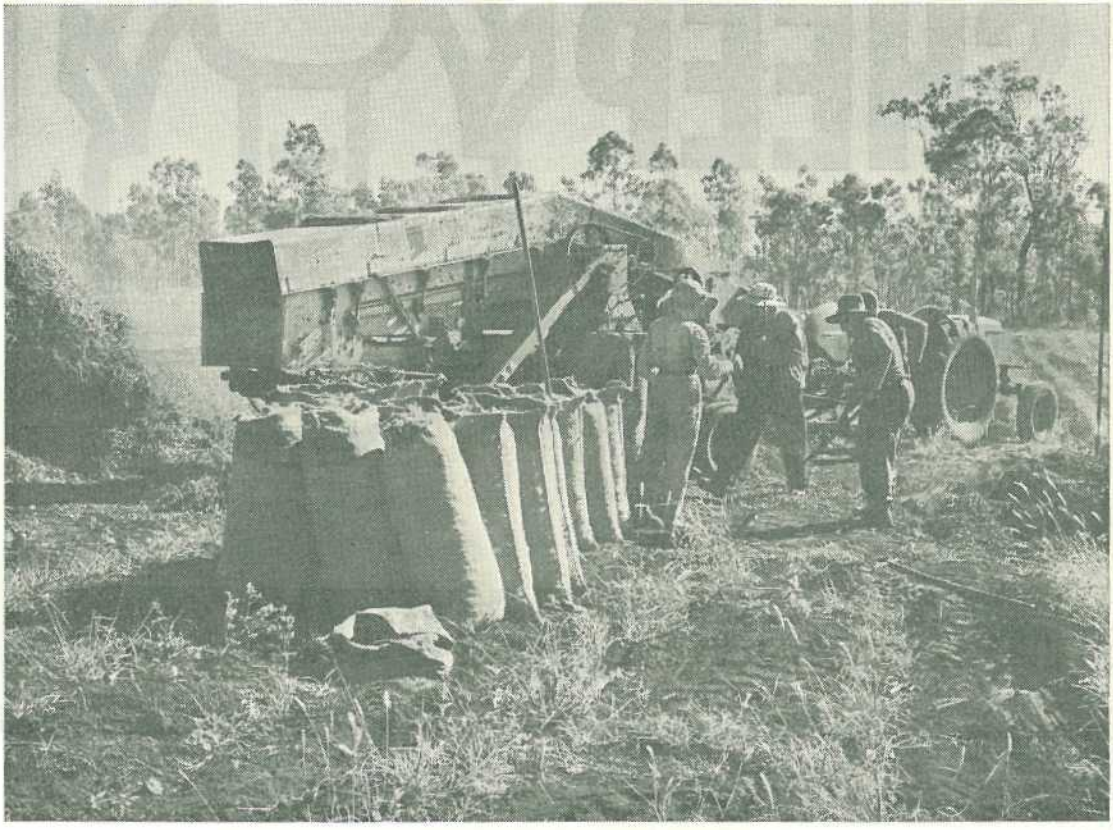
The indications of a mature crop are a colouring on the inside of the shell, at least at the peg (pod stem) end, and a darkening of the veins. With Virginia Bunch, weakened or broken pegs on the oldest peanuts indicate the crop is mature, as does a darkening of the pink seed coat. Harvesting at this stage is essential to avoid excessive losses of quality peanuts.

Unlike Virginia Bunch, a mature crop of the Red Spanish variety does not lose the peanuts, but if they are left in the ground too long, a costly build-up of moulds and other diseases can occur.

The benefits of good ground preparation and weed control are obvious when cutting and pulling the crop. Hard and uneven ground coupled with weed infestation will cause tremendous losses of both money and tempers!

The introduction of modern threshers and drying systems enables peanuts to be harvested at the correct stage. Ideally, peanuts should be threshed when the moisture content of the nut in shell is between 20% and 24%. If the weather is kind, this stage is reached 3 to 4 days after pulling.

Mechanical damage can be severe if peanuts are threshed too wet or too dry. High levels of loose shell kernels (LSK) can result with significant final pay losses as a consequence.



The good old days! An Oliver stationary peanut thresher in use at Rocky Creek.

Correct curing or drying of peanuts need care and attention. Drying must begin immediately the pod is separated from the peanut plant. Instrumentation is needed to ensure that the optimum drying conditions are maintained. Full details are available in 'Peanut drying' published by the Department of Primary Industries as a Farmnote in May 1978.

A warning

Growing peanuts is not easy and not cheap. Considerable finance and machinery must be available before starting.

Perhaps the most essential need is suitable on-farm storage. There could well be a thresher available to harvest a crop, but unless a grower has his own bins, drier and on-farm storage, the crop can be lost overnight.

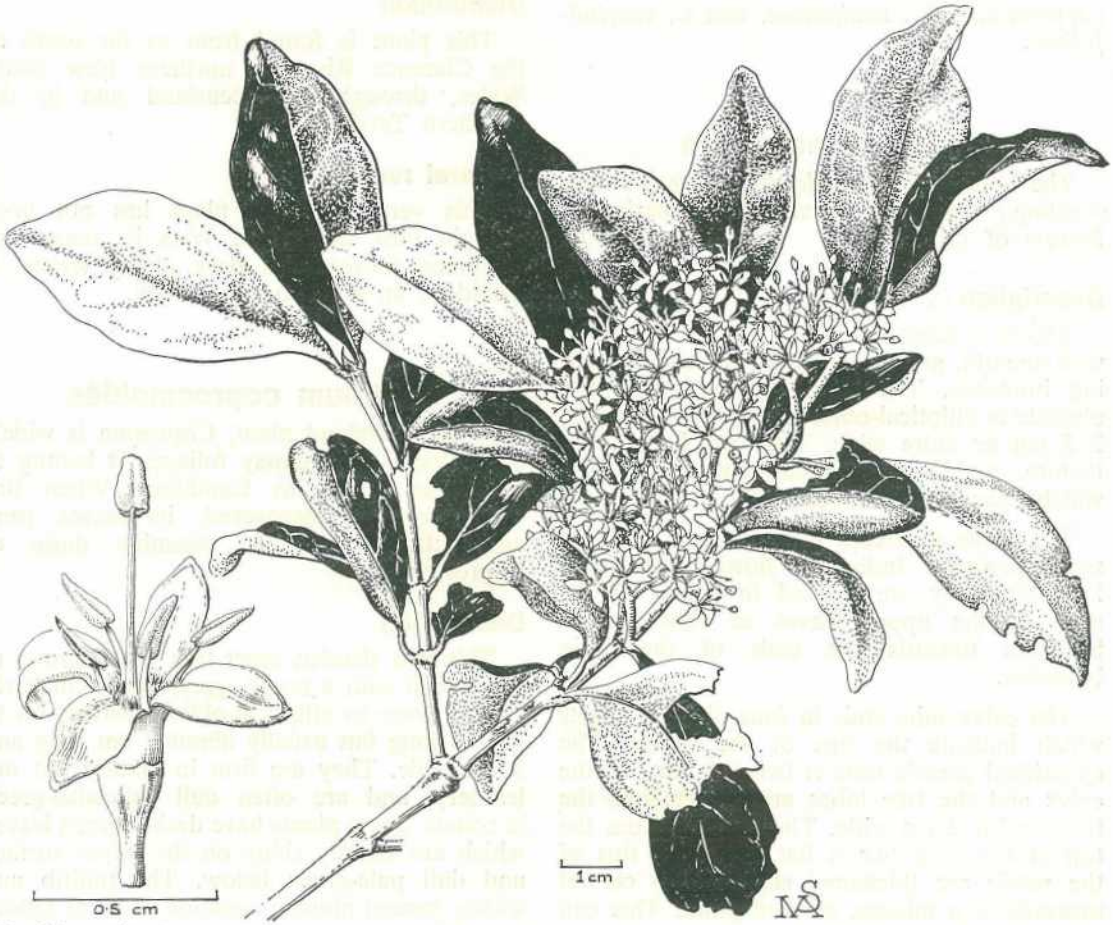
Do not try to grow too much if you are growing peanuts for the first time. Far better to grow 15 hectares well than to make a mess of 30 hectares. Many experienced Tableland peanut farmers with all their own equipment consider 40 hectares is as much as they can safely handle. It contributes greatly to their success.

The Canthiums of South-eastern Queensland

by Beryl A. Lebler, Botany Branch

THE first Canthium species described was found on the Malacca Coast in Malaysia where its local name was canti. The generic name Canthium was derived from this common name.

Canthiums are always woody plants, either shrubby in habit or developing into slender, narrow trees growing to a height of 10 m. The leaves are opposite, with interpetiolar stipules. This is a characteristic feature of the family Rubiaceae to which these plants belong. These stipules are triangular structures having a broad base and are tapered to a narrow point. They lie on either side of the stem and connect the bases of the petioles. They are easily seen in the young growth at the branch tips. Though the stipules are shed (further back on the old wood) their original position is indicated by a ridge-like scar across the stem.



Canthium odoratum

The flowers are white or cream and are often very sweetly perfumed. They are arranged in axillary clusters or in cymes. These are branched inflorescences in which the central flower opens first. Each flower has four sepals, four or five petals, as many stamens as petals and an inferior ovary with two cells. The sepals are united into a tube which is joined to the outer wall of the ovary, and the petals are united into a short or cylindrical tube which ends in four or five free lobes. The stamens alternate with the corolla lobes and are inserted near or at the top of the tube. The fruit is succulent and globular, either compressed or two-lobed. When mature, it is either black or red in colour.

Canthiums are found in many tropical parts of the world. Four species are native to south-eastern Queensland: *Canthium odoratum, C. coprosmoides, C. buxifolium,* and *C. vaccinii-folium.*

Canthium odoratum

The Latin adjective *odoratum* means sweet-smelling or fragrant and refers to the perfumed flowers of this species.

Description

This is an erect tree which grows to 5 m high with smooth, grey, persistent bark and spreading branches. The glossy leaves are ovate, obovate or elliptical-oblong, 6 cm or more long, 2·5 cm or more wide. They are leathery in texture, and have a prominent midrib and widely-spaced pinnate veins.

The white to cream flowers have a strong, sweet perfume. Individual flowers are 1 cm long and they are massed in cymes in the axils of the upper leaves of short lateral branches towards the ends of the main branches.

The calyx tube ends in four obscure points which indicate the tips of the sepals. The cylindrical corolla tube is twice as long as the calyx and the free lobes are longer than the tube and 0·2 cm wide. They spread from the top of the tube like a flat star. The tips of the petals are thickened slightly and curved upwards in a minute, hooked point. This can be seen with magnification.

The stamens alternate with the petals. The anthers are as long as the petals and the thick, white style ends in a large mitre-shaped stigma, which is held well above the flower. The throat of the tube is closed by a ring of fine, white, spreading hairs attached to the inner surface of the tube beneath the point of attachment of the staminal filaments. The fruit is globose, about 0·5 cm in diameter and black when ripe.

Flowering time

This Canthium blooms in late spring or autumn.

Habitat

It grows in mixed softwood scrub, in brigalow patches and in fringing rain-forests.

Distribution

This plant is found from as far south as the Clarence River in northern New South Wales, throughout Queensland and in the Northern Territory.

General remarks

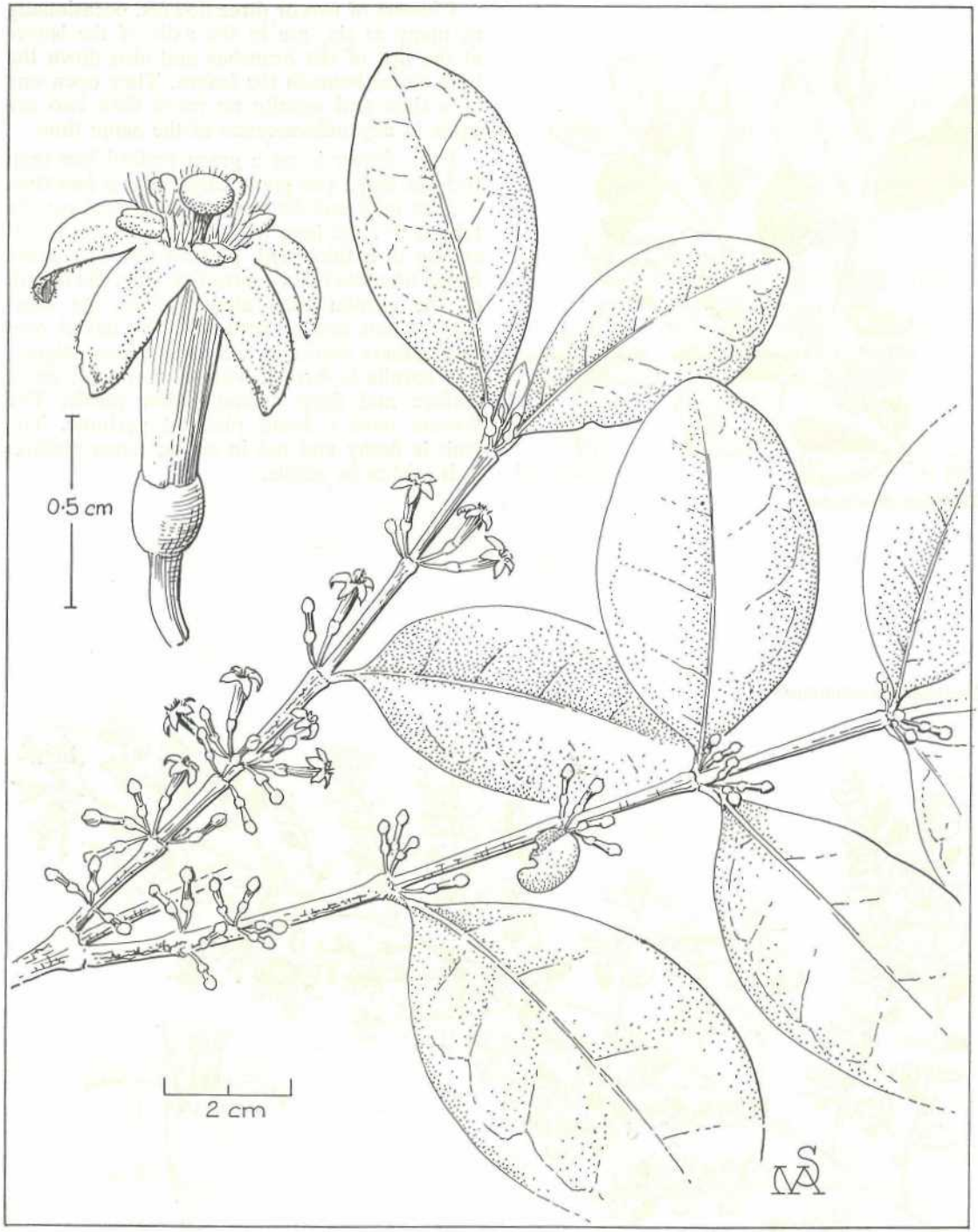
This very attractive plant has not been brought into cultivation. With its masses of perfumed flowers and dark glossy leaves, it would be an asset to any garden.

Canthium coprosmoides

A New Zealand plant, Coprosma is widely cultivated for its glossy foliage. It belong to the same family as Canthium. When this Canthium was discovered, its leaves were apparently thought to resemble those of Coprosma.

Description

This is a slender, erect tree which grows to 6 cm high with a rough, grey, persistent bark. It has ovate to elliptical-oblong leaves, up to 10 cm long but usually about 7 cm long and 3 cm wide. They are firm in texture but not leathery, and are often dull yellowish-green in colour. Some plants have darker green leaves which are slightly shiny on the upper surface and dull pale-green below. The midrib and widely spaced pinnate venation show as lighter green lines.



Canthium coprosmoides

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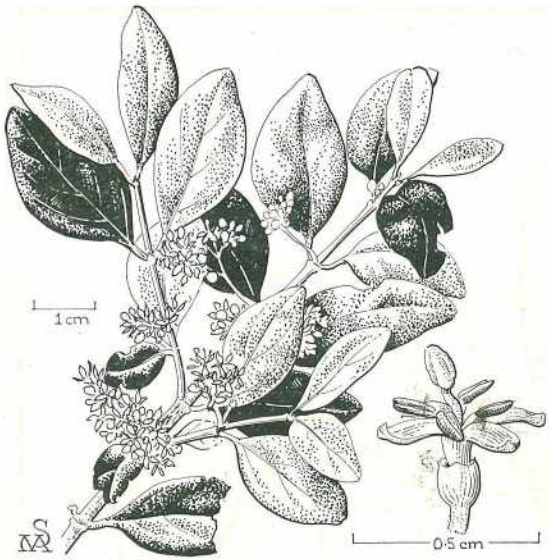
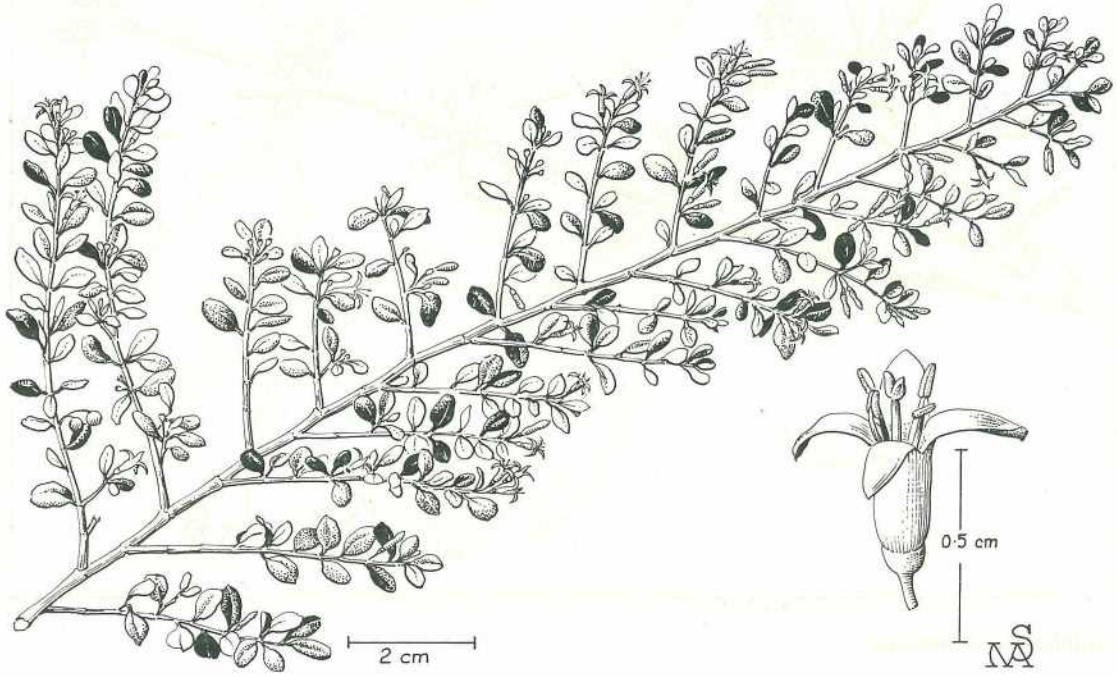


Canthium buxifolium

Clusters of two or three flowers, occasionally as many as six, are in the axils of the leaves at the tips of the branches and also down the bare stems beneath the leaves. They open one at a time and usually no more than two are open in any inflorescence at the same time.

Each flower is on a green pedicel less than 0·5 cm long. The green calyx tube is less than 0·2 cm long and the narrow, cylindrical corolla tube is 0·7 cm long with slightly shorter lobes, ending in a thickened, pointed tip. The dense fringe of white hairs protruding from the mouth of the corolla tube almost hides the erect anthers and can be seen with the naked eye. The anthers surround the thick peltate stigma. The corolla is flushed with green on the outer surface and deep creamy-yellow inside. The flowers have a faint, pleasant perfume. The fruit is fleshy and red in colour when mature. It is said to be edible.

Canthium vaccinifolium



Flowering time

This Canthium blooms from late summer to midautumn.

Habitat

It grows in open forest, on creek banks or near water, and is common on the edge of rain-forest.

Distribution

It is found throughout eastern Queensland to as far south in New South Wales as Port Jackson.

Canthium buxifolium

The common box tree, Buxus, an evergreen shrub widely grown as an ornamental and hedge plant in Europe, has leaves which are dark green and shining on the upper surface. The specific epithet for this Canthium means box-leaved. Obviously, when this plant was described, the similarity between the leaves of these two plants was observed.

Description

This is a slender tree growing to a height of 7 m with its branches spreading or ascending. Its leaves are up to 4 cm long and 2 cm wide. They are ovate in shape and firm in texture with a dark green, shiny upper surface and a dull, much paler lower surface. The only prominent vein is the midrib, seen as a paler green line on the upper surface.

The axillary cyme contains about 20 white flowers, with corolla tubes barely exceeding the calyx tubes. The pointed corolla lobes are between 0·2 and 0·3 cm long and spread from the end of the tube. The short filaments are inserted near the middle of the corolla tube and the white anthers are 0·1 cm long. The white mitre-shaped stigma is held well above the petals by a thick, white style. The flowers have little or no perfume. The fruit is globose, 0·5 cm in diameter and when ripe is shiny black.

Flowering time

This Canthium blooms in summer but does not flower every year.

Habitat

It is common in mixed open forest and on the edges of brigalow scrubs.

Distribution

This plant grows only in Queensland to as far north as Biloela in eastern Queensland, and the Blackdown Tableland, and as far west in the south as Chinchilla.

Canthium vaccinifolium

Blueberries and cranberries are edible fruits of species of Vaccinium, a genus of plants in both Europe and America. These plants have small, shiny, dark green leaves, The specific epithet for this canthium means 'with leaves like Vaccinium'.

Description

This is an erect shrub or slender, small tree to 5 m in height with spreading branches bearing many short, slender, straight stems. The characteristic appearance of this plant is due to the numerous, slender divaricate branches which are more or less in one plane, and also to the leaves, which are obovate to oblong. They are usually about 1 cm or less long, and dark green and shiny on the upper surface. Plants can sometimes be found with practically no leaves and are therefore very spiny in appearance.

Two or three flowers form little axillary cymes which are almost sessile. The pale green calyx tube is less than 0·1 cm long and is cup-shaped. The corolla tube is less than 0·5 cm long and the lobes are about 0·3 cm long. They end in a fine point and magnification shows the thickened tip. The staminal filaments are inserted at the mouth of the tube and hold the anthers above the petals at about the level of the top of the thick, white style. The stigma is ovoid and divided to the base into two thick lobes.

