

# *Queensland* **AGRICULTURAL JOURNAL**

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COVER. Harvesting Queensland's wheat crop. See '100 years of wheat at Dalby' in this issue. Photograph by A. J. Ernst.

Editor, P. R. Lee

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## Sown pastures in the South Burnett

HENRY STUART RUSSELL set out from Cecil Plains in 1842 in search of sheep country.

He found suitable country in the western area of what is now called the South Burnett and selected 'Burrandowan'. In 1842, Simon Scott established the first holding at Taromeo. Tarong, Nanango and Taabinga quickly followed, and by 1850 most of the land was settled.

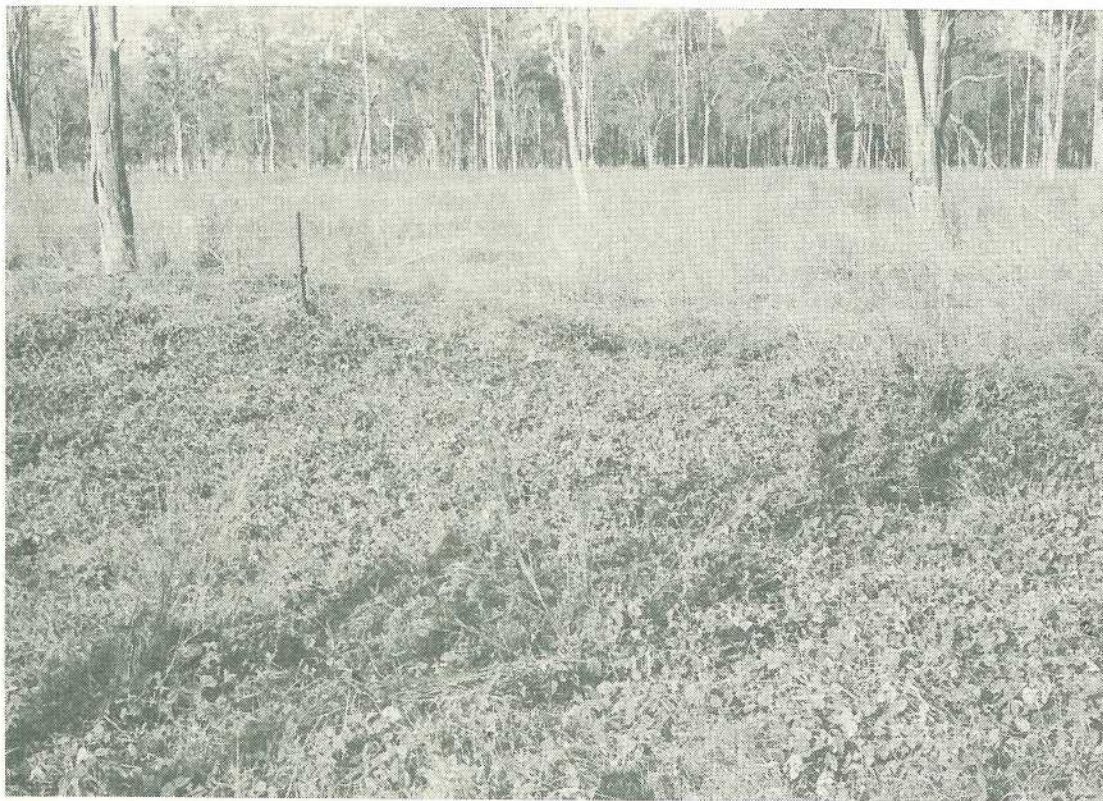
The native pasture species found in the area included kangaroo grass (*Themeda australis*), forest bluegrass (*Bothriochloa bladhii*), Queensland bluegrass (*Dichanthium sericeum*), black spear grass (*Heteropogon contortus*), pitted bluegrass (*Bothriochloa decipiens*), burr grass (*Cenchrus* sp.), love grasses (*Eragrostis* spp.) and wire grasses (*Aristida* spp.) and the legumes *Glycine tabacina* and *Rhynchosia minima*.

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by A. Hodge, Agriculture Branch.

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Photograph above. Bullocks grazing green panic/siratro pasture. Green panic grows well in the shade of trees.



*Low key development. Siratro oversown into native pasture.*

In 1861, the district had 18 400 sheep, 23 000 cattle and 36 pigs. Wool was the main product.

Frequent burning and overgrazing depleted the better native grasses and during the 1880s an increase in black spear grass and worms caused a swing away from sheep and an increase in cattle numbers. By the turn of the century, there were fewer than 7 000 sheep as compared with 84 000 cattle. Present day stock numbers (1978) are 268 000 beef cattle, 30 000 dairy cattle, 1 100 sheep and 88 600 pigs.