The flowers are perfumed and are white when the bud first opens. The colour changes to creamy-yellow as the flowers age. All the flowers in the cluster can be open at the same time. The fruit is globose, about 0·5 cm in diameter and black when ripe.

Flowering time

This Canthium flowers in late summer.

Habitat

It grows in rain-forest and is very common in mixed softwood scrub and on the edges of brigalow scrubs.

Distribution

It is found only in coastal New South Wales from as far south as the Macleay River and in eastern Queensland to as far north as Mt. Garnet, west of the Atherton Tableland.

Field key to the Canthiums of South-eastern Queensland

1. Leaves from 5 to 15 cm long ..... 2.

   Leaves from less than 2 cm to 4 cm long ..... 3.

2. Leaves always shining and dark green on the upper surface, ovate to oblong-elliptical, up to 15 cm long. Inflorescence with many sweetly perfumed white flowers up to 1 cm long, with mitre-shaped stigmas. Fruit black ..... *Canthium odoratum*

   Leaves usually dull yellowish-green on both surfaces, ovate, obovate or elliptical-oblong, up to 10 cm long. Inflorescence with three to six white to cream flowers up to 1·2 cm long. Stigma thick and peltate. Fruit red ..... *Canthium coprosmoides*

3. Leaves ovate or broadly elliptical, up to 4 cm long. Inflorescence with 15 to 20 white flowers, less than 0·5 cm long. Stigma mitre-shaped. ..... *Canthium buxifolium*

   Leaves obovate to oblong, 0·6 to 1 cm long. Inflorescence with two to three white flowers up to 0·6 cm long. Stigma ovoid, divided to the base into two thick lobes. *Canthium vaccinifolium*

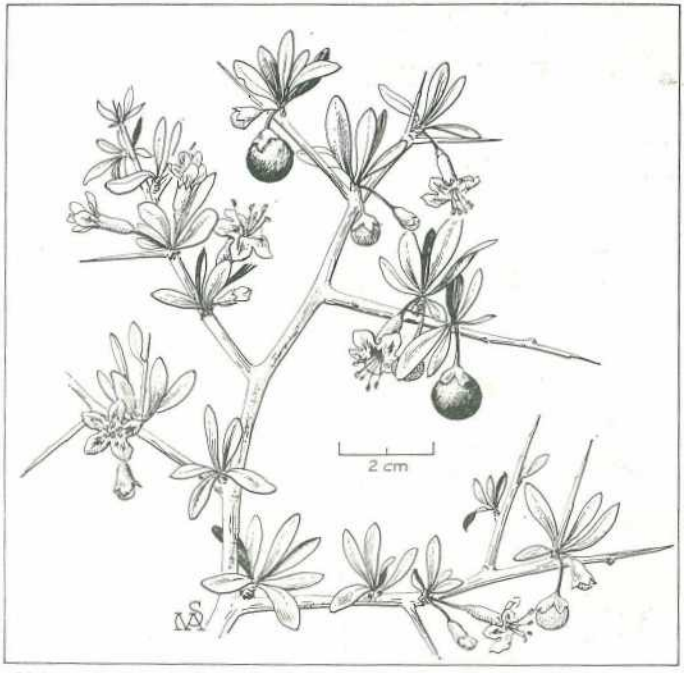
Is African boxthorn a problem?

AFRICAN boxthorn, *Lycium ferocissimum* (Miers), is a perennial shrub that has been a thorn in the side of many Queensland farmers for generations.

A survey on the southern Darling Downs showed that the weed caused significant economic problems on several farms, particularly in the Warwick, Millmerran, Toowoomba, Goondiwindi and Roma districts. The weed is still a problem in the same areas now as it was 50 years ago.

African boxthorn does not appear to be spreading outside the current areas of infestation, but it is regenerating at a rate sufficient to be a continuing problem within these areas. Control measures are expensive and labour intensive. This makes control a difficult task particularly in less accessible areas.

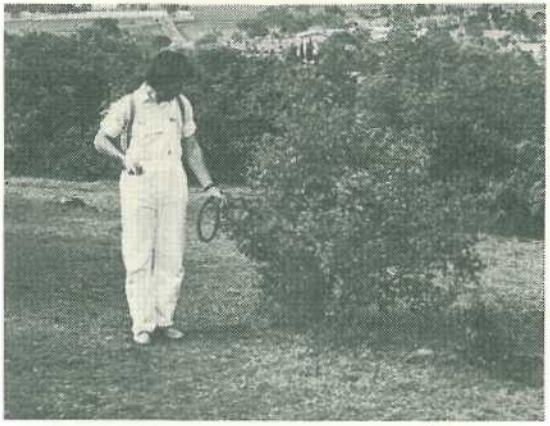
The weed grows mainly in the southern areas of the State and is widely dispersed throughout New South Wales and Victoria. A native of southern Africa, it can grow up to 6 m high and is covered in a mass of long, needle-pointed thorns. These thorns seem to have an attraction to human flesh and vehicle tyres.



African boxthorn (Lycium ferocissimum).

by A. N. Lee, Department of Lands.

Overall spraying African boxthorn.



Basal bark spraying with 2,4,5-T in diesel. All stems for about 30 to 40 cm up from ground level should be sprayed.

The author clearing the hard way with a brush-hook.

Control

Control of dense infestations can be achieved by bulldozing and then spraying the regrowth with a 1 in 50 solution of Tordon 50-D in water. Isolated standing plants are best controlled by a basal bark spray using 2% 2,4,5-T ester in diesel oil. The bark all round the base of the plants, and for a distance of 30 to 40 cm up the stem from ground level should be sprayed. Any grass obscuring the base should firstly be cleared with a brush-hook.

The best time to treat boxthorn is in the autumn when there is a better chance of chemicals being translocated downwards into the roots. It is the roots which must be killed for effective control.

Survey

The Department of Lands' Sir Alan Fletcher Research Station contacted individual landholders and Shire Councils to survey the extent of economic problems caused by African boxthorn. Questionnaires were sent to farmers in the Glengallan, Millmerran, Pittsworth, Rosalie, Rosenthal, Gatton and Inglewood Shires.

Thirty-one shire councils were also surveyed to obtain their views on the magnitude of the African boxthorn problem.

Effect on property values

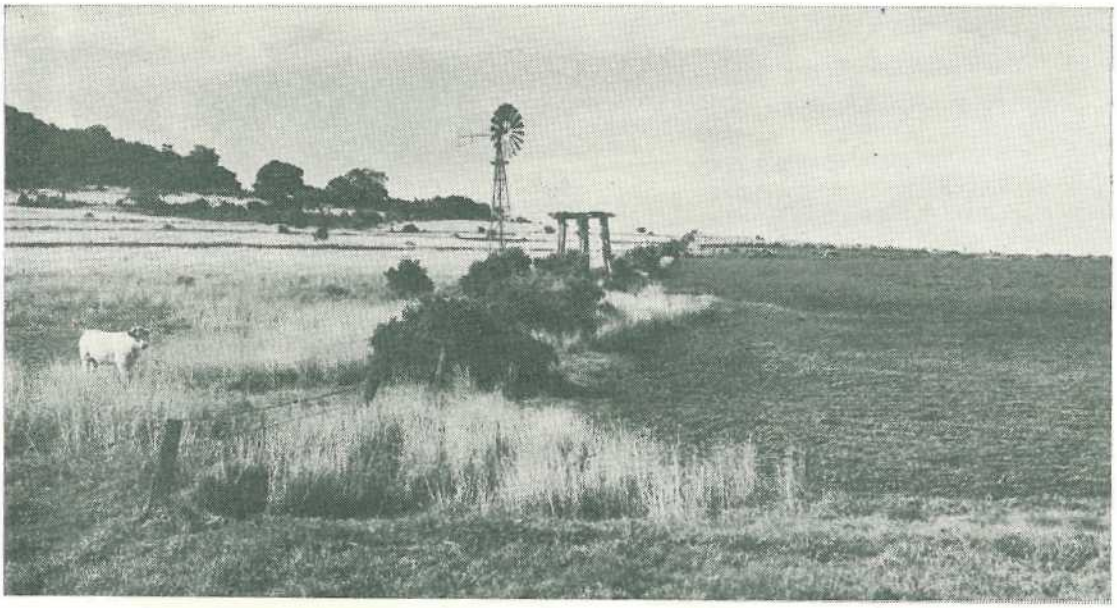
Of the farmers surveyed, 42% said their property's value was reduced because of infestation by African boxthorn.

Most farms recorded a reduction in value of less than $1 000 with many showing no reduction at all. However, 9% of properties estimated their value to be reduced by $15 000 to $20 000, indicating more extensive and dense infestations.

Effect on annual income

The annual income of 29% of surveyed farmers was reported to be decreased by the presence of African boxthorn on their properties.

Most affected properties estimated their reduction in annual income to be only slight (less than $100). However, on five farms, income was reduced from $3 000 to $5 000 annually. The reduced income would most likely be caused by reduced carrying capacity.



Typical fence-line infestation of African boxthorn.

Effect on land use

On 90% of surveyed farms, land usage was not affected by the weed. The survey showed that the infestation on most properties was only fairly light, with plants scattered over an area of less than 10 ha. However, on 10% of farms, the boxthorn was completely stopping use of infested land; on a further 30% it was partially stopping use.

Heavy infestations of boxthorn are impossible for man or beast to penetrate.

Effect on carrying capacity

On 30% of the farms surveyed, infestation by the weed had reduced the carrying capacity of the farm.

While most affected farms had only a slight reduction in carrying capacity (less than five head), about 3% had a reduction of 50 to 100 head, indicating the severity of some infestations.

Area and type of country infested

The area and density of infestations was estimated and is shown in table 1.

African boxthorn is mainly a pest of grazing country, but significant areas exist in country more suited to cultivation. Although the weed would grow on arable land if allowed, it is controlled by cultivation.

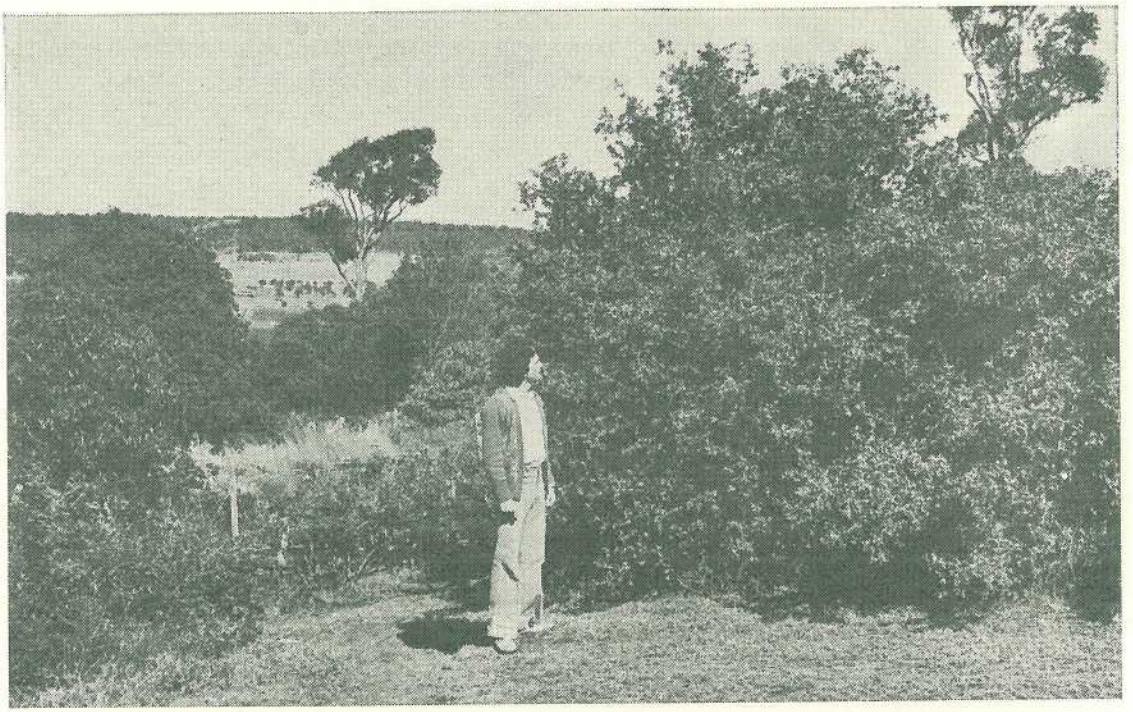
Rate of spread

Of the farmers interviewed, 32% claimed that the weed was spreading at a faster rate now than 5 years ago. Another 45% estimated that the rate of spread had not increased.

Almost all of those estimating that the rate of spread was faster now had a problem with the weed or complained of a badly infested neighbouring property. Overall, it seems that the weed is spreading at a fast enough rate to cause concern in areas fairly close to its present occurrence, but is not spreading very fast outside these areas.

Cost of control

The total expenditure on control of African boxthorn in the area surveyed was $27 400 over the last 3 years. Of this amount, $19 400 had been spent on chemical control (see table 2).



ABOVE. A healthy specimen of African boxthorn about 4 m high.

BELOW. Grass around the base of the plant should be cleared before basal bark treatment.

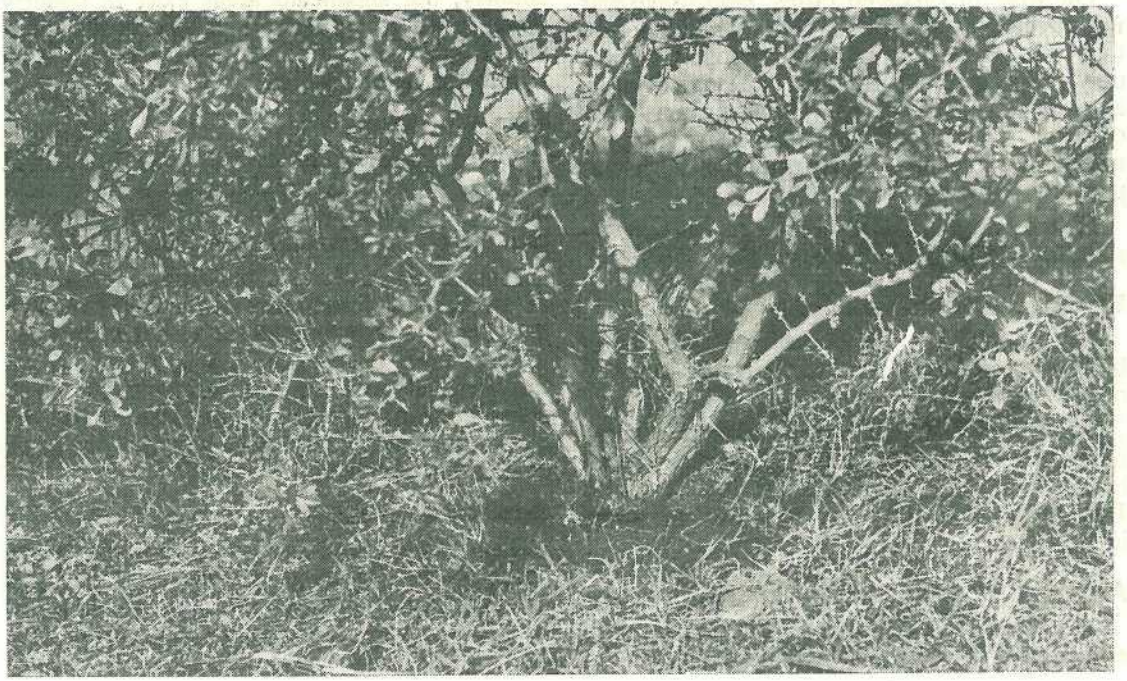


TABLE 1

Class A: Good usable country (grazing or cultivation)	Area (ha)
Dense to impenetrable	1
Abundant but easily penetrated	124
Scattered	682
	807
Class B: Limited use country (grazing only)	
Dense	50
Abundant	414
Scattered	880
	1 344
Class C: Unusable country (stony ridges, deep gullies, etc.)	
Dense	74
Abundant	8
Scattered	74
	156

Manual control would require only relatively small amounts of capital expenditure on materials, though it is labour intensive.

Time spent on control

Time spent on control over the last 3 years of 15 395 hours represents about 55 hours or 1 week's work per farm annually (see table 2).

The wide acceptance of chemical control is clearly shown.

Cost to clear existing weed

It was estimated that about $154 000 would be required to clear existing African boxthorn on the surveyed farms.

TABLE 2

Control Mehod	Cash Expenditure ($)	Labour Used Over Last 3 Years (man-hours)
Manual	1 453	3 766
Mechanical	6 617	2 237
Chemical	19 365	8 176
	27 435	15 395

Seventy-four per cent of farmers estimated their cost to clear would be less than $1 000—indicating only light infestations. However, four farmers estimated that more than $10 000 would be required to clear African boxthorn from their properties.

Change of occurrence with time

The survey of 31 shire councils in south Queensland showed there had been little change in the area of occurrence of the weed over the last 10 years. Shires with the largest infestations were Glengallan, Bungil, Millmerran, Rosalie and Waggamba. There had been little change in the distribution of the weed since 1968 when a similar survey was carried out.

Survey conclusions

The two surveys showed that despite the limited spread and occurrence of the weed, it still causes economic problems in a few isolated areas.

Many farmers said that although the weed did occur on their property, it caused little trouble or interference, particularly if seedlings were eradicated annually. As with all weeds, eradication or control lies with the enthusiasm and resources of the individual farmer.

Art in bark

by D. ZAM,
Art in Bark Association.

THE earliest white settlers in Australia had a difficult task to assimilate with nature in a climate so different to their own.

Living in hand-made slab huts, their homes were constant reminders of blood-blistered hands and breaking backs.

We surmise that it happened somewhere on the Darling Downs of Queensland, approximately 120 years ago—that settlers, dependant only on their personal abilities, first found that pieces of charred bark from the *Melaleuca* trees (tea-trees) could be used to depict landscapes or other scenes.

The rough interiors of the cabins became more attractive with the skilfully framed bark pictures. Neighbours and friends would admire the pictures and produce versions of their own—developing and improving until the style and variety of today had been reached.

Art in bark is indigenous to Australia, and possibly unique as an art medium. It can be shared by the whole family, and leisure hours spent in the country can be enjoyed creating bark pictures from materials gathered in the district. Everyone can learn to make good pictures! You can learn to create bark pictures if you possess intelligence, an open mind, normal eyesight, a lot of sincere interest plus an equal amount of perseverance.

Skill can be acquired and in a reasonable length of time very acceptable work can be produced. Many beginners fall by the wayside because of lack of interest, confidence or perseverance. Before attempting a difficult subject you must master the small and simple ones.

Learn to see the beauty of shape, colour and texture while you are collecting bark. All bark (paper bark, banana trash, thin eucalyptus bark, etc.) should be sprayed with insecticide, pressed between newspaper and stored in polyethylene bags for future use.

The base for bark pictures should be as solid and light as possible. Recommended bases are: solid board (core boards), plywood, masonite or other chipboards.

Glue is water soluble of white colour and clear when dry. Other instruments required are a thin filleting knife for splitting banana trash and bark; a polyethylene bag of sand (minimum 5 kg) for pressing glued bark; a soldering iron (30TS–240V 30W) for soft burning of bark and a rag to take off excess glue before pressing.

Once you know something about the unique colours and textures of bark, and how to use and apply them, an attempt at a simple landscape can be made by drawing the outline in charcoal or soft pencil.

Start with the sky—in one piece or more—and work from the top down. Apply glue and spread evenly on the area covering the sky. The colour of the bark representing the sky should be lightest on the horizon. The bark must be as thin as possible, and the whole area must be spread with glue for good application.

When pressed under a sandbag, an excess of glue will appear on the edges and this must be removed by pressing with a rag. Any folds in the bark are easy to patch up with off-cuts. Loosely tear the thin bark and stick over the holes. Beating of the bark edges with a small hammer, or another hard object, will give you perfect joins.

Remember that objects in the foreground are of stronger colour value than in the far distance. Compare sizes, shapes and values.

Enthusiastic bark artists should share their knowledge with each other. The Bark Association of Australia provides lectures for members once a week in the Further Education Building, Brisbane. For more information, contact Further Education on (07) 224-6846.

Bark provides a protection for plants against the effects of heat and cold, fire and mechanical damage and by a continuing process bark is shed and renewed.

People using bark should be aware that care is needed when collecting material from living plants. The collector should be selective and ensure that irreversible damage is not done.

By adopting an understanding attitude, the bark artist can collect materials without harming Queensland's natural beauty.

Farming on the Darling Downs

by R. G. Wilson, formerly of Agriculture Branch.

THE Darling Downs region is an area of great agricultural diversity. Over 715 000 ha of the State's 2 million ha of cultivated land is farmed in the region.

Over 90% of the region's wealth is produced on the 7 350 rural holdings whose combined area totals 3·5 million ha. The gross value of rural production in 1976 was estimated at $208 million, about 16% of the State's rural production and 25% of rural production excluding sugar-cane, which is not grown in the region.

The Darling Downs region comprises the Shires of Allora, Cambooya, Chinchilla, Clifton, Crows Nest, Glengallan, Inglewood, Jondaryan, Millmerran, Pittsworth, Rosalie, Rosenthal, Stanthorpe and Wambo.

The region covers an area of 40 235 km² and has a population of over 143 000. Major cities and towns are Toowoomba (72 000), Warwick (9 400) and Dalby (9 600).

Table 1 sets out the region's comparative importance to Queensland in terms of major rural activities carried on in the region.

Dick Wilson was a well-known agricultural adviser in southern Queensland. He retired in July this year.

TABLE 1

THE DARLING DOWNS REGION IN RELATION TO QUEENSLAND

Particulars	Unit	Darling Downs Region	Percentage of Queensland
Total area of all crops ..	ha	714 600	34·5
Lucerne and other pasture	ha	12 700	41·0
Number of tractors ..	no.	12 434	16·7
Area fertilized	ha	223 331	31·4
Area irrigated	ha	29 465	15·8
Beef cattle	no.	633 000	6·0
Dairy cattle	no.	112 000	22·3
Pigs	no.	156 000	38·0
Sheep	no.	710 000	5·0
Gross value of rural production	$1 000	208 475	16·3

(Source: Australian Bureau of Statistics 1976)

Early development

The Darling Downs region was discovered and named by Alan Cunningham in 1827. Sheep were the first stock brought in to the Darling Downs by the early settlers in the 1840s. The squatters utilized the lightly wooded, natural grasslands. They were opposed to the use of land for agricultural purposes and restricted further development until Queensland became a State in 1859.

Closer settlement was encouraged from 1860 to 1870, and Acts were passed to subdivide larger pastoral holdings for agricultural use. The Acts, together with an influx of migrants mainly from Germany, initiated the trend to closer settlement which eventually resulted in the movement of the squatters further west.

After 1890, the Queensland Government encouraged dairying and by 1937 there were over 6 500 dairy farms on the Darling Downs. The number of farms has declined since the 1950s and with the amalgamation of smaller properties, grain growing and beef production have increased in importance. Dairying is still an important industry in the basaltic uplands of the eastern Darling Downs.

An important influence on settlement in the western part of the region was the spread of prickly pear which was introduced as an ornamental and a subdivisional plant in the early 1840s. The pear spread out of control and one measure of physical control used in dairying areas close to towns was to subdivide the land to areas that could be managed by one man. The pear was spectacularly vanquished in the 1930s by the introduction of the caterpillar *Cactoblastis cactorum* from Argentina in 1925 and most of these small blocks have since been aggregated into larger holdings.

Threshing the 1916 wheat crop by steam and hand at Wellcamp.

Topography

The region slopes away from the Great Dividing Range to the west and south. Altitudes along the Range vary from 800 m and 1 100 m in the north-east to 1 200 m and 1 370 m in the Granite Belt and border highlands to the south-east.

The Condamine River is the main stream in the region. Its headwaters are in the south-east border highlands with streams feeding in as the river flows north initially and then south-west and out of the State into the vast Darling/Murray River Basin.

The southern border area is drained by the Dumaresq River into the same basin. This river drains the granite and traprock areas south and west of Warwick.

TABLE 2

ALTITUDE OF MAJOR TOWNS ON DARLING DOWNS

Town	Altitude (m)
Toowoomba	586
Dalby	345
Chinchilla	302
Killarney	516
Warwick	453
Inglewood	284
Stanthorpe	810
Crows Nest	543
Millmerran	407
Pittsworth	519

The centrepiece of the region is an extensive open plain enclosed by the Great Dividing Range to the east and north and by the granite tablelands in the south. Apart from the Condamine River, there are no defined physical boundaries to the west.

A prickly pear infestation.

The same area after release of the Cactoblastis *caterpillar.*

Climate

Although the region is in a summer-dominated rainfall zone, both winter and summer crops are grown. Winter planting rains, though light, are usually reliable. These winter crops also rely on soil moisture stored in the summer months, the black soils of the Darling Downs being renowned for their moisture holding capacity.

Annual rainfall is highest along the elevated areas of the Great Dividing Range and Granite Belt. The sharp drop in elevation from Toowoomba west and south is consistent with decreasing rainfall. Compared to Toowoomba with an annual rainfall of 1 000 mm, Westbrook, 10 km west, records 650 mm.

Two-thirds of the rainfall is received during the summer months (October to March). The rainfall has a high degree of variability and storms of high intensity are frequent. Hail often accompanies these storms and damage to crops and property may occur. Tropical cyclones can also influence the rainfall pattern, inducing heavy run-off and flooding of drainage lines and flats.

TABLE 3

AVERAGE ANNUAL RAINFALL

Town	Rainfall (mm)
Toowoomba	1 000
Dalby	644
Chinchilla	691
Killarney	731
Warwick	700
Inglewood	655
Stanthorpe	744
Crows Nest	837
Millmerran	654
Pittsworth	668

TABLE 4

RAINFALL DISTRIBUTION IN RELATION TO WINTER CROPPING

Centre	Fallow Dec./April	Planting May/June	Growing July/Oct.
Dalby	359 mm	74 mm	167 mm
Pittsworth ..	371 mm	80 mm	177 mm
Inglewood ..	332 mm	84 mm	174 mm

Too much rain can create difficulties during land preparation, planting, and at harvest. Late spring rains may delay harvest and can result in 'shot' grain where seed germinates in the head. This lowers the value of the crop and these rains can also cause weed problems at harvest.

Air temperatures range from a July minimum of 3°C to a January maximum of 30°C. Extremes of up to 46°C have been recorded in the region.

Heatwaves during summer can affect summer crop returns, depending on duration, intensity, soil moisture levels and the growth stage of the crop.

On average, there are 265 frost-free days ranging from 180 on the Granite Belt to 267 in the Pittsworth area. Frosts can be both beneficial and disastrous. Fast-growing, leafy winter cereals need growth checks to prevent early flowering whereas a September frost may cause severe damage to these winter cereals. Low soil temperatures can delay summer crop planting.

Average annual humidity at 9 a.m. is around 61% at Dalby, 68% at Stanthorpe and 74% at Toowoomba. Prevailing winds are mainly moist easterlies in the summer and chill, drying westerlies in winter.

Geology, soils, vegetation and land use

The distribution of the major surface geological units is shown in map 1. The following discussion relates to these units. The oldest exposed rocks in the region are the metamorphics (sedimentary beds which have been chemically altered by pressure and temperature through burial)—Texas and Maronghi Creek Beds—(350 million years old) and the granites (250 million years).

Soils derived from the metamorphic rocks are dominantly grey to brown, angular, stony, shallow clay loams overlying clays with shallow, stony soils on the higher areas. Soils derived from granite are moderately deep, grey sands to sandy loams.

The granites and the metamorphics sustain layered open forests of narrow-leaved ironbark, gum topped box, yellow box, rusty gum, New England blackbutt and wattles. The soils are considered inherently infertile. Apart from the areas of granite used for fruit growing around Stanthorpe, the area is used for grazing of native and improved pastures by sheep and cattle.

Uplift of the metamorphics and granites produced large mountain blocks to the north, south and east, and the Darling Downs region became an area of rivers and fresh and salt water lakes. The eroded material from the large mountain blocks was deposited in this environment, during the period 220 to 100 million years ago and compacted to form sedimentary rocks.

Lowering of the sea level relative to the land surface resulted in the emergence of the sedimentary rocks which were subsequently dissected and eroded. During this period, both predominantly coarse-grained and predominantly fine-grained sediments (sandstones etc.,) were deposited.

The Marburg Formation, Woogaroo Sub Group, Evergreen Formation, Tarong Beds and sections of the Kumbarilla Beds are typical of the predominantly coarse-grained sediments. The undulating sandstone landscape gives rise to either:

- Shallow sands, or shallow sands to sandy loams overlying a clay with the vegetation communities dominated by open forests of gum topped box, narrow-leaved ironbark, poplar box *Angophora* species and wattles.

- Deep sands supporting an open forest of cypress pine.

Boron deficiency in papaws

BORON deficiency in horticultural crop plants has become increasingly obvious in many areas of central and southern coastal Queensland in recent years.

This has resulted from heavy summer rainfall and increased use of irrigation, particularly on light, sandy soils and heavily-weathered red soils.

Symptoms

The first noticeable symptom of deficiency in papaws is a slight yellowing of the third, fourth, and fifth visible leaves down from the growing point and downward curling of the tips, with some death of leaf tips and margins. Leaves are brittle in texture and claw-like.

In rapidly-growing plants, the upper part of trunk, leaf stalks and the underside of the main leaf veins show a pink-brown latex type exudate. Corky splits or cankers (up to 20 mm long) later develop on the underside of main leaf veins and leaf stalks close to the blade. Later still, young leaves show a marked reduction in area of the blade, severe marginal distortion, brittle texture and necrotic margins. Some interveinal translucence and water soaking may be evident.

Stem cracks develop where the leaf stalk joins with the growing point. As the cracking becomes very severe, the trunk near the growing point is twisted and distorted and becomes scabby, corky or measle-like in appearance. Young leaves are coated with exudate, very young leaves fail to develop leaf blades, and growth almost ceases. Older leaves persist around the now almost leafless growing point and as they die there is a temporary revival in the growth of young leaves. As the growing point dies, there is usually a re-generation of side shoots from the stem below, but these also die. Deficient plants are dwarfed and may take some months to die.

Root systems are reduced in size, lumpy roots are common and terminal roots often die. A proliferation of side roots occurs from just behind the dead root tips.

Internal examination of deficient plants shows brown staining in the vascular tissue in the stem, leaf traces, leaf stalks and roots. This stain is first evident in the young, developing phloem.

In flowering and fruiting plants, the earliest indication of boron deficiency is flower shedding. This is particularly noticeable on male trees. Resultant fruit set on female trees is poor and leaf-like structures may be present on the flower stalk. If the deficiency is not severe or is slower in development, fruit set occurs on what appears to be a healthy plant. However, as the fruit develop, a secretion of milky (white to pink-brown) latex often occurs on the surface of the fruit in the evenings.

Later, the fruit surface becomes rough and lumpy or bumpy in appearance. This is the bumpy fruit stage recognized as boron deficiency in Queensland and Taiwan. These fruit are unmarketable. Most seeds in affected fruit are either abortive, poorly developed, or absent. Fruit from boron deficient plants often ripen unevenly and have low sugar levels.

Boron levels in leaves and fruit

Bumpy fruit have boron levels in dried tissues of 5 to 10 p.p.m. while healthy fruit have levels of 20 or greater. Corresponding levels of boron in the leaf blades of plants with bumpy fruit range from 5 to 15 p.p.m. The levels of 20 p.p.m. in fruit and possibly higher suggest that fruiting plants have a higher requirement for boron.

by K. R. Chapman, J. D. Glennie, F. A. Aquilizan and B. F. Paxton, Horticulture Branch

Boron deficiency

Boron deficiency in papaws at an early stage. Downward cupping of harsh, brittle, claw-like leaves and marginal necrosis are typical.

Boron deficiency—showing stem cracking, and exudation of latex. Note leaf necrosis and margin reduction and distortion.

Severe boron deficiency on a fruiting plant—showing terminal growth cessation and proliferation of side shoots. Bumpy fruit are present.

Boron deficiency—cessation of growth of the growing point and young leaves. Note severe leaf distortion and cracking of stem.

in papaws

Early stage of boron toxicity. Note the leaves cupping upwards, marginal yellowing and necrosis.

Vascular staining as a result of boron deficiency in papaws.

Severe boron toxicity in the advanced stage showing spectacular interveinal scorching and death of tissue.

Severe bumpy fruit stage caused by boron deficiency present for some months.

In Queensland, leaf blade samples rarely exceed 50 p.p.m. and on most farms the levels are commonly 20 to 30 p.p.m. or lower. Boron toxicity symptoms have been observed at 120 p.p.m. or greater in leaf blades. Adequate levels of boron for papaw plants in Hawaii are defined as 30 to 50 p.p.m. in the third fully expanded leaf blade.

Factors influencing boron deficiency

The development of boron deficiency in papaws is influenced by soil, climate and cultural practices.

- SOILS. Mild boron deficiency is commonly found on coarse sandy soils, sandy loams and highly-weathered red soils with high contents of silica or free alumina, and on calcareous or chalky soils.

The availability of boron is influenced by the pH status of soils. Under acid conditions, it is soluble and may be easily leached or removed by crops. With alkaline conditions, boron is tied up chemically with the associated calcium and is not readily available. Maximum fixation of boron occurs with high aluminium and high calcium soils (over-limed red soils).

Nematodes, poorly drained soils and cold soils may also predispose boron deficiency particularly when air temperatures are conducive to growth.

- CLIMATE. Heavy leaching rainfall removes boron from acid surface soils.

Drought also produces severe boron deficiency by limiting plant uptake. Drought effects are particularly dramatic following heavy leaching rainfall. The worst conditions appear to be those associated with hot, dry winds in spring, and cool, dry winds in autumn. Papaws are restricted in growth and hence boron uptake by soil temperatures below 15°C.

- CULTURAL PRACTICES. Cultural practices which induce boron deficiency are over-irrigation, excessive liming, excess applications of potash and nitrate fertilizers, low levels of phosphorus in the plant, prolonged cropping without fertilizing, and physical and biological root damage.

These problems can be avoided or overcome by sound management. Deficiency is less common where organic manures are used regularly and in plantations with less vigorous plants.

Control

In addition to observing the measures discussed under cultural practices, boron deficiency in papaws is readily corrected by: (1) A basal dressing plus an annual sidedressing or (2) A basal dressing plus boron sprays.

- BASAL DRESSINGS of fertilizer with boron added, applied before planting, for example, a 5:7:4 mix with boron added or other basal fertilizers plus 20 grams of Borax (R) (11.3% boron) per plant site (square metre) on sandy soils or 10 grams of Borax (R) on heavier soils.

- A SIDE DRESSING in January on established plants 9 to 10 months old, of 10 grams of Borax (R) per plant site.

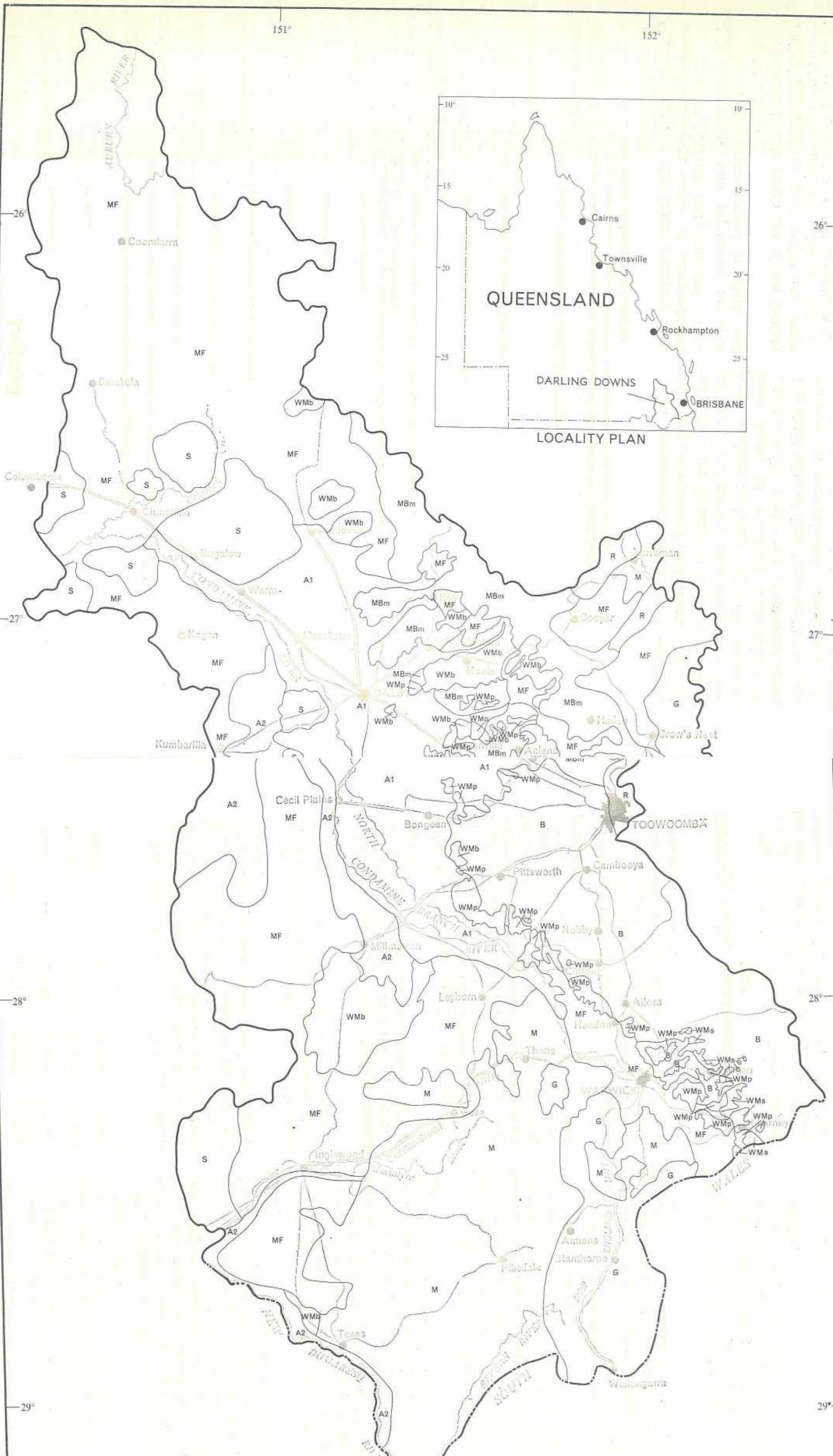
- BORON SPRAYS TO RUN-OFF APPLIED FROM THE FIRST SPRING ONWARDS AS REQUIRED. Soluble polyborate (Solubor (R), 20.5% boron) can be applied at rates up to 300 grams per 100 litres of water or Borax (R) at up to 500 grams per 100 litres. In central Queensland, rates should not exceed 150 grams Solubor (R) or 250 grams Borax (R) per 100 litres of water. A wetting agent should be used and Borax (R) should be dissolved in hot water, before adding to the spray tank.

Applications at 4 week intervals may be necessary from the first spring. If leaf burn occurs, spray rates should be reduced. If toxicity symptoms show, then sprays should be discontinued for at least 6 weeks. Sprays give a quicker response and are safer to use and are more effective than side dressings during the colder months.

Solubor (R) and Borax (R) may be mixed with standard 1% urea sprays and standard wettable sulphur sprays or both, without damage, if the hot part of the day is avoided when applying these materials.

Boron toxicity

The first symptoms of boron toxicity in papaws are characterized by a yellowing of the leaf tip and margins of older leaves and upward curling of the leaf margins. The marginal yellowing and death spreads inwards from the margins between the veins towards the midribs. Such leaves eventually die and shed prematurely. Finally, the whole plant dies.


QUEENSLAND
Cairns
Townsville
Rockhampton
DARLING DOWNS
BRISBANE
LOCALITY PLAN
151°
152°
26°
27°
28°
29°
AUBURN RIVER
Coondarra
Barakula
Columboola
Chinchilla
Brigalow
Warra
Kogan
Macalister
DALBY
Kumbarilla
Cooyar
Haden
Crow's Nest
Acland
Cecil Plains
Bongeen
TOOWOOMBA
NORTH BRANCH CONDAMINE RIVER
Pittsworth
Cambooya
Nobby
Millmerran
Clifton
Leyburn
Allora
Hendon
Thane
WARWICK
Inglewood
Texas
Amiens
Stanthorpe
Pikedale
Wallangarra
NEW SOUTH WALES
DUMARESQ RIVER
MF
S
WMb
MBm
A1
A2
R
M
G
B
WMp
WMs

Map I—Darling Downs
Land resource areas
Legend

M	Metamorphics
G	Granites
MF	Predominantly coarse-grained sediments (eg., Marburg Formation)

WM PREDOMINANTLY FINE-GRAINED SEDIMENTS (eg., WALLOON COAL MEASURES)

WMp*	Supporting poplar box woodland
WMb*	Supporting brigalow belah open forest
WMs*	Supporting softwood scrub open forest
B	Basalts
R	Lateritized basalts
S	Clay sheet—brigalow

MB** MIXED BASALTS AND PREDOMINANTLY FINE-GRAINED SEDIMENTS (eg., WALLOON COAL MEASURES)

MBm	Supporting mountain coolibah (includes areas of B, WM, and MF.)

A ALLUVIUM

A1	Clay alluvia derived mainly from basalts
A2	Mixed fine and coarse alluvia material.

*Includes areas of mixed basalts and Walloon Coal Measures

** The poplar box, brigalow belah, and softwood scrub mixed basalts and Walloon Coal Measures land resource areas are not shown. They occur within and adjacent to those areas mapped as Walloon Coal Measures.

- Sandy loams to clay loams overlying clays with an open forest of narrow-leaved ironbark, bull oak, rusty gum and wattles.
- Shallow, stony soils supporting an open forest of narrow-leaved ironbark and rusty gum.

The soils in this group are of low fertility and will respond to most major and minor nutrients. Low moisture storage capacity together with unreliable rainfall generally makes cropping uneconomical on most of these soils. The soils are generally used for grazing of native pasture or for State forest.

The predominantly fine-grained sediments (including the Walloon Coal Measures and small sections of the Kumbarilla Beds) give rise to dark-grey and brown, moderately deep, uniform, medium to heavy clay soils supporting open forest to woodland communities of brigalow-belah, poplar box or softwood scrub. The distribution of these three vegetation communities on predominantly fine-grained sediments is shown in map 1. Because of the high fertility status and moderate moisture storage capacity, the soils are important for cropping.

Approximately 100 million years ago, considerable volcanic activity occurred mainly in the vicinity of the present Great Dividing Range. Volcanic rocks—chiefly basalt—were poured from deep in the earth over parts of the landscape. Subsequently, much of the basalt was eroded away. This re-exposed some of the sedimentary rocks and left basalt remnants including the Great Dividing Range, the Cooyar and Blackbutt Ranges and the basaltic uplands.

Shallow to moderately deep, black and brown, uniform-textured, medium to heavy clay soils have developed from the basaltic rocks. The landscape is hilly to undulating. Vegetation communities developed on the basaltic soils vary from layered open forests to closed forests of 'scrub species' to grassy open woodland of mountain coolibah with some areas of woodland of silver-leaved ironbark and narrow-leaved ironbark. The soils are highly fertile and have a high moisture storage capacity. They are used extensively for cropping.

The basalts in the vicinity of Toowoomba and on the Cooyar and Blackbutt Ranges were lateritized (chemically altered) approximately 13 to 25 million years ago. Red clay soils have developed on the lateritized basaltic materials. The predominant vegetation community is a layered open forest of Sydney blue gum, tallow wood, white stringy bark and red bloodwood with an understorey of wattles and black she oak. The soils are moderately deep, of moderate fertility and will respond to phosphorus fertilizer.

To the north of Toowoomba is an area of soils derived from mixed basalt and predominantly fine-grained sediments (MBm). The soils are similar to those of basalt origin but with sandstone influence and support an open forest of mountain coolibah. Included in this mapping unit are soils derived from basalt (shallow, finely-structured soil supporting scrub vegetation), predominantly coarse-grained sediments and predominantly fine-grained sediments.

Erosion of the sedimentary rocks and basalts (particularly in the last 1 million years) has led to the accumulation of the following deposits:

- **S.** Extensive clay sheets supporting an open forest of brigalow and belah on grey and brown, moderately deep, uniform-textured, medium to heavy clay soils. It is believed that this clay sheet was laid down as vast plains under lake conditions, from sediments derived from sedimentary rocks. The area still retains the original plain appearance except where dissected by rivers and creeks. Soil fertility and moisture is similar to the predominantly fine-grained sediments. The soils are used for both cropping and grazing of native and improved pastures.