### **Present and potential land use**

The South Burnett covers an area of 1 000 000 hectares and includes the Shires of Kingaroy, Nanango, Wondai and Murgon, together with that part of Kilkivan Shire west of the Coast Range and that part of Rosalie Shire east of the Great Dividing Range.

Livestock production is carried out on three major types of properties:

- Large properties of at least 800 ha where the cattle grow on native pasture and are finished on oats. Most of the native pasture areas have had some timber treatment.

## Climate

- Smaller properties with more intensive timber treatment and a fair proportion of cultivation. Most beef and dairy farms are in this group. Because of the higher land values, some improved pastures are used to increase production. These properties are usually found adjacent to the main areas of cultivation.
- Crop farms of around 140 ha where old or difficult cultivation areas are planted to pasture and utilized by beef or dairy cattle.

The present land use in the South Burnett is as follows:

Present Use	% of Total	Area (ha)
Cultivation .. .. .	16	160 000
Sown pasture and lucerne .. .. .	7	70 000
Forestry and timber reserves .. .. .	9	90 000
Towns and roads .. .. .	8	80 000
Native pasture (improved by timber treatment) .. .. .	60	600 000

Source: Soil Conservation Branch

The potential land use in the South Burnett under present day farming practices is as follows:

Potential Use	% of Total	Area (ha)
Suitable for cultivation .. .. .	20	200 000
Improved pasture and lucerne .. .. .	52	520 000
Unsuitable for development .. .. .	11	110 000
Remainder, reserves, towns, etc.	17	170 000

The 600 000 ha of native pasture can be sub-divided into various land capability classes:

Land Class	%	Area (ha)
Potential cultivation .. .. .	6.7	40 000
Potential pasture .. .. .	75.0	450 000
Not suitable for cultivation or improved pasture .. .. .	18.3	110 000

This indicates that the greatest potential for expansion is in sown pasture. The expansion of sown pasture will, however, be slow compared to the more remunerative cropping. Reasons include:

- Suitable topography, soil and proximity to markets favour intensive production.
- Financial returns from crop production are usually much greater than from pastoral production.
- Cropping in the area is traditional and is well understood.
- The structure and function of intensive integrated crop/livestock systems are not well understood.

While most of the area receives an annual rainfall of 700 to 850 mm, rainfall varies from 1 000 to 1 250 mm in the east, down to 700 mm at Boondooma in the west. Some 70% falls during the summer months (October to March). December to February are the hottest months with a mean daily maximum temperature of 29.1°C. Heatwaves are seldom experienced and cyclonic influences rarely extend beyond the Coast Range.