- **A1.** The fine-textured alluvial deposits derived mainly from basalt, with some sandstone contribution, along the flood plain of the Condamine River and its tributaries. These alluvial plains are extensive on the eastern bank of the Condamine River. Soils developed on the basaltic alluvium are predominantly dark-grey to black, uniform-textured, heavy clays. In its natural state, grassland of Queensland blue grass or an open woodland of poplar box covered this vast plain. Soil fertility and moisture storage is similar to those soils formed on basalt. These are the most important cropping soils in the region.

- **A2.** The flat to gently undulating plains derived predominantly from erosion of the coarser-grained sedimentary rocks. The soils consist of loams to clay loams overlying a clay and support an open forest to woodland of narrow-leaved ironbark, bull oak and poplar box. Fertility problems are similar to those of the predominantly coarse-grained sedimentary rocks.

Farming systems

Farming systems in the region vary according to farm size, topography, soil type and fertility, climate and availability of irrigation water as well as markets. Table 5 shows agricultural establishments in the Darling Downs region classified according to their predominant activity.

On the central black soil plains area of the region, wheat, barley and grain sorghum is the major dryland cropping combination used. Cotton, soybeans and sunflowers are combined where irrigation is available along the Condamine River.

The major systems on the basaltic uplands are dairying and cropping, beef cattle and cropping, or a combination of all three. Crops include fodder crops and small areas of cereals.

Also in the basaltic uplands can be found specialist farming systems which include pig raising, poultry raising (mainly for egg production) and horse breeding. Near Toowoomba, land use becomes complex with the influence of the city and may include areas of hobby farmers and intensive cultivation such as market gardeners and nurseries.

Double cropping is not a general feature of cultivation systems in the region because of the need to build adequate soil moisture and nitrogen levels for the following crop. Crop rotation, however, is practised widely and crops involved vary from farm to farm.

Rural land use in the Stanthorpe, Rosenthal and Inglewood Shires is completely different from that of the central plain and the basaltic uplands. The major industries are horticulture, wool growing and beef production. Rosenthal Shire includes an area similar to the central plain where beef raising, dairying and cropping are carried out. Smaller areas of intensive, irrigated cultivation are located on the alluvial plains of the Dumaresq River and Macintyre Brook where the main systems are tobacco growing and lucerne for hay production.

Beef production is the major industry in the poorer sandstone—solodic country to the west of the Condamine River and in the northern part of Chinchilla Shire. Any cropping as part of the farming system is dependant on the limited areas of suitable soils. Pig and poultry raising are also important specialist activities, especially in the Chinchilla and Millmerran Shires.

State forests and timber reserves in the region cover over 580 000 ha. Apart from timber products, most State forests are leased for beef cattle grazing and the mixed hardwood areas within the State forest complex are highly prized and sought for honey production. Trees also provide a habitat for crop-pollinating bees.

Irrigation and water supplies

Irrigation from ground water supply has been extensively established in the central Downs where sand and gravel alluvium generally underlie the clay surface soils. Observation of ground water levels by the Irrigation and Water Supply Commission has led to the conclusion that this ground water storage of about 2 million m*l* was being used up by irrigators, there being very limited natural recharge.

Control by licensing was imposed in 1970 by refusing any further irrigation bore licences in the central Downs and by stating an annual allocation for each existing bore. Control by failure of supply is a possibility within the next decade, despite continued research and effort by the Commission to find practical aquifer recharge methods.

It appears that conjunctive use of ground water and surface supply (operating bores only in years when surface supply is not available) will be the long term method to maintain existing irrigation development of about 25 000 ha. In the meantime, irrigators are being encouraged to construct ring tank surface storage on their properties to water-harvest local run-off and lessen the demand on ground water.

There is no prospect for expansion of the irrigated area supplied from the Condamine River. Water yield from this River would be satisfactory in a series of good rainfall years but stream flow records show a very low yield in a series of drought years. River storage sites available are shallow and therefore not capable of storing water for use over several dry years. Downstream riparian rights, which are substantial, lessen considerably the proportion of flows available for storage in such years.

Water quality in the alluvium is generally good near the Condamine River but is poor at the alluvium edge near the ground waters of the sandstone rock base. This effect is more pronounced at the downstream end so that from Cecil Plains to Dalby and beyond quality is doubtful to unsatisfactory for irrigation.

Irrigation supplies occur in the alluvium of tributary creeks and in the basalt areas. The basalt aquifers vary greatly and require pump testing over a long period to determine reliable supply. Both in creek alluvium and in basalt, supply is limited and a careful system of allocation in these areas is also being introduced under licence.

Existing surface water supplies of some 12 000 and 15 000 m*l* from both the Leslie Dam and Coolamunda Dam have been allocated. The Glen Lyon Dam supply is shared with New South Wales under the Dumaresq-Barwon Border Rivers Agreement. The Queensland share is 45 000 m*l*.

TABLE 5

AGRICULTURAL ESTABLISHMENTS CLASSIFIED BY PREDOMINANT ACTIVITY, DARLING DOWNS REGION: 1975–76

Activity	Allora	Cambooya	Chinchilla	Clifton	Crows Nest	Glengallan	Inglewood	Jondaryan	Millmerran	Pittsworth	Rosalie	Rosenthal	Stanthorpe	Wambo	Darling Downs
Cereal grain	109	101	220	226	9	175	27	339	233	241	177	16	1	674	2 548
Sheep—cereal grain ..	2	1	10	7	..	1	16	3	15	2	1	4	..	6	68
Meat cattle—cereal grain	27	14	72	35	24	74	35	22	34	18	67	23	..	78	523
Sheep—meat cattle ..	..	..	17	..	1	3	30	2	8	..	..	32	16	3	112
Sheep	..	..	18	2	..	4	69	2	10	..	..	13	40	2	160
Meat cattle	20	22	125	12	137	83	31	21	29	8	96	47	22	70	723
Milk cattle	45	104	27	35	165	114	3	152	4	72	274	25	3	56	1 079
Pigs	12	22	22	11	35	20	12	16	13	10	50	13	4	44	363
Poultry	1	16	..	1	11	4	..	10	4	7	4	..	..	1	59
Fruit and grapes ..	..	..	3	..	..	1	2	..	..	..	..	20	497	4	527
Vegetables	1	16	4	4	2	13	3	2	1	..	1	7	68	1	123
Multi-purpose and other n.e.i.	6	32	13	24	14	36	37	16	8	8	15	17	15	12	253
Total establishments ..	223	328	531	357	398	528	265	585	359	366	685	217	666	951	6 459

Source: Australian Bureau of Statistics

The rolling topography of the upland areas of the Downs offers potential for gully dam irrigation storage.

However, as yield from catchments varies greatly during drought years and wet years, this type of water harvesting is more appropriate to fodder crop and opportunity cash crop production. Reticulation from storage needs careful study to avoid expensive spray irrigation equipment being idle too frequently.

Generally, water supply for irrigation on the Downs is limited and subject to high evoporation losses in drought years. The basic aim of irrigation must be conversion of stored water to grain or hay before natural water loss severely limits useful water yield.

Irrigation of crops

The major irrigated crop areas in the region are located along the upper reaches—Cecil Plains to Yandilla—of the Condamine River Basin, the Macintyre Brook and the Dumaresq River.

Irrigation involves nearly 6% of the cultivated area of the region or about 18% of the irrigated area of the State. Of the 29 465 ha irrigated on 1 032 holdings in 1975/76, the individual areas of crop watered were 19 665 ha of cereals for all purposes, 407 ha of cotton, 821 ha fruit, 831 ha vegetables and 253 ha of tobacco. Pasture irrigated was lucerne 3 113 ha and other pasture 1 734 ha. In addition, 2 640 ha of other crops were irrigated. These include sunflowers, soybeans, navybeans and mung beans. In the slightly drier 1974/75 period, a total of 35 871 ha was irrigated.

With the trend to row cropping in the Condamine River basin, the development of cotton under furrow irrigation was followed by irrigated grain and vegetable crops such as canning tomatoes.

Fertilizer is used widely on irrigated crops. Nitrogen fertilizer in the form of anhydrous ammonia is in common use at from 30 to 130 kg N per ha according to the previous cropping history and crop grown. On some of the plains soils such as Mywybilla and Cecilvale soil types, phosphorus is required at from 10 to 22 kg P to ha. Zinc applications are also in wide use—particularly where linseed is grown on longer fallows. A double crop situation is more suitable for this crop.

The number of irrigations varies according to seasonal conditions and the crop. Prewatering is more frequent with winter cereals than with summer crops.

Underground irrigation bore capacities in the Condamine River Basin range from 23 m^3 per hr. to 227 m^3 per hr. and an average pumping rate of 144 m^3 per hr. Bore depths are from 30 to 60 m with water levels of from 12 to 24 m below ground level.

Crop rotations are practised but there are no set patterns followed—the rotation being governed by markets and, to some extent, the residual effects of some chemicals used in weed control of the previous crop or crops planted.

Irrigated cropping along the Condamine River is valued at over $14 million annually.

Irrigated agriculture in the Inglewood Shire was, until the late 1960s, almost confined to tobacco and lucerne production and it is only since then that any diversification has been achieved.

In monetary value, tobacco is still the most important crop under irrigation in the Inglewood Shire. The district quota of tobacco leaf is currently 480 000 kg and based on the 1976 district average price of 326 cents per kg, the crop is worth approximately $1.6 million.

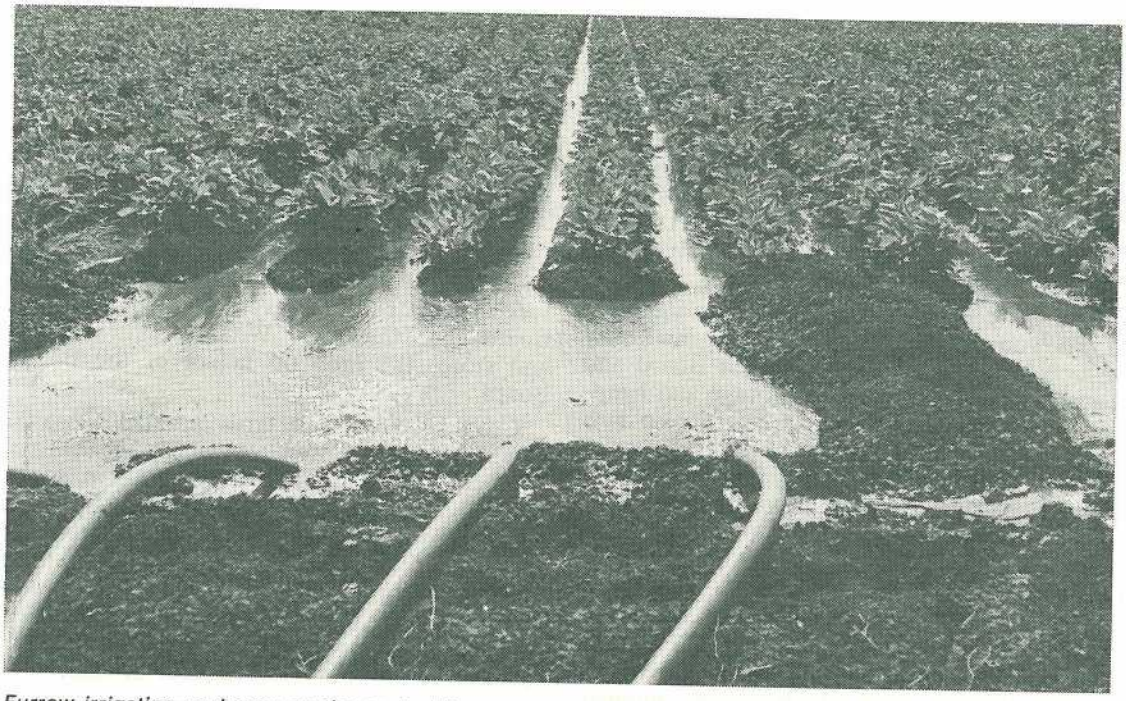
Of the 300 ha sown annually to tobacco, approximately 68% is under spray irrigation and the remainder flood irrigated. Because of labour shortages, there is a trend to become more mechanized. Part of this programme is the establishment of solid set irrigation systems.

Diversification into horticultural crops has resulted from the establishment of additional water storage dams and the high price of these products.

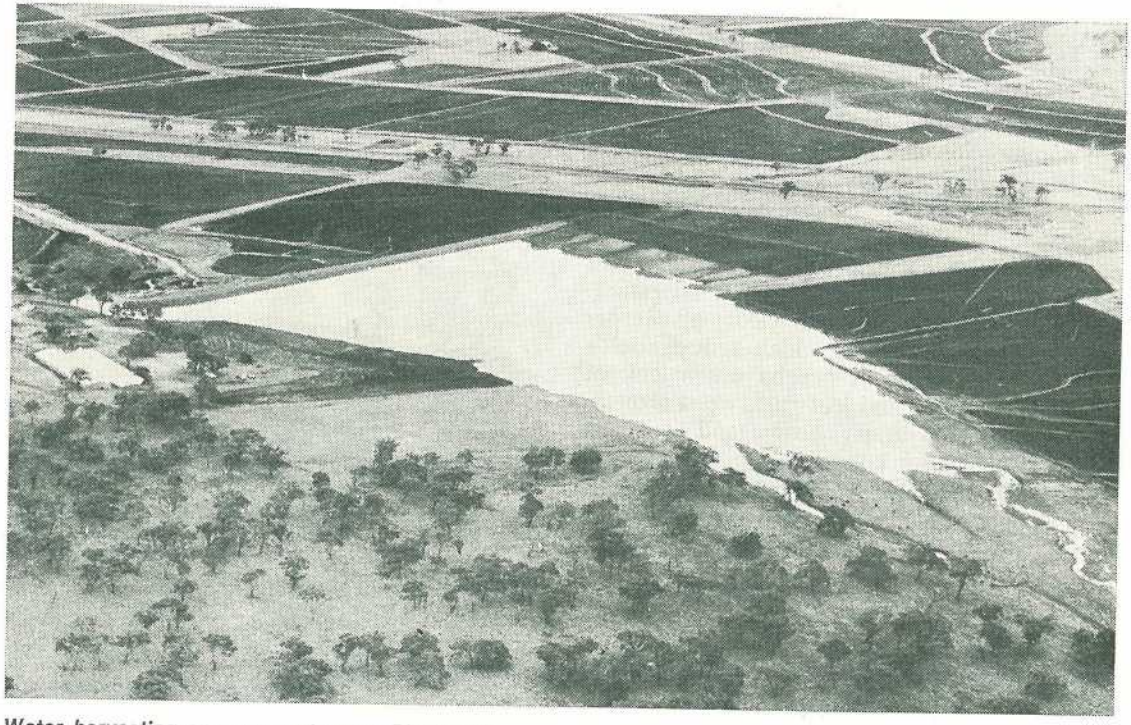
Agricultural crops

To 1976, the region had 715 000 ha under crop with winter cropping predominant. This area represented 34% of the total area of crops planted in Queensland.

Of the State total, the region produces 42% of the wheat, 83% of the barley, 48% of grain sorghum, 32% of maize, 90% of millet and panicum, 33% and 22% respectively of the sunflower and soybean crop. In addition, the region produces 4% of Queensland's tobacco, 3% of its peanuts and 5% of its cotton.



Furrow irrigating soybeans on the central Downs.



Water harvesting on a property near Pittsworth.

Wheat

Wheat is the major winter grain crop in the region. Over the 1971 to 76 period, the average area grown was 177 563 ha (range: 128 000 to 211 000 ha). The average yield was 1.6 t per ha. Downs wheat has a protein content of 10 to 16%. The average of 12% could be increased by using nitrogen fertilizers. The highest grain protein comes from the brigalow soils.

The State Wheat Board, with headquarters in Toowoomba, acts as a handling authority on behalf of the Australian Wheat Board and is responsible for the intake, storage and handling of the wheat crop. The Board also acts on behalf of other marketing authorities, receiving and storing barley, grain sorghum and oilseed crops such as sunflowers and soybeans. The Board selects, grades and distributes seed wheat and also operates a compulsory hail insurance scheme.

Wheat is normally sown from late May to July and harvested in November. The time of planting varies according to the arrival of suitable planting rains which, in this summer dominant rainfall environment, may vary considerably from year to year.

Each year, the Department of Primary Industries runs a number of wheat varietal trials to assess the potential of new varieties and check new wheats. Comparisons are made with commercial varieties in field performance and grain baking quality. Established varieties are constantly monitored for rust and other diseases.

Some of the current wheat varieties have yielded up to 6.6 t per ha under irrigation. Average commercial dryland yields of 4 t per ha are common. Factors which reduce yields to the average of 1.6 t per ha are a lack of soil moisture, stem and leaf rust, weed growth, hail damage, cold injury, crown and root rots and wet harvesting conditions.

The region produces all hard wheat with the exception of two or three growers who contract privately to grow soft biscuit wheats.

Barley

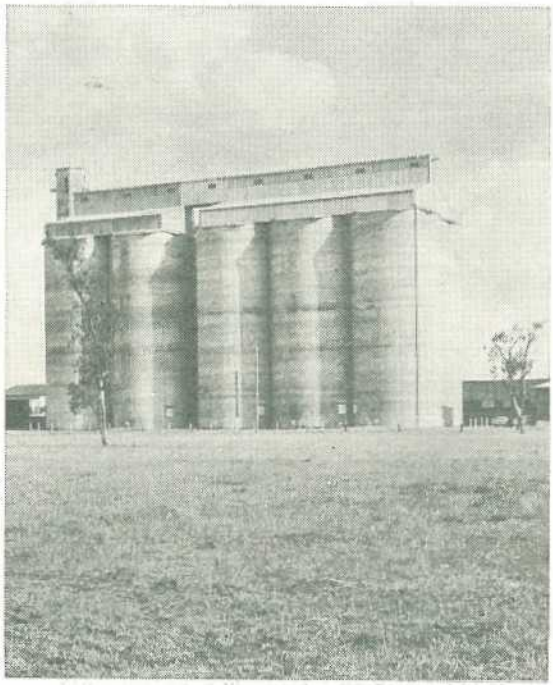
Barley is the second winter crop of the region. The average area grown for the 1971 to 76 period was 121 990 ha (range: 62 000 to 184 000 ha). The average yield was 1.64 t per ha. Clipper is the only variety accepted for malting purposes.

Ideally, barely should be sown in late May. The harvest is normally complete before the wheat crop is ripe and this assists in crop handling by the State Wheat Board.

Commercial yields of 4.5 t per ha are common, but the farm yields range from 2 to 2.5 t per ha under dryland conditions and 3.5 to 4 t per ha under irrigation.

The Barley Marketing Board is an independent statutory authority and provides an industry service similar to that given by the State Wheat Board, but the State Wheat Board handles and stores the crop on behalf of the Barley Board.

Crop production hazards parallel those of wheat. Under a new classification scheme, Clipper, with an upper limit of 1.9% nitrogen will be accepted as malting grade. Clipper is the only variety which will be accepted for manufacturing classification, with no upper limit on nitrogen level. All other varieties are now classed as feed grain. Though untroubled by rust, the crop is subject in most years to the less severe powdery mildew disease.



Grain silos on the Darling Downs.

TABLE 6

MAJOR AGRICULTURAL CROPS, DARLING DOWNS REGION

Crop		Unit	1971–72	1972–73	1973–74	1974–75	1975–76
Wheat	area	ha	210 632	175 691	126 740	182 895	191 858
	production	tonnes	361 985	188 360	189 346	344 293	351 847
	yield	t/ha	1·72	1·07	1·49	1·88	1·83
Barley	area	ha	130 647	61 779	105 339	128 078	184 105
	production	tonnes	212 287	64 258	176 392	254 166	348 472
	yield	t/ha	1·62	1·04	1·67	1·98	1·89
Sorghum	area	ha	143 058	145 336	153 820	146 031	119 879
	production	tonnes	416 140	366 119	433 695	393 778	353 220
	yield	t/ha	2·91	2·52	2·82	2·70	2·95
Sunflower	area	ha	22 392	39 712	29 171	22 777	19 432
	production	tonnes	13 307	30 457	19 509	17 800	12 851
	yield	t/ha	0·59	0·77	0·67	0·78	0·66
Millets	area	ha	16 733	20 834	31 567	17 643	22 677
	production	tonnes	15 210	24 253	28 568	18 501	22 457
	yield	t/ha	0·91	1·16	0·90	1·05	0·99
Maize	area	ha	20 232	15 852	10 225	9 495	9 000
	production	tonnes	39 765	31 049	21 954	25 367	24 698
	yield	t/ha	1·97	1·96	2·15	2·67	2·74
Linseed	area	ha	1 652	2 474	1 461	7 905	919
	production	tonnes	1 166	1 652	1 234	10 236	942
	yield	t/ha	0·71	0·67	0·84	1·29	1·03
Canary seed	area	ha	4 231	4 450	7 512	5 266	14 820
	production	tonnes	3 211	2 574	5 217	5 049	14 014
	yield	t/ha	0·76	0·58	0·69	0·96	0·95
Oats for seed	area	ha	10 753	6 025	11 113	14 542	7 315
	production	tonnes	10 703	5 279	8 579	17 933	8 582
	yield	t/ha	1·00	0·88	0·77	1·23	1·17
Soybeans	area	ha	7 688	11 146	14 143	8 148	4 308
	production	tonnes	9 688	13 985	20 736	13 914	7 164
	yield	t/ha	1·26	1·25	1·47	1·71	1·66

The Department of Primary Industries researches varietal and nutritional requirements of barley. The breeding programme being carried out at the Hermitage Research Station near Warwick could result in the release of new varieties to meet the specific demands of the export as well as the local market.

Oats

The region produces about 80% of the State's annual grazing oat seed requirements. The 1971 to 76 average seed area was 9 950 ha (range: 6 000 to 14 500 ha) with an average yield of 1 t per ha. The hot finishing weather prevents the production of high quality oats seed, but as certain varieties in demand are specific to Queensland, a steady market exists for limited quantities of this material. Currently, this includes such varieties as Minhafer, Saia, Bentland, Garry and Camellia. Other oat varieties, such as Algerian are mainly imported from southern States at a lower price than locally-produced seed.

A pure oat scheme is operated by the Oat Seed Certification Committee. The Department of Primary Industries has released to the Seed Industry Association pure seed lines of Saia, Stout, Bentland, Minhafer, Garry, Algerian and Camellia oats which are being grown by selected growers.

A wheat crop approaching harvest on the Downs.

Canary seed

Canary seed is a winter crop of fluctuating popularity depending on market price. There are no problems with the storage of canary and it is common practice for farmers to store the grain for a couple of years until the price becomes attractive.

The region grows almost all the Queensland and Australian crop. In the 1971 to 76 period, the average area grown was 7 256 ha (range: 4 000 to 15 000 ha) with a yield average of 0·8 t per ha. As the grain is used only in the bird seed trade, Australian demand is directly tied to the fluctuations in production of more favourably situated countries to the birdseed market such as Morocco and Argentina.

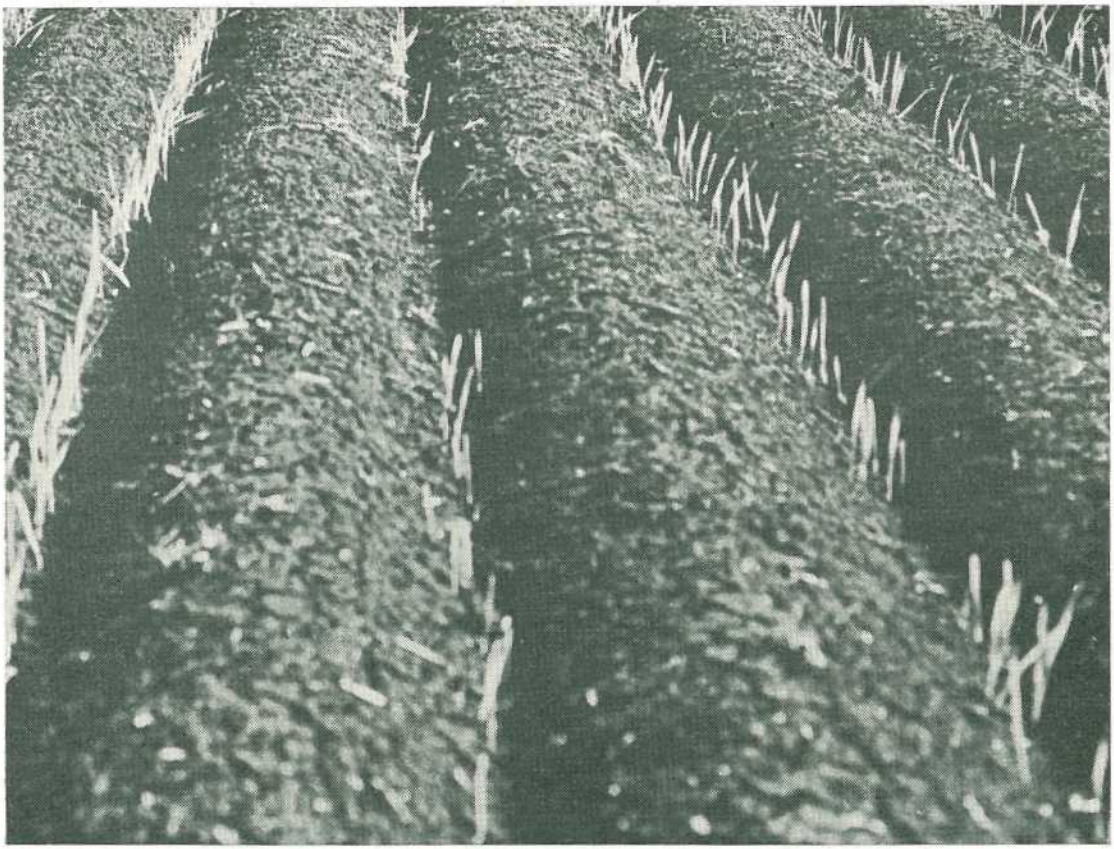
The crop is well suited to the Darling Downs but it gives its best production in a wet winter or when irrigated. Irrigated crops will yield on average about 2 t per ha but with dryland crops, yields of 1 t per ha are most common. As dehulled seed is not acceptable to the bird seed trade, care must be exercised in harvesting this crop.

Linseed

The popularity of linseed has declined due to the competition of other vegetable oils but interest in the seed oil has recently been revived. The average area grown from 1971 to 76 was 2 882 ha (range: 900 to 8 000 ha) and the average yield was 0·9 t per ha.

Linseed performs best on the lighter, loamier soils. For optimum growth and yield on the heavier and more alkaline soils, zinc foliage sprays are recommended within 3 weeks after emergence. Dryland yields are in the vicinity of 1 t per ha while irrigated yields are up to 2·5 t per ha.

The crop is most susceptible to insect damage from *Heliothis* in the flowering period. Also snap frosts around flowering can cause heavy grain losses and growers on the open Downs have little alternative but to delay plantings until the end of May.



Press wheels aid establishment. Press wheel planted barley in 35 cm rows 18 days after emergence.

Grain sorghum

Grain sorghum is the leading summer crop in the region. Good export markets and summer seasons have resulted in greatly increased areas of grain sorghum being planted in the last 5 years. On average, the region produces 45% of the Queensland crop. The average area grown in the 1971 to 1976 period was 141 625 ha—(range: 120 000 to 154 000 ha).

Dryland yields range from 2·5 to 3 t per ha while irrigated crops regularly yield up to 7 to 8 t per ha.

Despite its hardiness and drought tolerance, grain sorghum still needs adequate moisture at critical growth periods for high yields. Lack of moisture at the head forming stage and flowering results in severe yield losses while a late moisture stress results in the plants being prone to lodging should harvest be delayed. Best yields usually follow October plantings and these crops usually miss midge infestations. Late crops have to be sprayed to control sorghum midge.

The State Wheat Board handles the grain sorghum intake and storage on behalf of the Queensland Grain Growers Association (Q.G.G.A.) which has been able to take advantage of the export markets for grain sorghum. Grain sorghum not contracted through the Q.G.G.A. is normally sold on the open market. There is no marketing board for this crop in southern Queensland. Seed is supplied by private companies who offer growers a large number of grain sorghum hybrids.

Midseason hybrids are the best overall performers in the region.

Sunflowers

Oilseed sunflowers are now the second major summer crop in the region. With their short growing season of 3½ to 4½ months, sunflowers are an ideal changeover crop, fitting well into cropping rotations. Because of their tolerance to lower soil temperatures, planting can be made earlier (late August–September) than for other summer crops. Alternatively, late plantings can be made up to the end of January. In the 1971 to 1976 period, the average area grown was 49 507 ha (range: 20 000 to 40 000 ha). The yield average was 0·7 t per ha.

The introduction of hybrid sunflowers with rust resistance has resulted in the greater use of sunflowers for irrigation. These hybrids are also most suitable for midsummer or late plantings. Severe rust, which attacks the open pollinated varieties can reduce yields by as much as 70%, as well as decreasing oil content. Yields of 2·5 t per ha can be achieved under irrigation but the average farm yield would be about 1 t per ha.

Grain sorghum on the central Downs.

High-yielding canary seed grown in the Cambooya area of the upland basalts.

Millets and panicums

Millets fall into two distinct groups. Grazing millets are white panicum and Japanese millet. Grain millets in use are white French panicum, Panorama millet and Shirohie millet.

Apart from seed from grazing crops of Japanese millet and white panicum, the small-seeded grain millets are grown entirely for the bird seed trade. The average area grown in the 1971 to 1976 period was 21 891 ha (range: 17 000 to 32 000 ha). The average yield was 1.02 t per ha.

Millets are quick-maturing and thus are more suited to double and changeover cropping than other crops. These crops are generally limited by cold temperatures and water availability. Rain is required to set secondary roots and growth is often disappointing if cool conditions prevail during the growing period.

Average farm yields range from 1·5 to 2·5 t per ha depending on variety and season. Because the crop threshes readily, it is possible to harvest with a high moisture content. If this happens, the grain will heat up and mould in storage unless the grain is artificially dried.

Soybeans

Soybeans are well suited to irrigation and the more moist dryland areas of the region. The area planted fluctuates with price and demand. The crop is grown for edible and industrial oil purposes and protein meal for stock food. The average planted area in the 1971 to 1976 period was 9 087 ha (range: 4 000 to 14 000 ha). The yield average was 1·5 t per ha.

The average farm yield for irrigated soybeans would be in the vicinity of 2·5 t per ha. Dryland crops average 1 to 1·25 t per ha.

Navy beans

Some 20% of the Queensland crop is produced on the lighter to medium clay loams of the eastern Downs. About 5% is under irrigation at Inglewood. Navy beans are not suited to the heavier and more alkaline clay soils of the central Downs. During 1975-76, 1 640 ha were grown and the yield averaged 549 kg per ha.

Navy beans are grown for the edible dry bean canning-baked bean and package trade. The beans are highly nutritious with a protein content of about 23%.

They are a short season crop of 14 weeks. Research into this crop on the Darling Downs has established that the use of two to three zinc sprays spaced a fortnight apart, with the first applied some 10 to 14 days after emergence, can result in significant yield increases to the main commercial varieties Kerman and Gallaroy.

Sundry crops

- COTTON. The Darling Downs is climatically suited to produce high yields of cotton. When the active growing season is long enough it can also produce high quality fibres. Cool weather in the October–November and/or March–April periods can often lead to a delayed maturity which adversely affects cotton fibre quality. Midseason temperatures on the Downs are satisfactory for normal development.

In 1975 and 1976, 421 ha of cotton were grown for a production of 265 t in the irrigated areas near the Condamine River. A cotton ginnery operates at Cecil Plains.

- TOBACCO is grown in the Inglewood and Texas districts. Inglewood Shire production of tobacco in 1975–76 was 258 ha for a total production of 351 000 kg. The leaf is marketed in Brisbane through the Queensland Tobacco Leaf Marketing Board. The crop is grown under irrigation on the sandy soils and silty clay loams associated with Macintyre Brook and the Dumaresq River.
- PEANUTS are grown successfully on the red brown soils of the Clifton area. They comprise 3% of the State's peanut crop. The area grown in the 1975–76 season was 1 194 ha.
- MUNG BEANS are a relatively new crop for the irrigation and dryland areas where they are used mainly as an opportunist crop in a double crop situation.

The sprouting bean industry was founded on newer varieties which are much quicker maturing and are higher yielding than the old commercial mung beans.

The small green seed variety, Celera, was first grown. The larger-seeded variety, Berkin, was then released in 1974 but it is more subject to powdery mildew than Celera. It is

higher yielding and less prone to lodging and shattering than Celera. Regur is a black-seeded type with good resistance to pod shatter and rain damage at maturity.

LUPINS. Small trial plantings of late autumn lupins were made in the north-central Downs during 1977. The variety used was Unicrop, an early-maturing type. Lupin grain is crushed and used to supplement protein in pig and poultry rations.

The beef cattle industry

In terms of gross value of production, beef stands in second place to grain in the region.

Beef cattle are the region's principal means of converting grass and stubble to dollars and provides producers with an alternative source of income.

There are six meatworks within and associated with the Downs region for processing fat cattle while the saleyards at Dalby and Toowoomba market more fat cattle than any others in Queensland.

A feature of Downs beef production is the fattening of cattle on annual crops. About 250 000 ha of forage crops are grown annually and over half of this area is oats for fattening in the winter and spring.

The growing of fodder crops and improved pastures on the better soils calls for relatively intensive husbandry methods. Management is of a more extensive nature on the poorer soils where lower carrying capacities dictate bigger and less capitalized properties.

Standing crop stubbles from winter and summer crops, particularly grain sorghum, act as a short term fodder reserve whilst most properties have a reserve of hay or grain. Silage is also stored.

When the economics are favourable, the region is also Australia's most prominent lot feeding region.

Though the beef industry is significant on the Darling Downs, this is not always obvious as beef cattle are commonly run in association with other enterprises. Grain farming,

Navy beans ready for harvest at Nobby.

Cotton is a major irrigated crop on the Darling Downs.

dairying, wool growing and fruit production are all enterprises with which beef production is commonly associated on the one property. Over 50% of the 633 000 cattle run on the 4 923 holdings in the region are in herds which consist of less than 300 head.

All major beef breeds are represented. Artificial insemination has also brought about the presence of many European breeds. The most prominent breeds of beef cattle are Hereford, Poll Hereford, Santa Gertrudis, Angus, Poll Shorthorn, Shorthorn and Brafords. Additionally, there are quite a few crossbreds sired by Brahman, Simmental and Charolais bulls.

The region is the State's principal beef stud area. Jondaryan Shire alone has 49 studs representing 13 breeds.

The sheep and wool industry

Wool growing provided the main source of income for the first half century or so of development on the Downs. The break-up of the big runs for closer settlement relegated wool to a sideline status on areas suitable for cultivation of cash crops or dairy or beef production.

Unloading cotton from a module at the Cecil Plains gin.

Recent higher prices for grain and pig meats and the high prices for beef in the early 1970s resulted in a further move away from sheep and wool production in areas where alternative enterprises could be implemented. Sheep numbers have declined by about half over the last 30 years to over 710 000 on 827 holdings largely located in the southern and western Shires.

The region, however, still produces most of the State's prime lambs with weekly sales being held in both Dalby and Warwick. Prime lamb production is generally a sideline to grain production with the sheep being utilized to graze areas which cannot be cultivated—usually creek and river frontages. Sheep also control weeds in cultivations.

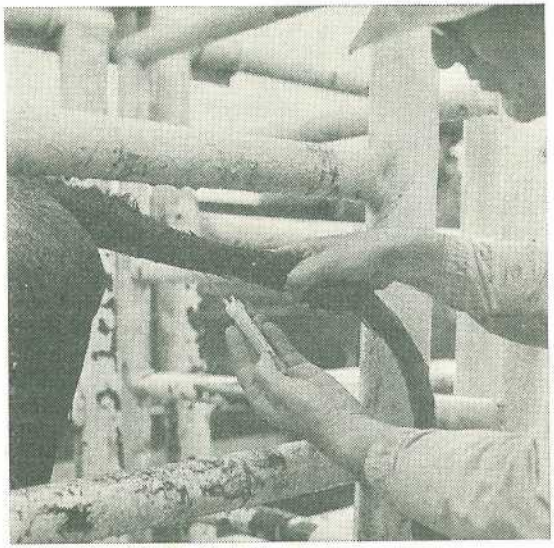
Prime lambs are usually fattened on grazing crops. Irrigated pastures have been tried on several properties, but generally have not been as profitable as irrigated cash cropping.

Wool growing is still a major source of income for landholders in the Chinchilla, Inglewood, Millmerran, Rosenthal, Stanthorpe and Wambo Shires. The inability to provide a continuity of quality feed in many of these areas has meant that they are not suitable for breeding. Purchased wethers initially were run successfully and produced high-yielding, fine wools which frequently brought top prices for Queensland produced wools. However, in the last 20 years or so, breeding flocks have been introduced on most properties.

Sown pastures help overcome the nutritional stress imposed on animals which graze native pasture. However, areas suitable for these pastures in the region are limited.

The primary sheep blowfly (*Lucilia cuprina*) is a cause for considerable losses from time to time. The 'mules' operation adopted to control breech strike is not widely used. Recent resistance of the blowfly to modern insecticides has made it imperative that mulesing be adopted if breech strike is to be controlled. Chemical mulesing has aroused wide interest, but is still in the experimental stages.

Internal parasites remain a problem from time to time but adequate control can be achieved by the use of modern spectrum anthelmintics.



Testing for brucellosis in a Darling Downs herd.

The dairying industry

Some of Queensland's outstanding stud herds are located on the Darling Downs, and several of these studs have produced champion milking cows both under official test and in milking competitions.

The total number of dairy cattle in the region is over 112 000 on 1 313 holdings (1976). The average-sized herd is 50 to 60 cows.

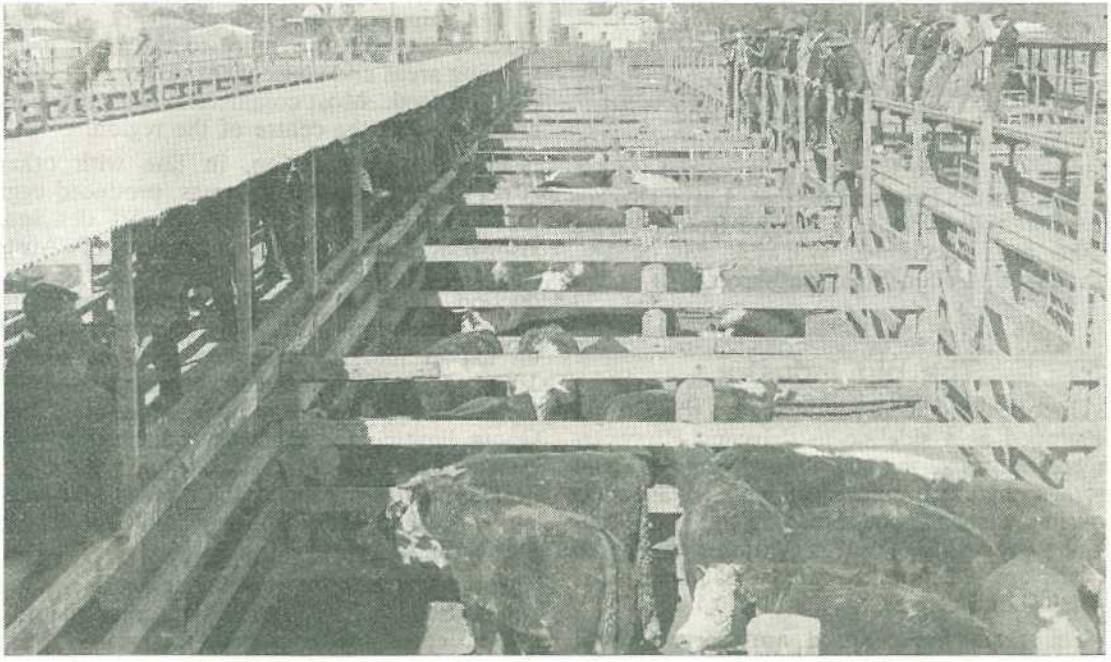
While all the main breeds of dairy cattle are to be found in the region the Jersey, Guernsey and Ayrshire breeds are in the minority. The most popular in the milk supply areas are the A.I.S. and Friesian.

Although there has been a drop of about 40% in the number of commercial dairy farmers in the last 5 years, production has remained fairly stable regardless of seasonal conditions. This indicates an increase in individual farm output largely achieved by improved herd management including better feeding practices.

There has been a fairly consistent trend from cream supply to bulk manufactured milk throughout the region. To some extent, this

ABOVE. Winter crop fattening. These steers will fatten within 100 days at a stocking rate of two head per hectare. Daily liveweight gain is about 1 kg.

BELOW. Cattle sales at Dalby.



has been dictated by changes in factory policy and the development of bulk milk pick-up.

Labour has been a significant factor in recent trends within the industry. Some dairymen have moved towards expansion of their enterprise by the construction of herringbone milking sheds which facilitate increased throughput of cows with a minimum number of labour units.

Properties vary in size from 64 ha to 800 ha, but in the western districts farms of up to 1 000 ha are not uncommon. The average dairy farm is about 160 ha.

Feeding practices in most parts of the region are based on the grazing of fodder crops during both winter and summer. Fodder sorghums are favoured during the summer months while oat crops are almost universally grown as a major source of winter feed. Crops of sweet sorghums, cowpeas and lab lab bean are proving valuable in filling feed gaps particularly during the autumn. Lucerne is widely grown and utilized as a grazing crop and to provide reserves of hay. Grain storage is a general practice and an integral part of most farm feeding programmes.

Several dairy factories have closed during recent years but those remaining are strategically placed to handle the dairy produce available for processing. Milk for local consumption is pasteurised and bottled at Toowoomba, Dalby and Warwick, with packaged milk being sent to western centres such as Roma, Goondiwindi and Charleville.

Cheese is manufactured at Toowoomba, Warwick, Quinalow, Southbrook, Mt. Tyson and Pittsworth. Butter is manufactured at Toowoomba, Warwick, Oakey and Dalby. Powdered milk products and yoghurt are also made. The region is also an important source of milk for the Brisbane market. Large tankers transport milk daily to Brisbane from pick-up points at Toowoomba, Warwick, Mt. Sibley, Mt. Tyson, Felton and Southbrook.

The pig industry

Historically, the pig industry on the Downs developed as a sideline to dairying. However, in recent years, the pig industry has become more specialized, coinciding with advances in housing, management, breeding and nutrition. Today over 95% of all pigs produced on the Downs are fed a cereal-based diet mixed with protein concentrates.

The main breeds used are Large White, Landrace and crosses between these two breeds. There are very few Berkshire and Saddleback herds left. The demand for performance-tested stock has increased markedly over the last 10 years.

Pig numbers in the region have risen from 110 000 in 1962 to a peak of 166 000 in 1967 and levelled off at 156 000 on 1 295 holdings in 1976. Over the same period of time, the Downs contribution to the Queensland total pig numbers has risen from 27% to nearly 40%.

Most of the pigs produced are processed by the Darling Downs Co-operative Bacon Association at Toowoomba. This co-operative has an annual turnover of approximately $13 million.

In general, the industry has shown a trend towards fewer numbers of holdings each with increased numbers of pigs. This trend will probably continue along with the practice of selling pigs direct to the factory on weight and grade basis.

The poultry industry

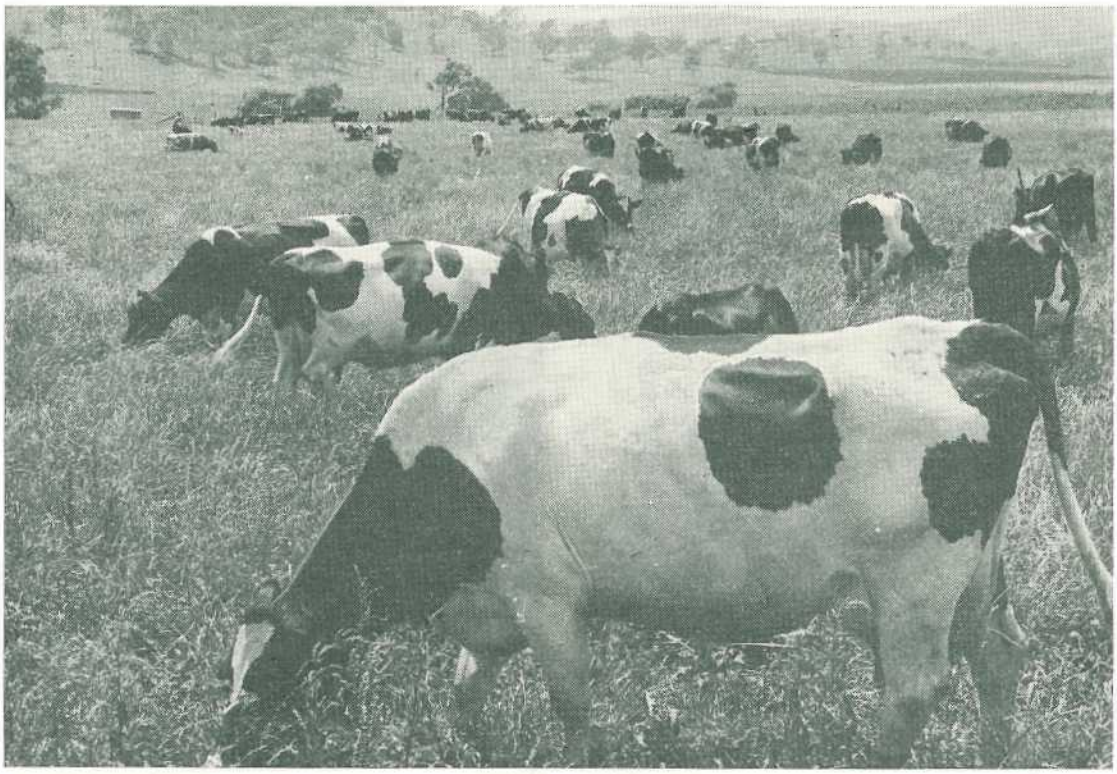
Egg production is the major poultry enterprise. Production of chicken meat is an insignificant activity in the region.

The stimulus to development of the egg industry was the proximity to the main grain growing areas and consequent savings in freight costs on feed. Most commercial egg producers are located in the centre of the region.

Formerly, the region, in line with other Australian egg-producing areas, produced eggs to meet both domestic and export demand. However, many former importers of Australian eggs became self-sufficient in egg production. This left Australia with a surplus to domestic requirements. The surplus was sold on export markets at uneconomic prices. In 1972, all Australian states agreed to statutory measures to control egg production by a Hen Quota limiting the number of hens that producers can hold. The Basic Hen Quota has been set at 1.8 million laying birds for Queensland of which approximately 600 000 are on the Darling Downs.

Some commercial egg-producing flocks are still housed on deep litter but the great majority are in cages. Most pullets are reared from day-old to approximately 18 weeks in one shed and the floor is covered with wood shavings—the deep litter system.

Some pullets are reared in cages. Flock sizes in deep litter sheds on the Downs range from a few hundred up to 10 000 birds. After 18 weeks, pullets are transferred from deep litter sheds, rearing cages, to laying cages where they spend their laying life.



Dairy cattle on the basaltic uplands.

The region comprises districts 4 and 5 of the South Queensland Egg Marketing Board area. Eggs are picked up at the farm gate or delivered to the Board depot in Toowoomba and those surplus to local requirements are transferred to Brisbane. Some large producers market their own eggs under permit from the Board. These are sold mainly in Brisbane. In the 1976-77 year, the Darling Downs region produced an estimated 9.5 million dozen eggs.

Pastures

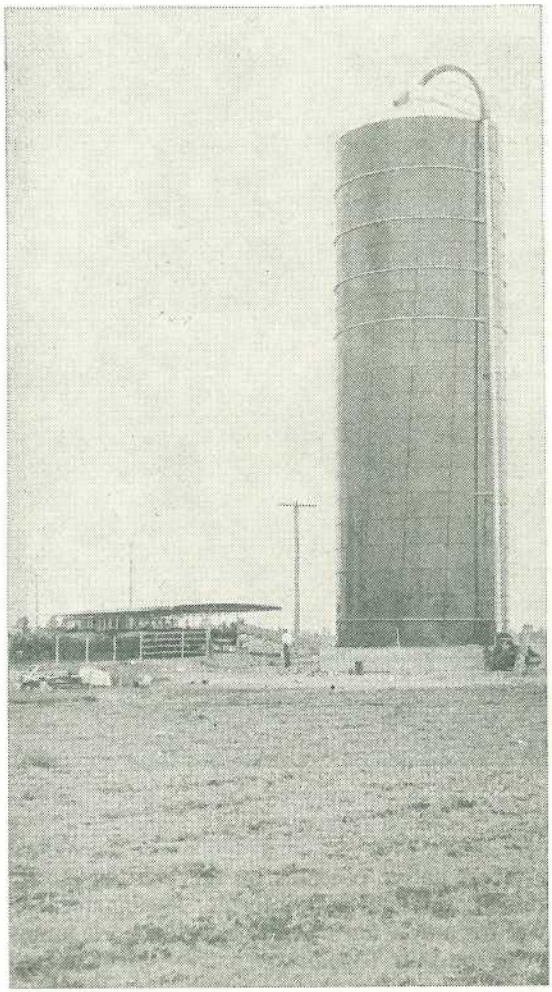
Native pastures

A long history of continuous grazing by sheep and cattle, frequently at heavy pressure, has changed the botanical composition of pastures and in most situations, the original grasses have been extensively replaced by less desirable species.

Most native pastures on the Darling Downs remain on land too infertile, steep, stony or wet for arable agriculture. Naturalized legumes, common burr (*Medicago polymorpha*), woolly burr (*M. minima*) and black (*M. lupulina*) medics are widespread on fertile soils.

These useful legumes provide high quality feed in winter and spring and supply nitrogen to associated grasses. Increased legume production may be obtained on many soils by the addition of sulphur and in some cases phosphorus fertilizers. However, these three medics are hosts of the spotted and blue-green lucerne aphids which first appeared in autumn 1977.

Carrying capacities under continuous stocking vary from 1·5 ha per beast on the best blue grass (*Dichanthium sericeum*) grassland to 10 ha per beast or more on infertile cypress pine (*Callitris columellaris*), bull oak (*Casuarina luehmannii*) and poor, hilly eucalypt woodland country.

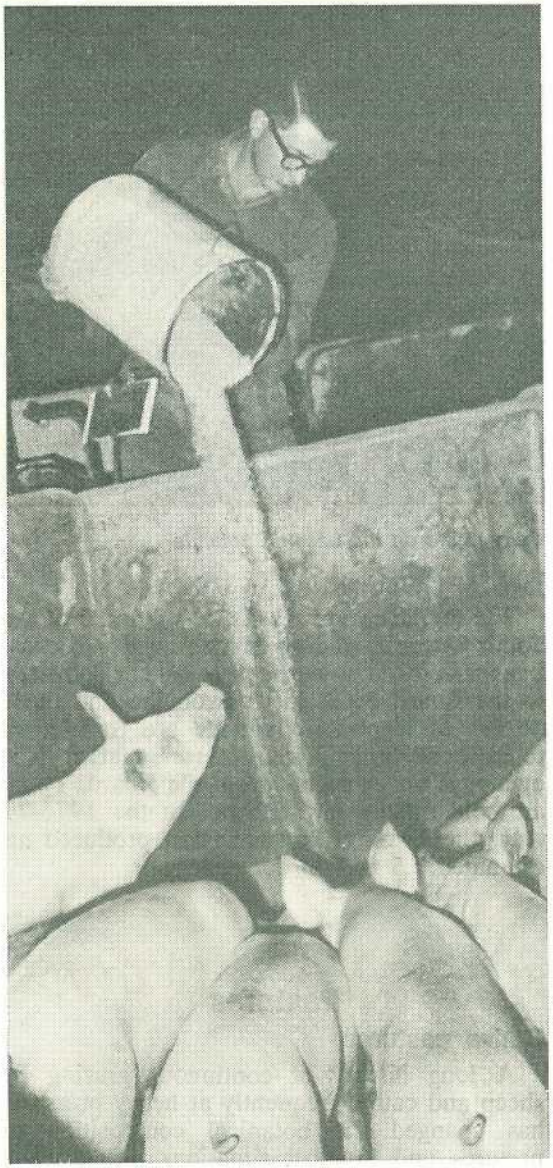


A harvestore on a dairy in the Dalby district.

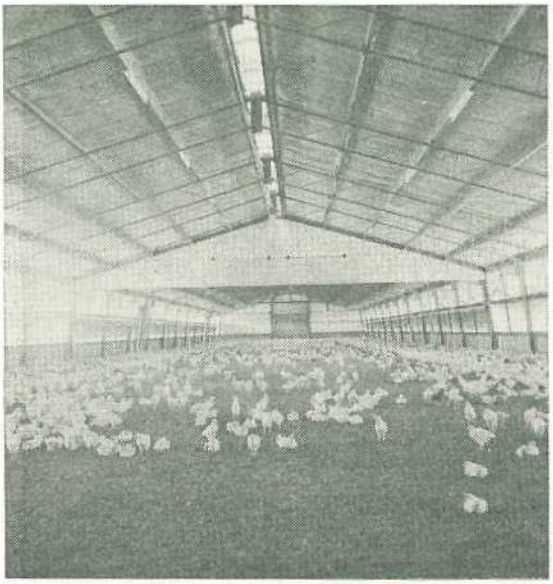
Native pasture on the Darling Downs rarely forms the sole forage source for sheep and cattle and is generally used in conjuction with forage crops, crop stubble and, in some cases, sown pastures.

Sown pastures

Temperate pastures of predominantly fescue (*Festuca arundinacea*), ryegrass (*Lolium* spp.), phalaris (*Phalaris tuberosa*), clover (*Trifolium* spp.) and annual medics provide high quality feed in autumn to early summer under irrigation and in the wetter eastern section of the Darling Downs. The small areas of temperate pasture are grazed principally by dairy cattle.



Intensive pig raising is an important farm enterprise on the Downs.



Commercial layers being reared in fully intensive batch shedding.

Lucerne is an important summer legume grown in pure swards for grazing and hay and as a component in temperate and tropical pastures. Spotted and blue-green lucerne aphids are severe pests of lucerne.

Introduced and naturalized tropical species, paspalum (*paspalum dilatatum*) and kikuyu (*Pennisetum clandestinum*) provide an important forage source on the Darling Downs. Vegetative planting and, in recent time, seedings of kikuyu have increased the area of this grass.

Rhodes grass (*Chloris gayana*), green and Gatton panic (*Panicum maximum*), buffel grass (*Cenchrus ciliaris*), Makarikari grass (*Panicum coloratum* var. makarikariense), annual medics and lucerne are the major sown species in the region.

Sown pasture seeds are traditionally broadcast on or drilled into a fine, firm seedbed. More recently, furrow contour planting of seeds with following press-wheels has been shown to be a very successful method for establishing sown pastures. Midwinter sowings of temperate grasses and legumes together with a tropical grasses using this method have given successful pasture establishment. Tropical grasses on their own are best sown in January.

On heavy cracking-clay soils, establishment of small-seeded tropical grasses remains unreliable. However, recent work aimed at selecting grasses giving more reliable establishment on heavy clay soils has identified promising useful species in creeping blue grass (*Bothriochola insculpta*) and purple pigeon grass (*Setaria porphyrantha*) from Rhodesia.

Horticultural crops

All of Queensland's production total of 55 000 t of apples, pears, apricots, peaches and other deciduous tree fruits is produced in the region.

The major area of production is the raised granitic tableland to the south of the Downs proper, known as the Granite Belt. The Granite Belt and 'traprock' country occupies all of Stanthorpe Shire and parts of the Shires of Rosenthal, Glengallan and Inglewood. All of the region's pome fruits and most of the region's stone fruits are produced in this area.

This area is also Queensland's largest producer of grapes for both table and wine-making. An infant wine industry has been established in recent years with some growers producing commercial wines on their farms. In 1975-76, 1 011 ha produced 4 900 000 kg of table grapes and 43 ha produced 238 000 kg of wine grapes.

The Granite Belt also produces a wide range of vegetables, the most important of which is tomatoes. In 1975-76 the region had 1 764 ha under vegetables. Of this, 646 ha were located in the Stanthorpe Shire and tomatoes comprised 316 ha of that area.

Potatoes are grown mainly around Killarney and onions are grown on the alluvial soils of the south-eastern Downs and under irrigation on the central plains. Green beans for processing is a recently-developed crop under irrigation at Inglewood. This crop is also grown in the Clifton-Warwick area.

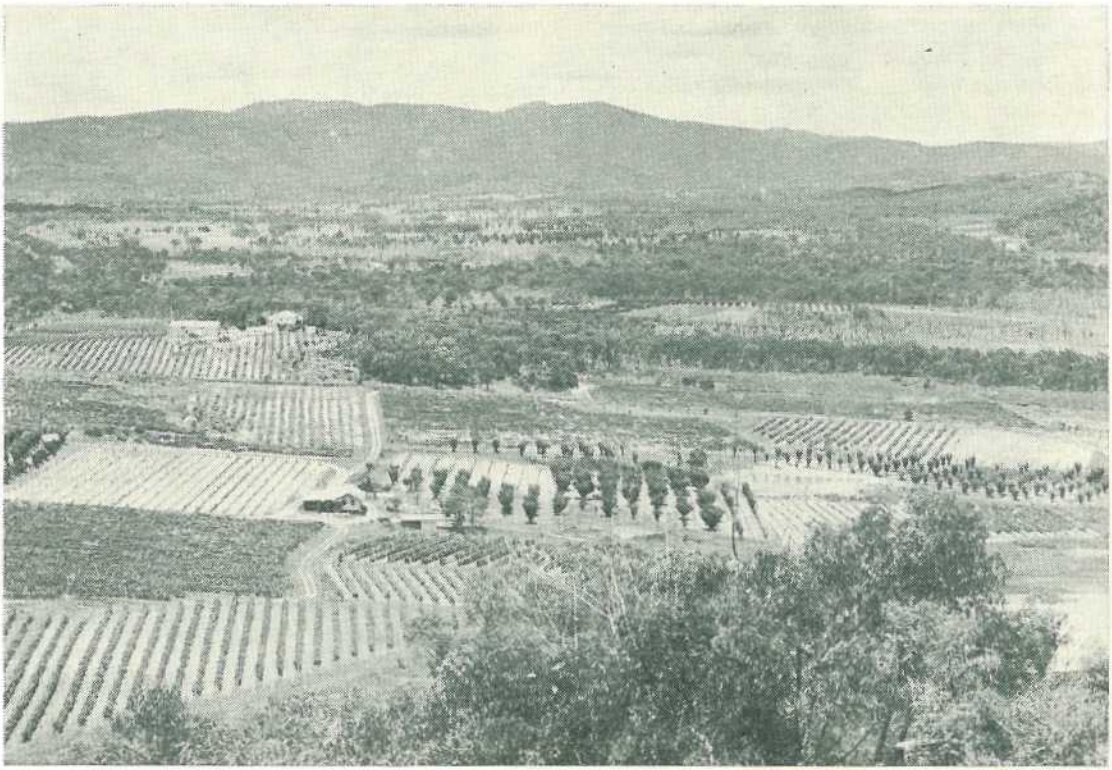
A crop of Panorama panicum at Jandowae.

Weeds of crop and pasture

On the Darling Downs, excellent opportunities exist for cultural control of annual weed species. The accepted practice of fallowing to accumulate soil moisture combined with the suitability of much of the region for the production of both summer and winter grain crops allows adequate mechanical control of annual weeds of winter crops during periods of summer crop production and vice-versa.

However, this system of weed control becomes less attractive when a wide disparity exists between the prices for summer and winter grains. Also, periodic floods on the plain country can disrupt cultural control programmes through movement of weed seeds on to previously clean areas. Selective herbicides are used in these situations.

Of the annual weeds of winter crops, wild oats—*Avena ludoviciana* and to a lesser extent *Avena fatua*—are probably the most troublesome in terms of potential yield reductions and difficulty and cost of chemical control. The herbicides, di-allate and tri-allate, as soil-incorporated, pre-planting treatments have provided consistently good control of wild oats in winter grain crops. Post-emergence herbicides are being assessed. The wild oat problem is least acute on the eastern Downs where predominantly mixed farming enterprises allow for an additional measure of cultural control with the production of grazing and hay crops.

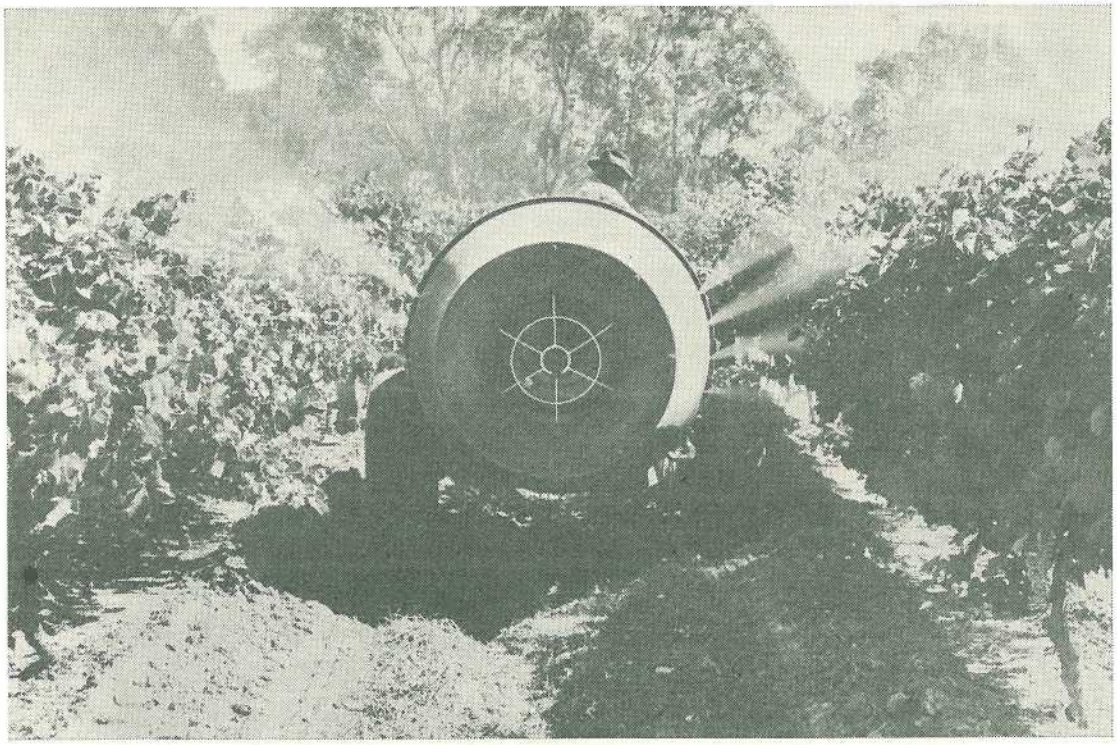


Orchards in the Granite Belt.

The other major annual weeds species of winter crops are climbing buckwheat (*Polygonum convolvulus*), wireweed (*Polygonum arviculare*), wild radish (*Raphanus raphanistrum*), mustards (*Sisymbrium* spp.), variegated thistle (*Silybum marianum*), hexham scent (*Melilotus indica*), spiny emex (*Emex australis*) and New Zealand spinach (*Tetrogonia tetragonioides*). Control of these broadleaved species is possible by the use of post-emergence herbicides.

Summer-growing annual weeds are particularly aggressive and heavy populations, if not controlled, can lead to total dominance over the crop in wet seasons. The most troublesome species are barnyard grass (*Echinochloa* spp.), urochloa grass (*Urochloa panicoides*), thornapples (*Datura* spp.), mintweed (*Salvia reflexa*), redshank (*Amaranthus cruentus*), bladder ketmia (*Hibiscus trionum*) and annual ground cherry (*Physalis angulata*).

Apple grading in the Stanthorpe area.



Spraying grapes on the Granite Belt.

Weed problems can be minimized by one or a combination of:

- The use of selective herbicides in appropriate crops.
- Delayed planting with several pre-planting cultivations.
- The growing of row crops with inter-row cultivation.

Some species cannot be selectively controlled in some crops with herbicides and in these cases the choice of crop to allow for chemical control is important.

Perennial weeds of cultivation are an increasing problem in the region. Bindweed (*Convolvulus arvensis*) and Johnson grass (*Sorghum halepense*) are increasing in distribution and intensity. Perennial species of lesser distribution include nut-grass (*Cyperus rotundus*) Russian knapweed (*Centaurea repens*), hoary cress (*Cardaria draba*), perennial ground cherry (*Physalis virginiana* var. sonorae) and perennial raspweed (*Haloragis heterophylla*). When confined to small patches, these species can be eradicated with chemicals. Over larger areas, eradication with chemicals is not feasible and cropping programmes must be modified to allow for their control.

Annual weeds can be troublesome during the establishment period of sown pastures. The problem is largely avoided by planting in late summer to autumn when neither summer nor winter-growing weed species are particularly aggressive.

Farm mechanization

As a result of the diversity of farming within the region, there is a large variation in both the type and size of farm equipment in use. The grain and intensive animal production industries in particular have benefited greatly from the mechanization introduced over the last 20 years.

The most visible farm equipment is that used for field work on grain farms—tractors, tillage, spraying, planting and harvesting equipment. Recently, the size of this equipment has increased dramatically. Large four-wheel-drive or crawler tractors pulling tillage machines of widths greater than 15 m are becoming commonplace. Today's header harvesters, although similar in principle to machines of 50 years ago, incorporate sophisticated equipment such as eletcronic monitors to keep a check on various components and machine performance.

Mechanization in the dairy, pig and poultry industries allows one man to look after many more animals than he could have done 20 years ago. In livestock buildings, the environment can be controlled to suit the needs of particular animals or particular age groups. In the poultry industry, machines are used to automatically blend, mix and distribute feed and to collect eggs. Modern dairy equipment allows bulk milk handling and quick, easy handling of cows during milking.

Further examples of mechanization can be seen in the fruit and tobacco growing industries. In these industries, where traditionally there has been a lot of hand labour, further mechanization will be needed to contain rising costs of production.

Mechanization plays a large part in cotton production in the region. Cotton is harvested by conventional spindle-type pickers and the seed cotton dumped into bulk bins. The seed cotton is then transported to the cotton ginnery at Cecil Plains in either trailers or bins on trucks. In the 1977 season, module building was introduced and has speeded-up harvesting considerably.

Soil conservation

The dark, self-mulching clay soils of the area are highly susceptible to erosion by water.

Early tillage systems, including the bare fallowing of winter crop land during the high rainfall summer months, resulted in excessive run-off and erosion. It was common practice to burn winter crop stubbles as soon as possible after harvest and to prepare the land for another winter crop. Emphasis was directed at the conservation of rainfall in the soil through the control of weeds and the maintenance of a fine surface soil tilth.

Unfortunately, these methods often resulted in the surface sealing of soil during rain storms and in high run-off and severe sheet and gully erosion. 'Gully filling' after summer storms was a matter of routine necessity on many hillside farms.

First attempts by the Queensland Government to combat soil erosion on the Darling Downs were made between 1935 and 1940. These efforts were interrupted by World War II but staff was recruited and trained and a series of trial projects and farm demonstrations were commenced in 1946-47.

Today, some 30% of the farm land in the region has been brought under some measure of control.

Improved and more diversified cropping systems have been adopted to a large degree. Tillage and seeding implements have and are being redesigned to enable crop residues to be retained as a protective cover for the soil surface and to enable the number and frequency of soil workings to be minimized. Coupled with these important changes has been the contour banking and working of large areas of sloping, cultivated land.

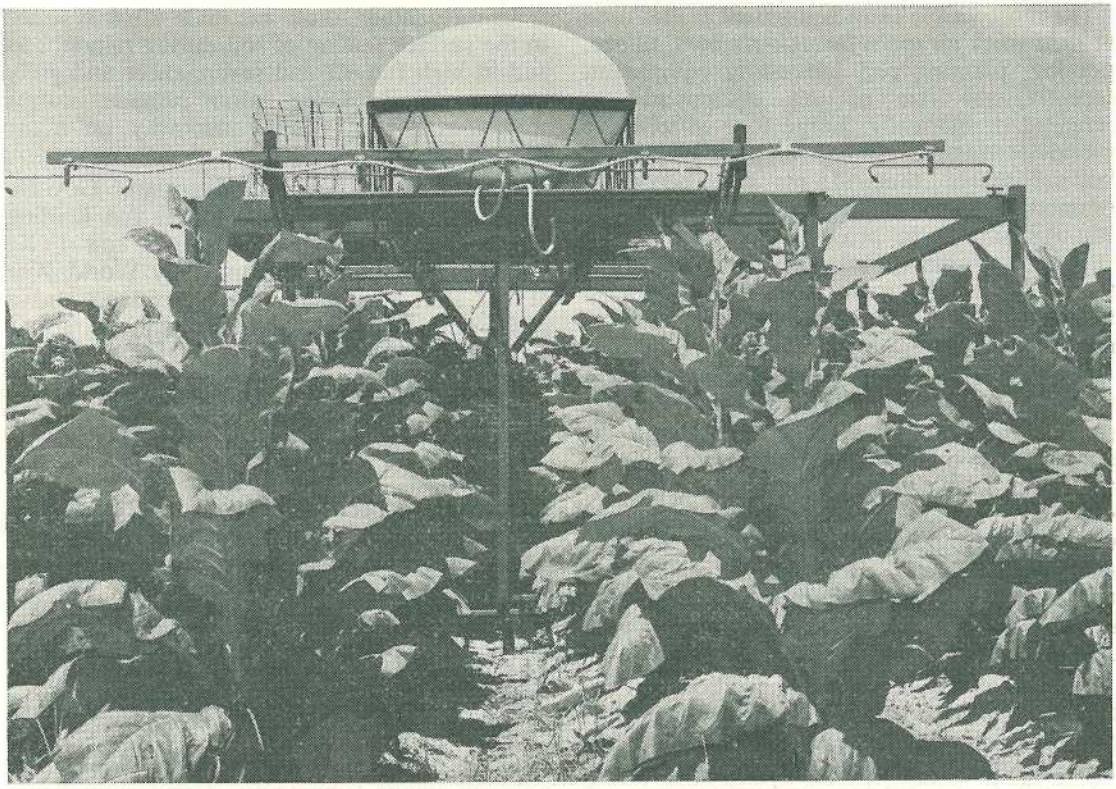
On a vast area of the lower slopes and adjacent plains fringing the Condamine River and its tributaries, systems of contour strip cropping are being employed to spread flood run-off from the hills.

The control of erosion on the Darling Downs poses many practical, technical and financial problems but the challenge is being gradually resolved through the combined teamwork of the Government, Shire Councils and farmers.

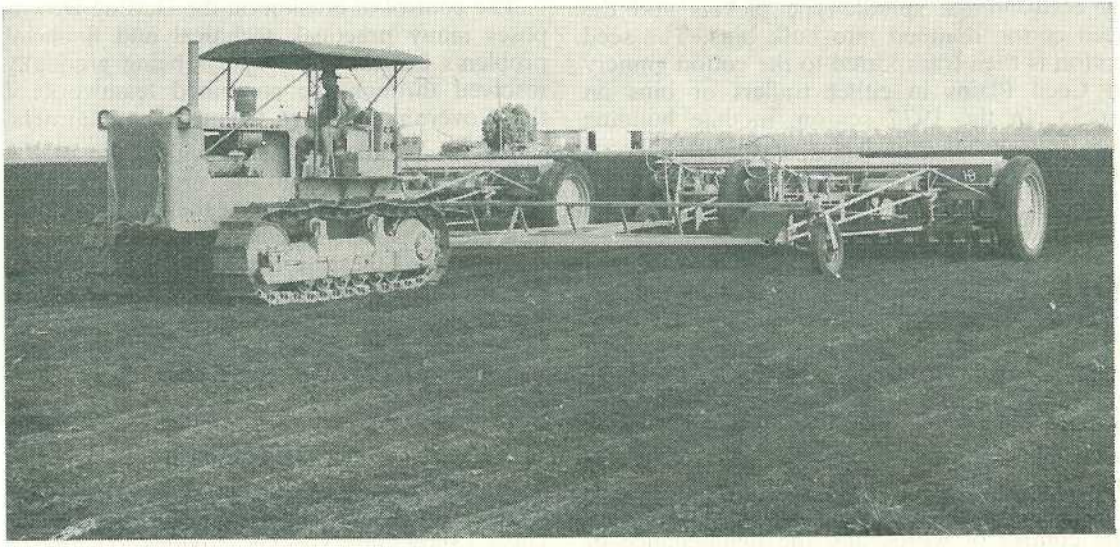
All local authority areas within the region have been declared to be areas of erosion hazard within the meaning of the Soil Conservation Act of 1965. Briefly, this means that all land within these areas must be classified according to its land use capabilities and used within these limitations. Certain costs incurred by farmers in implementing approved soil conservation programmes are entitled to Government subsidy.

Economics

In 1975-76, agricultural production in the region was worth over 200 million dollars. Table 7 shows how various activities contributed to this total.



A taxi harvester working in a tobacco crop in the Inglewood area. An increasing number of south Queensland tobacco growers are using labour-saving devices to contain rising production costs.



Three combine seed drills in tandem planting winter cereals on the plains.

A four-wheel-drive tractor wide ploughing wheat stubble in the Dalby district.

Table 7 shows that the fortunes of farmers on the Downs are tied very strongly to crop prices, especially those of coarse grains and wheat. Crop-growers are vulnerable to changes in international markets. In contrast, livestock activities on the Downs are less vulnerable to market changes.

The milk supplied by most dairy farmers is used in both the fluid milk and manufacturing milk markets. Thus, these farmers are to some extent protected from the fluctuating fortunes of the manufacturing sector.

Eggs and pig meats are produced mainly for the Australian market, and thus producers do not face the possibility of erratic price movements due to events in world markets. With a 'factory' type production technology, these producers also face much less production uncertainty than graingrowers. In addition, egg producers are insulated from market forces by a price support scheme.

TABLE 7

ECONOMIC ACTIVITIES ON THE DARLING DOWNS

Enterprise group	Main activities	Percent of gross value of agricultural production 1975–76	
		%	%
Wheat	Wheat	20	
Other Grains ..	Sorghum, Barley	34	
Oilseeds	Sunflower ..	5	
Fruit, Vegetables ..	Apples	10	
Other	..	3	
		—	72
TOTAL CROPS			
Livestock disposals	Beef, Pigs ..	15	
Livestock products	Milk, Eggs ..	13	
		—	
TOTAL LIVESTOCK	.. ..	..	28
			—
Total	.. ..		100

Source: Australian Bureau of Statistics (Queensland Office): Agricultural Industry, Queensland, 1975–76 Season. Sections 1, 2 and 3, Brisbane, 1977.

While beef production is a common activity, and is at times subject to subtantial price movements, very few farmers rely on it for their sole or main source of income. It is mainly found on farms where graingrowing or dairying is the principal enterprise. Few store cattle are produced for sale in the region, the main activity being fattening. Variation in beef prices has a much greater effect on store production than on fattening activities, so that beef producers on the Downs are somewhat insulated from extreme price movements.

The wool producers of the traprock-granite grazing district in the south are extremely vulnerable to wool price movements. However, wool production is a very minor part of the total Downs output, and in recent years, diversifications into cattle and the wool reserve price scheme have reduced this vulnerability.

Thus, the major activity, graingrowing, is also the one most subject to price uncertainty. Production uncertainty is also greater in cropping activities than in livestock enterprises. Darling Downs farmers adjust to these twin uncertainties by operating diversified enterprises, especially in upland areas and by flexibility, especially on plains country. Flexibility involves the ability to switch quickly between various groups of products whose prices are determined in different markets, that is, wheat, coarse grains, oilseeds, small seeds and crop fattening of beef catle.

Departmental services

Livestock services

The most important task in the region is controlling the spread of ticks to the Darling Downs region from tick-infested areas east of the Great Dividing Range. This involves manning a series of clearing dips along the range area for the inspection and treatment of stock moving westward. In spite of these measures, serious outbreaks occur periodically

Soil conservation works in the Felton district.

on the Downs. This necessitates the imposition of quarantine areas and supervision of control and eradication procedures.

In recent years, the campaign under the national scheme for the eradication of tuberculosis and brucellosis has become more intensified so that additional control measures against introduction of cattle from T.B.-infected properties to the Downs have been implemented. Considerable work has been undertaken to determine the extent and distribution of brucellosis in the region. This is achieved by blood sampling of herds, milk sampling, and collection of blood samples at meatworks. As a result, eradication procedures are now in progress, involving full scale herd testing.

An ever increasing role in disease prevention and control is being undertaken by private veterinary practitioners. However, disease problems involving herds are investigated by officers of the Department's Veterinary Services Branch. Diseases causing infertility, blackleg, metabolic disturbances and poisoning are the most common. Bacterial disease in pigs occurs from time to time.

There are six abattoirs located within the region. Three abattoirs, one at Oakey, one at Purrawunda and the other at Warwick, slaughter cattle only. Two abattoirs at Toowoomba and another at Killarney slaughter cattle, sheep and pigs.

Meat inspectors stationed at the abattoirs provide a disease control monitoring service for the disease status of individual properties or the district of origin of the livestock passing through the abattoirs.

Standards in farming

The inspection service provided by the Standards Branch at Toowoomba covers many facets of primary production within the region and surrounding districts. Inspection of various commodities are made from fruit and vegetable packing and presentation checks, to sampling and quality control of stock food preparations, as well as seed sampling and testing.

Roughly 7 000 seed samples are processed annually by the Seed Testing Laboratory in Toowoomba. These include inspector's survey samples, tests for commercial companies and a free seed testing service for primary producers. An advisory and quality control service for seed producers includes assistance with planting, harvesting, grading, storage and seed viability.

A close check is kept on seed quality at the Standards Branch Seed Testing Laboratory in Toowoomba.

All pest destroyers, herbicides, veterinary medicines and the like must be registered before they may be sold in Queensland. Periodic checks of many retail outlets ensure that only registered products are sold. Prepared stock food lines are sampled regularly to ensure that they are 'true to label' and comply with regulations.

Under the terms of the Agricultural Chemical Distribution Control Act 1966-1970, both aerial and contract ground spraying of agricultural chemicals must be carried out only by licensed commercial operators, whose equipment is approved and covered by insurance policies designed to cover accidental damage to a third party's property. Officers of the Department may also be called upon to investigate situations where chemical spray drift may have caused damage to neighbouring crops or contributed to stock losses.

The quality of produce is checked again at the Brisbane Markets.

Major wholesale and retail fruit and vegetable outlets are regularly inspected to see that the produce offered is acceptable to the public and that the grading, packing and presentation regulations are adhered to.

An export inspection service is also provided on behalf of the Commonwealth Government to ensure that grain and seed for export is free from live insects, weeds, diseases and foreign matter which may prevent entry into the importing country.

The greater use of containers for shipment has meant that an increasing number of export inspections are done where the seed is packed, even though this may be hundreds of kilometres from the nearest wharf facilities. Over 30 export seed packers are situated throughout the Darling Downs region.

Rural research

The Department has three research stations in the region. The Hermitage Research Station near Warwick covers a range of research interests including crop and pasture research, pig breeding, beef cattle nutrition, and weeds and soil fertility studies. Hermitage is the main centre for crop breeding research. There is a fauna research unit of the National Parks and Wildlife Service located on this station.

The Inglewood Field Station, located at Whetstone near Inglewood, is the site for research into irrigation methods and the irrigated crops of the Inglewood-Texas-Yelarbon district.

The Granite Belt Horticultural Research Station located at Applethorpe is the centre of research into deciduous fruit crops and vegetables for the Granite Belt.

In addition, the Queensland Wheat Research Institute, located at Toowoomba, is also staffed and operated by the Department of Primary Industries. A major role of the Institute's programme is to breed new wheat varieties for Queensland. Other important research at the Institute includes fertilizer requirements, weed control, disease incidence and water relations of the wheat crop. Research is also undertaken into problems of soil erosion and surface management.

Other research programmes are being conducted by various officers of the Department of Primary Industries stationed at Warwick and Toowoomba.

Extension services

The main extension services are located at Toowoomba, Warwick and Dalby, with individual officers stationed in the smaller centres.

Departmental extension officers provide a free service to the rural community in all aspects of farm management—crop, pasture, soil and livestock husbandry, farm engineering and farm economics.

Departmental extension officers are located at the following centres on the Darling Downs:

Wheat trials at the Hermitage Research Station near Warwick.

Allora, Clifton, Crows Nest, Dalby, Inglewood, Jandowae, Killarney, Millmerran, Oakey, Pittsworth, Stanthorpe, Toowoomba, Warwick.

All Branches are not represented at each centre and farmers will be referred to the appropriate extension officer should they have an inquiry which cannot be handled at any one centre.

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Map of region—J. A. Mullins, B. E. Vandersee.

Grain sorghum planting guide

Central and North Queensland 1978-79 season

Compiled by S. R. Walsh, Agriculture Branch.

THE grain sorghum hybrids recommended for planting in central and northern Queensland are listed in this guide. They have not been listed in order of preference.

A number of characteristics are considered in assessing hybrid performance. These include yield, lodging resistance, disease resistance, maturity, height, head characteristics, reaction to insecticides and many other features.

In order to reduce risk, it is always advisable to sow more than one hybrid. Some hybrids appear to be closely related and are therefore interchangeable (for example, Texas 626 and Yates 212).

A reaction to some insecticides, particularly monocrotophos, may occur. The severity of the reaction may vary with the growth stage of the plant. The open-pollinated variety, Alpha, shows a marked reaction to monocrotophos.

Open-headed hybrids are desirable in the more humid regions and in areas where head caterpillars are important.

The hybrids recommended have been well tested and are proven performers. The hybrids listed as 'for trial' should be sown in smaller areas on a trial basis.

The established plant population for rain-grown crops will vary from 75 000 to 100 000 plants per hectare. The rate should be increased to establish about 250 000 plants per hectare when grown under irrigation.

The planting rate will vary according to available soil moisture, time of planting, soil type and hybrid. Your Agricultural Extension Officer will provide further information.

Grain sorghum seed sold by major seed companies is of high quality and is required to have a laboratory germination of 70% or higher. Seed size varies with hybrids but is generally in a range of 20 000 to 40 000 seeds per kilogram.

APPROXIMATE PLANTING RATE FOR GIVEN PLANT POPULATIONS

Plants/ha	Planting rate kg/ha
50 000	2·5 –3·0
75 000	3·75–4·0
100 000	5·0 –5·5
150 000	7·5 –8·0

The performance of a hybrid will vary between districts depending on soil type, time of sowing and other factors. This guide is basic information only, your Shire Agricultural Extension Officer should be consulted.

A guide to grain sorghum charactertistics was published in the September–October issue of the *Queensland Agricultural Journal.*

Region/Shire	Planting Time	Recommended hybrids
Far North Queensland		
Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Etheridge Shires	Dec.–mid Feb.	S: Yates 300F MS: E57 MQ: Yates 233; Goldfinger
		For trial
	Dec.–mid Feb.	S: Tropic; Monsoon MS: Dorado; Golden Acres Y101
North Queensland		
		Rain-grown
Hinchinbrook, Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires	Dec.–Mar.	MS: E57 MQ: Yates 233; Goldfinger
		For trial
	Dec.–Mar.	S: Pacific 303; Tropic; Monsoon; Dorado; Golden Acres Y101
		Irrigated
	Mar.–July	MS: E57; Texas 671; E55e; Yates 275
		For trial
	Mar.–July	S: F64a; Dorado; Golden Acres Y101; Pacific 303; Tropic; Monsoon
Capricornia		
		Rain-grown
Livingstone, Fitzroy, Calliope, Nebo, Broadsound Shires	mid Dec.–mid Feb.	E57; F64a
		For trial
	mid Dec.–mid Feb.	Dorado; Golden Acres Y101; Leader; Big Red
		Irrigated
	mid Dec.–late Jan.	E57; F64a; Texas 626
		For trial
	mid Dec.–late Jan.	Texas 671; E55e; Yates 275; Big Red; Tropic; Dorado; Golden Acres Y101; Leader; Yates 266; Yates 233; Goldfinger
		Rain-grown
Banana, Duaringa Shires	mid Dec.–mid Feb.	E57; F64a
		For trial
	mid Dec.–mid Feb.	Leader
		Irrigated
	mid Dec.–late Jan.	E57; F64a; Texas 626
		For trial
	mid Dec.–late Jan.	Texas 671; E55e; Yates 275; Big Red; Tropic; Dorado; Golden Acres Y101; Leader; Yates 266; Yates 233; Goldfinger
		Raingrown
Emerald, Peak Downs, Belyando, Bauhinia Shires	mid Dec.–mid Feb.	E57; F64a
		For trial
	mid Dec.–mid Feb.	Dorado; Golden Acres Y101; Leader
		Irrigated
	Sept.–Oct.	Dorado; Golden Acres Y101; Tropic; Pacific 303

KEY

S = Slow maturity **MS** = Medium slow maturity

M = Medium maturity **MQ** = Medium quick maturity

Q = Quick maturity

For further information on hybrid performance, fertilizer requirements, irrigation schedules in your own district, consult your Agricultural Extension Officer.

Chemical weed control guide summer crops—1978

by J. E. Rawson, J. M. T. Marley and S. R. Walsh, Agriculture Branch

THE following tables are a guide to the chemical control of weeds in summer crops.

The following points should be considered for the successful use of herbicides:

- Correct identification of the present or anticipated weed problem.
- In very weedy areas, selection of a crop such as maize in which chemical control is relatively simple rather than a crop such as sunflowers for which few herbicides are available.
- Selection of a herbicide which is going to give satisfactory results for an acceptable cost without harmful residual effects on the proposed following crop. If a highly residual herbicide must be used, the future cropping programmes may have to be modified.
- Careful study of the manufacturer's label, paying particular attention to rates and method of application, incorporation details where applicable and timing of application.
- Consider any harmful effects on the treated crop, neighbouring crops, following crops, operators and the environment.
- Apply the herbicide strictly in accordance with the manufacturer's directions.

This guide is basic information only and further advice to your own farm needs should be obtained from your Agricultural Extension Officer. He will also know the current prices of the various chemicals.

Attached to this guide is a list of common weeds and some general notes on the use of herbicides. This should be read in conjunction with the tables for individual crops.

WEED CONTROL GUIDE—SORGHUM

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence					
Atrazine	Several products (80% wettable powder, 50% flowable)	Rates and method of application as on manufacturers' registered labels	Post-planting, pre-emergence or split application (pre and post-emergence)	Most annual grasses and broad-leaved weeds. (*Urochloa* may not be completely controlled)	Refer to manufacturers' labels for rates of application for different soil types. Under furrow irrigated conditions a light incorporation is desirable There is a risk of residue damage to crops other than maize, sorghum and broom millet, planted in the rotation Refer to manufacturers' labels
Propachlor ..	Ramrod 65	6·7 kg	At planting	Most annual grasses, including *Urochloa*, and some broad-leaved weeds	No residual problems
Post-emergence					
2,4–D amine ..	Several 50% products	1 100 ml	Post-emergence when crop is 10 to 25 cm high and secondary roots have developed	Most broad-leaved weeds	SOME CROP INJURY MAY OCCUR. Do not apply from misting machines and boomless jet nozzles as uneven spray application and consequent crop damage may result. Drift hazard is also accentuated. Some varieties are more susceptible to 2,4–D than others
Picloram + 2,4–D	Tordon 50D	1 400 ml	As for 2,4–D	Full season control of *Datura* spp. Most other broad-leaved weeds including annual ground cherry and mintweed are controlled	For uniformity of application and reduction of drift hazard, ground-operated boom sprays are preferred. Refer to manufacturer's label for residual effects on subsequent crops. If row cultivated, avoid 'throwing in ' soil
Atrazine	80% wettable powder 50% flowable (Several products)	2·8 kg–4·2 kg or 4 500 ml–6 700 ml	Post-emergence when weeds are in the 3 leaf stage or less The sorghum plants must have at least 3 leaves	Most annual grasses and broad-leaved weeds Some annual broad-leaved weeds including mintweed and black pigweed may be controlled at lower rates	Wetting agent is added at the rate of one part of 50% to 60% product to 500 parts of spray mixture Refer to manufacturers' labels for residual effects on subsequent crops
Dicamba	Several products	700 ml–1 400 ml	Crop height to 30 cm, 10 to 25 days after emergence	*Amaranthus* spp., mintweed, blackberry nightshade	Refer to manufacturer's label

WEED CONTROL GUIDE—MAIZE

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence					
Atrazine	Several products (80% wettable powder or 50% flowable)	2·8 kg–4·2 kg or 4 500 ml–6 700 ml	Post-planting, pre-emergence	Most annual grasses and broad-leaved weeds (*Urochola* may not be completely controlled)	Refer to manufacturers' labels for rates of application for different soil types Under dryland or furrow-irrigated conditions, a light incorporation is desirable There is a risk of residual damage to crops other than maize, sorghum and broom millet planted in the rotation Refer to manufacturers' labels On the Atherton Tableland, best results are obtained from split application 1·4 kg/ha pre-emergence followed by 1·4 kg/ha post-emergence 80% product (2 240 ml/ha using 50% product)
Propachlor ..	Ramrod 65	6·7 kg	At planting	Most annual grasses, including *Urochloa*, and some broad-leaved weeds	No residual problems
Post-emergence					
2,4–D amine ..	Several 50% products	1 100 ml	Post-emergence when weeds are small and maize is 10 to 30 cm in height and the secondary roots have developed	Most broad-leaved weeds	Avoid drift to nearby susceptible crops
Picloram + 2,4–D	Tordon 50D	1 400 ml	As for 2,4–D	Full season control of *Datura* spp. Most other broad-leaved weeds including annual ground cherry and mint weed are controlled	For uniformity of application and reduction of drift hazard, ground-operated boom sprays are preferred Refer to manufacturer's label for residual effects on subsequent crops Avoid 'throwing in' of soil during subsequent cultivation
Atrazine	Several products (80% wettable powder 50% flowable)	2·8 kg–4·2 kg or 4 500 ml–6 700 ml	Post-emergence when weeds are in the 3 leaf stage or less	Most annual grasses and broad-leaved weeds *Urochloa* may not be completely controlled Mintweed and black pigweed may be controlled at lower rates	Wetting agent is added at the rate of 1 part of 50% to 60% product to 500 parts of spray mixture Refer to manufacturers' labels for residual effects on subsequent crops

WEED CONTROL GUIDE—MILLETS and PANICUMS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence		No pre-emergence chemicals commercially available			
Post-emergence 2,4-D amine ..	Several 50% products	1 100 ml	When crop is stooling and secondary roots have developed	Most broad-leaved weeds	Avoid spray drift to neighbouring susceptible crops

WEED CONTROL GUIDE—SUNFLOWERS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence–Pre-planting Trifluralin ..	Several products	1 400 ml–2 800 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturers' labels for incorporation methods, rates required on different soil types and residual effects on subsequent crops
Post-emergence	None commercially available				

WEED CONTROL GUIDE—SOYBEANS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence–Pre-planting Incorporated					
Trifluralin ..	Several products	1 400 ml–2 800 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturers' labels for incorporation methods, rates required for different soil types and residual effects on subsequent crops
Penoxalin ..	Stomp 330E	3 000 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods and residual effects on subsequent crops
Pre-emergence–Post-planting					
Chlorthal-dimethyl	Dacthal W75	6·7 kg–11·2 kg	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for rates of application for different soil types
Linuron	Linuron 50 Afalon	2·2 kg–5·6 kg	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturers' labels for rates of application for different soil types, crop planting depth and residual effects on subsequent crops
Chlorthal-dimethyl /linuron mixture	Shamrox WP	8·0 kg–13·0 kg	Post-planting	Many annual grasses and some broad-leaved weeds	
Penoxalin ..	Stomp 330E	4 500 ml	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for residual effects on subsequent crops
Post-emergence					
Bentazone	Basagran	1 500 ml–2 000 ml	From 1st. trifolate leaf stage of crop growth and when weeds are small	*Datura* spp., Noogoora burr and bellvine	The lower rate for seedling *Datura* spp. and Noogoora burr. Refer to manufacturer's label for spray volume

WEED CONTROL GUIDE—PEANUTS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-planting–Pre-emergence					
Vernolate ..	Vernam	3 000 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to label for incorporation details Use only on red soils
Trifluralin ..	Several products	1 400 ml–2 100 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturers' labels for incorporation methods, rates required on different soil types and residual effects on subsequent crops
Penoxalin ..	Stomp 330E	3 000 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods and residual effects on subsequent crops
Post-planting–Pre-emergence					
Alachlor	Lasso	4 500 ml	Apply immediately after sowing or within 2 days and incorporate Peanuts should be sown to at least 5 cm deep	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods
2,4–D amine ..	Several products	4 500 ml	Apply at or immediately after planting	Many annual grasses and broad-leaved weeds. Does not control Mossman River grass or Noogoora burr	DO NOT incorporate. NOT recommended in North Queensland. Heavy rain after spraying can result in some crop damage
Penoxalin	Stomp 330E	4 500 ml	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for residual effects on subsequent crops

WEED CONTROL GUIDE—PEANUTS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Post-emergence					
MCPB	Tropotox Nufarm metacide	1 400 ml–2 800 ml	After crop seedlings have emerged but before crop flowers	Many annual broad-leaved weed seedlings	Not more than 1 400 ml at or after the crop flowers. Some symptoms of crop injury may occur
2,4–DB	Several products	1 400 ml–2 100 ml	As for MCPB	As for MCPB. Also controls spiny emex	Some symptoms of crop injury may occur
Dinoseb	20% (Several products) 40% (Several products)	5 600 ml–11 000 ml 2 800 ml–5 500 ml	Must be applied before weeds are 15–20 cm tall	Some annual broad-leaved weeds including *Datura* spp., bellvine, wild gooseberry	Follow manufacturers' instructions regarding spray volumes and safety of operator
Bentazone ..	Basagran	1 500 ml–2 000 ml	After crop is 12 cm tall and weeds small	*Datura* spp., Noogoora burr, bellvine, star burr	The lower rates for seedling *Datura* spp. and Noogoora burr Refer to manufacturer's label for spray volume

WEED CONTROL GUIDE—NAVY BEANS

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence–Pre-planting					
Trifluralin ..	Several products	1 400 ml–2 800 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturers' labels for incorporation methods, rates required for different soil types and residual effects on subsequent crops
Pre-emergence–Post-planting					
Chlorthal-dimethyl	Dacthal W75	6·7 kg–11·2 kg	Post-planting, pre-emergence	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for rates of application for different soil types
Post-emergence					
Bentazone ..	Basagran	1 500 ml–2 000 ml	From 2nd trifoliate leaf stage of crop growth and when weeds are small	*Datura* spp., Noogoora burr and bellvine	The lower rates for seedling *Datura* spp. and Noogoora burr Refer to manufacturer's label for spray volume

WEED CONTROL GUIDE—COTTON

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Pre-emergence–Pre-planting Incorporated					
Trifluralin ..	Several products	1 400 ml–2 800 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods, rates required on different soil types and residual effects on subsequent crops
Nitralin	Planavin 75	1·5 kg–2·2 kg	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	
Dinitramine ..	Cobex	3 500 ml–4 000 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	
Fluometuron ..	Cotoran 80WP Flowable Cotoran 50%	1·7 kg–3·5 kg 2 700 ml–5 600 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	
Penoxalin ..	Stomp 33OE	3 000 ml	Pre-planting, soil incorporated	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods and residual effects on subsequent crops
Pre-emergence–Post-planting					
Nitralin	Planavin 75	1·5 kg–2·2 kg	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for incorporation methods, rates required for different soil types and residual effects on subsequent crops
Penoxalin ..	Stomp 33OE	4 500 ml	Post-planting	Many annual grasses and some broad-leaved weeds	Refer to manufacturer's label for residual effects on subsequent crops
Prometryne ..	Gesagard 50	3·3 kg–4·5 kg	Post-planting	Many annual grasses and broad-leaved weeds	Refer to manufacturer's label for rates of application under different conditions

WEED CONTROL GUIDE—COTTON

Herbicide	Trade names	Rate of application (product/hectare)	Method	Weeds controlled	Remarks
Diuron	Several products	1·1 kg–2·2 kg	Post-planting	Many annual grasses and broad-leaved weeds	Refer to manufacturers' labels for rates of application for different soil types and residual effects on subsequent crops
Fluometuron ..	Cotoran 80WP Flowable Cotoran 50%	2·8 kg–4·5 kg 4 500 ml–7 200 ml	Post-planting	Many annual grasses and broad-leaved weeds	Refer to manufacturer's label for rates of application under different conditions and soil types
Perfluidone ..	Destun	5 000 ml	Post-planting at sowing	Some annual grasses including nugtrass and some broad-leaved weeds	Irrigation or rain required for incorporation Refer to manufacturer's label for residual effects on subsequent crops and methods of application
Post-emergence Diuron	Several products	1·1 kg–2·2 kg	Apply as a directed spray after the cotton is 25–30 cm tall	Many annual seedling grasses and broad-leaved weeds	Add one part of 50%–60% non-ionic wetting agent to 250 parts of spray mixture Refer to manufacturers' labels for rates of application and residual effects on subsequent crops
Fluometuron ..	Flowable Cotoran 50%	1 300 ml–2 800 ml	Apply as a directed spray after cotton is 15 cm tall	Some annual grasses and broad-leaved weeds	Refer to manufacturer's label for additional wetting agent and weed growth stage. DO NOT apply more than once per season
MSMA	Daconate 8 (80% WV)	3 000 ml	Apply as a directed spray after the cotton is 7·5 cm tall and before the first bloom opens	Some annual grasses and broad-leaved weeds. Top kill of nutgrass and Johnson grass may be obtained	DO NOT apply after first bloom
	MSMA Weed-killer (50% WV)	4 300 ml			

GUIDE TO THE SUSCEPTIBILITY OF COMMON ANNUAL WEEDS TO HERBICIDES USED WITH SUMMER GRAIN AND OILSEED CROPS

Weed Species		Normal Time of Application															
		Pre-emergence					Pre or post-emergence				Post-emergence (*pre-emergence in peanuts)						
Botanical name	Common name	trifluralin nitralin dinitramine penoxalin	vernolate	alachlor	propachlor	chlorthal-dimethyl	atrazine	prometryne	linuron	diuron	2,4-D (amine)*	2,4-DB MCPB	Tordon 50D	dicamba	dinoseb	bentazone	MSMA
Broad-leaved Weeds																	
Acanthospermum hispidum	Star burr ..	R	—	—	S	R	S	—	—	—	S	S	—	—	S	S	—
Amaranthus cruentus	Redshank ..	S	S	S	S	S	S	S	S	S	S	S	S	S	—	PS	—
Amaranthus macrocarpus	Dwarf amaranth	S	R	S	R	—	S	—	S	—	S	PS	S	S	S	PS	—
Amaranthus retroflexus	Redroot ..	S	PS	S	S	—	S	—	S	—	S	PS	S	S	—	PS	—
Amaranthus viridis	Green amaranth	S	PS	S	S	S	S	—	S	—	S	S	S	S	—	PS	—
Anoda cristata ..	Anoda weed ..	R	—	R	—	—	PS	—	—	—	—	—	—	—	—	S	—
Argemone ochroleuca	Mexican poppy	—	—	—	—	R	—	—	—	—	S	I	S	—	—	—	—
Bidens pilosa ..	Cobbler's pegs ..	R	—	R	S	R	S	—	R	—	I	I	S	S	S	—	—
Chenopodium album	Fat-hen ..	S	S	S	S	S	S	S	S	S	S	I	S	—	I	S	—
Commelina benghalensis	Wandering jew	R	S	PS	PR	—	I	PS	PS	PR	S	I	S	—	S	S	—
Convolvulus arvensis	Bindweed (P) ..	R	R	R	R	R	—	R	—	—	S	—	S	S	—	—	—
Datura spp. ..	Thornapple ..	R	PS	R	R	R	S	—	—	S	I	I†	S	S	S	S	—
Emex australis ..	Spiny emex ..	R	—	—	—	PS	PS	S	S	—	I	S†	S	S	—	S	—
Galinsoga parviflora	Potato-weed ..	R	R	S	S	R	S	S	S	S	S	I	S	—	—	S	—

GUIDE TO THE SUSCEPTIBILITY OF COMMON ANNUAL WEEDS TO HERBICIDES USED WITH SUMMER GRAIN AND OILSEED CROPS

Weed Species		Normal Time of Application														
		Pre-emergence					Pre or post-emergence				Post-emergence (*pre-emergence in peanuts)					
Botanical name	Common name	trifluralin nitralin dinitramine penoxalin	vernolate	alachlor	propachlor	chlorthal-dimethyl	atrazine	prometryne	linuron	diuron	2,4-D (amine)*	2,4-DB MCPB	Tordon 50D	dicamba	dinoseb	bentazone	MSMA
Helianthus annuus	Sunflower ..	R	—	R	—	R	S	—	—	S	S	S	S	S	—	S	—
Hibiscus trionum	Bladder ketmia	R	—	PR	—	—	S	—	—	S	I	—	I	—	S	S	—
Heliotropium amplexicaule	Blue heliotrope (P)	R	R	R	R	R	—	—	—	—	R	R	—	—	—	—	—
Ipomoea plebeia	Bell-vine ..	R	R	R	P	R	S	S	PS	S	S	S	S	S	S	S	—
Ipomoea purpurea	Morning-glory..	R	PR	R	PR	PR	S	PS	PS	PS	PS	S	S	PS	PS	S	—
Medicago sativa	Lucerne (P) ..	R	R	R	R	R	R	—	—	I	I	R	S	S	—	R	—
Nicandra physalodes	Apple-of-Peru (Wild hops)	R	R	S	S	S	S	S	PS	—	S	S	I	—	S	—	—
Parthenium hysterophorus	Parthenium weed	R	—	PS	PS	PR	S	PS	PS	PS	S*	—	S	S	—	—	—
Physalis angulata	Annual ground cherry	R	—	R	R	PR	S	—	—	—	R	R	S	S	PS	PS	I
Physalis minima	Wild gooseberry	R	—	S	R	R	S	—	I	—	R	R	PS	—	S	R	—
Polygonum aviculare	Wireweed ..	S	S	—	R	S	S	PS	I	—	S	I	—	S	—	I	—
Polygonum convolvulus	Black Bindweed (Climbing buckwheat)	I	—	—	—	I	S	S	S	—	I	—	S	S	—	S	—
Portulaca oleracea	Pigweed ..	S	R	S	S	S	S	S	S	S	I	I	S	S	S	S	S
Raphanus raphanistrum	Wild Radish ..	R	R	I	R	R	S	S	S	S	S	R	—	R	S	S	—
Rapistrum rugosum	Turnip weed ..	R	—	—	R	R	S	—	S	S	S	S	I	R	PS	PS	—

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Rumex spp. ..	Dock (P) ..	R	R	R	R	R	—	—	—	—	I	S	S	S	—	—	—
Salvia reflexa ..	Mintweed ..	R	PS	S	PS	R	S	—	—	—	I	R	S	S	S	R	—
Sesbania cannabina	Sesbania pea ..	R	—	—	—	—	S	—	—	—	S	PR	S	—	—	R	I
Sisymbrium spp.	Mustards ..	R	—	—	—	R	PS	—	S	S	S	S	—	R	S	S	—
Solanum nigrum	Black-berry nightshade	R	—	R	S	S	S	S	S	S	S	—	—	S	—	S	—
Sonchus oleraceus	Common sowthistle	—	—	S	S	S	S	S	S	—	S	S	—	S	—	—	—
Tagetes minuta ..	Stinking Roger	R	—	S	S	R	S	—	S	—	S	S	S	—	—	—	—
Tetragonia tetrangonioides	New Zealand spinach	—	—	—	R	—	S	—	—	—	R	R	S	S	—	—	—
Trianthema portulacastrum	Giant pigweed (Black pigweed)	S	—	R	R	S	S	S	—	—	I	I	I	—	—	R	—
Tribulus terrestris	Caltrop ..	I	R	R	S	PS	I	—	R	S	I	—	I	—	S	—	S
Xanthium spp. ..	Noogoora and Bathurst Burrs	R	PR	R	PR	R	S	—	S	—	S	S	S	—	—	S‡	S
Grasses																	
Avena spp. ..	Wild oats ..	S	—	—	—	R	S	—	—	—	R	R	R	R	R	R	S
Cenchrus echinatus	Mossman River grass	S	—	S	S	S	I	R	—	S	R	R	R	R	R	R	—
Cyperus rotundus	Nut-grass (P) ..	R	S	R	R	R	—	—	—	—	I	—	—	—	—	—	S

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Digitaria spp. . .	Summer grass . .	S	S	S	S	S	S	R	S	S	R*	R	R	R	R	R	S
Dinebra retroflexa	Dinebra . .	S	PS	PS	PS	—	R	—	—	—	R*	R	R	R	R	R	PS
Echinochloa spp.	Barnyard grass	S	S	S	S	S	S	—	S	S	R*	R	R	R	R	R	S
Eleusine indica . .	Crowsfoot grass	S	S	S	S	S	S	R	R	S	R*	R	R	R	R	R	PS
Eragrostis cilianensis	Stink grass . .	S	PS	PS	S	S	S	R	I	S	R*	R	R	R	R	R	PS
Sorghum halepense	Johnson grass (P)	I	R	R	R	R	R	—	—	—	R	R	R	R	—	R	S
Sorghum halepense	Seedlings . .	S	—	—	R	R	R	—	—	—	R	R	R	R	—	R	S
Sorghum spp. (from seed)	. .	S	—	—	R	—	R	—	—	S	R	R	R	R	R	R	S
Themeda quadrivalvis	Grader grass . .	S	—	—	S	—	—	—	—	—	R	R	R	R	R	R	—
Urochloa panicoides	Liverseed grass (*Urochloa*)	S	PS	S	S	S	I	—	—	S	R*	R	R	R	R	R	PS

* These weeds are susceptible to 2,4–D as a pre-emergence treatment only (peanuts).
† Susceptible to 2,4–DB only.
‡ Xanthium spinosum (Bathurst burr) resistant.

KEY

S = Susceptible
R = Resistant
I = Intermediate (moderately susceptible)
— = Not known
PS = Probably susceptible
PR = Probably resistant
(P) = Perennial—established plants

Susceptibilities are for the generally recommended rates of application and for post-emergence herbicides weeds should be young and growing vigorously.

The above chart was compiled from a range of published and informal sources. Since the effect of herbicides is widely influenced by environmental conditions and rate of application there is no guarantee that any treatment will have the effect indicated in the chart.

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67976—S. R. HAMPSON, Government Printer, Brisbane

The macadamia leaf miner

THIS native leaf mining moth of the Family Gracillariidae is a major pest of cultivated macadamias particularly during early growth of the trees.

Most severe damage occurs in elevated rainforest areas and in plantings protected from the wind.

The macadamia leaf miner (*Acrocercops chionosema Turner*) is active throughout the year and is widespread in coastal areas of Queensland and New South Wales. Other hosts include the non-cultivated species of macadamia, *Polyosma cunninghamii* and *Stenocarpus salignus*.

Life history and habits

- ADULT. The adult is brown with prominent silver bands on the forewings and a wing span of about 8 mm. It is active mainly at night but is occasionally seen on foliage during the day.
- EGG. The egg is oval with a low, rounded profile and a flattened margin, about 0.5 x 0.4 mm in size. On the leaf, it resembles a tiny, glistening water droplet. Eggs are laid singly, mainly on the upper surfaces of young leaves and as many as 96 eggs have been counted on a leaf 50 mm long.
- LARVA. The larva passes through five stages during its development. The first three stages have flattened, blade-like mouth parts with which they lacerate the leaf cells and suck the sap. The last two stages have biting and chewing mouth parts with which they cut deeper into the leaf.

On hatching, the tiny larva cuts through the floor of the egg into the leaf where it makes a narrow, meandering mine just under the leaf surface. The mine varies in width from 0.2 mm to about 1 mm and may be up to 60 mm long by the second moult.

The third stage larva feeds voraciously and a single larva may mine 200-300 mm^2 of leaf surface. When larvae are numerous, the blister-like blotch mine may extend over the entire leaf. Older larvae are often concealed under the brown roof of secondary mines within the transparent, blister-like mine.

Larvae at first are a pale green but become white to bright yellow in colour, sometimes with an underlying dark hue. During the last stage, larvae develop bright red bands. Fully-grown larvae leave the damaged leaves and seek out pupation sites in debris on the ground.

- PUPA. Pupation occurs within an oval, flattened, silken cocoon spun by the mature larva, the pupa being about 4 mm long. After moth emergence, the pupal case is left protruding from the cocoon.
- DURATION OF THE LIFE CYCLE. Development from the laying of the egg of the adult requires 19 to 23 days in summer and 50 to 53 days in winter. In summer, the eggs hatch in 3 to 4 days and from hatching to commencement of the blotch mine takes only 4 days.

Damage

Mining is confined to lush, new foliage and during severe attacks both leaf surfaces may be entirely covered with mines causing the young foliage to crumple. Trees remain ragged and fire-scorched in appearance long after the attack has passed. Tree growth is retarded and sustained attacks can result in terminal dieback and probably reduced yields.

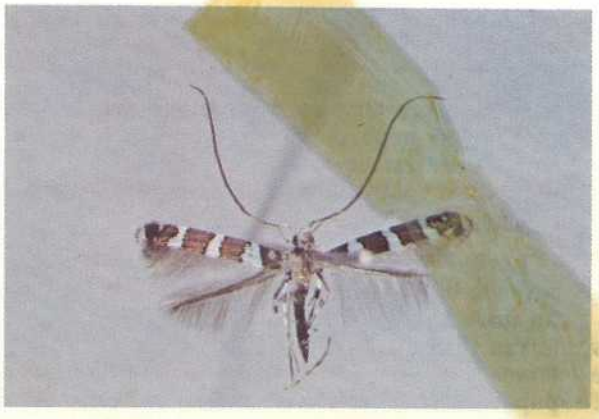
Heavy pruning should be avoided, particularly during the first few years of tree life, as such pruning may weaken the tree and intensify the effects of leaf miner damage.

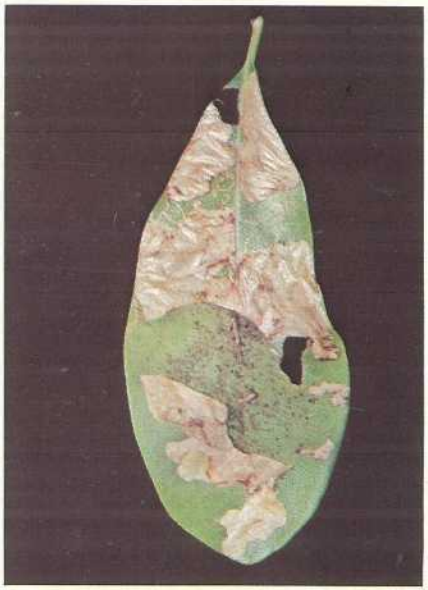
Natural enemies

Parasitism by a tiny wasp *Elachertus* sp. (Family Eulophidae) is at times important in regulating macadamia leaf miner populations. The parasite larva attaches itself to and feeds on the body of the pest larva soon causing its death. Spiders prey on fully-grown leaf miner larvae as they leave their mines to pupate.

by D. A. Ironside, Entomology Branch

The macadamia leaf miner





TOP LEFT. The moth of the macadamia leaf miner (wing span 8 mm).

MIDDLE LEFT. Mined macadamia leaf with portion of the blister mine removed exposing the larvae.

LOWER LEFT. Heavy leaf miner damage on the succulent growth of a young macadamia tree.

TOP RIGHT. Macadamia leaf miner eggs (glistening spots on the smaller leaf) and the narrow, meandering mines of newly-hatched larvae on the larger leaf (6.4 cm long).

ABOVE RIGHT. Fully-grown larvae (5 to 6 mm long) including the red-banded pre-pupal stage on a damaged leaf.