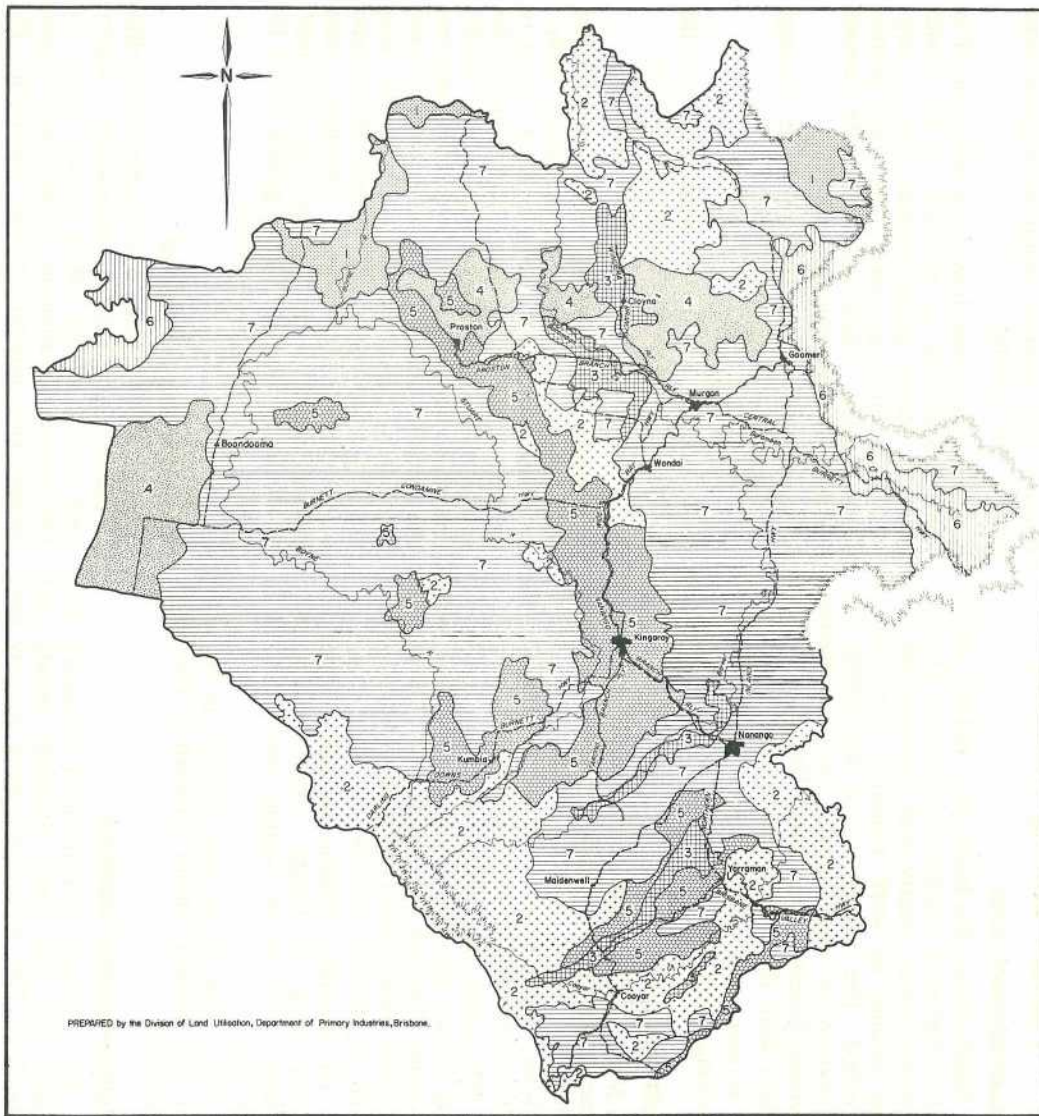
During winter, when mean daily maximum temperatures are 15.2°C, some 25 heavy and 45 light frosts can be expected at lower altitudes. These frosts occur from early May to late September and limit the production from tropical pastures. However, some elevated areas receive few frosts.

Prevailing winds are from the south-east but westerly winds are common in late winter and early spring. Although these winds have little effect on established pasture they can be detrimental to seedling establishment.

## Soils

Soils of the South Burnett have been described in accordance with the 'Northcote' classification as used in the CSIRO 'Atlas of Australian Soils' (1966). This system groups soils according to landforms, rainfall, natural vegetation and geology. There are seven main associations (groups) in the South Burnett:

1. Leached sandy soils (Uc2)
2. Leached loamy soils (Um2)  
Friable loamy soils (Um6)  
Dark cracking clays (shallow to moderately deep profiles) (Ug5)  
Friable loamy soils with red clay subsoil (Dr4)  
Friable loamy soils with brown clay subsoils (Db3)
3. Dark cracking clays (deep profiles) (Ug5)
4. Grey cracking clays (Ug5)  
Red earths (Gn2.1)  
Brown friable earths (Gn3.2)
5. Red friable earths (Gn3.1)
6. Hard-setting loamy soils with red clayey subsoil (Dr2)



PREPARED by the Division of Land Utilization, Department of Primary Industries, Brisbane.

QUEENSLAND  
DEPARTMENT OF PRIMARY INDUSTRIES  
SOUTH BURNETT REGION  
SOIL ASSOCIATIONS



LEGEND

- 1 Leached sandy soils (Uc 2)
- 2 Leached loamy soils (Um 2)  
Friable loamy soils (Um 6)  
Dark cracking clays - shallow to moderately deep profiles (Ug 5)  
Friable loamy soils with red clay subsoil (Dr 4)  
Friable loamy soils with brown clay subsoil (Db 3)
- 3 Dark cracking clays - deep profiles (Ug 5)
- 4 Grey cracking clays (Ug 5)  
Red earths (Gn 2.1)  
Brown friable earths (Gn 3.2)  
Red friable earths (Gn 3.1)
- 5 Hard setting loamy soils with red clayey subsoil (Dr 2)
- 6 Hard setting loamy soil with yellow clay subsoil (Dy 2)  
Hard setting loamy soil with mottled yellow clay subsoil (Dy 3)  
Sandy soil with mottled yellow clay subsoil (Dy 5)  
Hard setting loamy soils with red clay subsoil (Dr 2)
- 7

NOTE

Soils are described in accordance with the Northcote classification (C.S.I.R.O. Atlas of Australian Soils)

LOCALITY MAP



7. Hard-setting loamy soil with yellow clay subsoil (Dy2)  
Hard-setting loamy soil with mottled yellow clay subsoil (Dy3)  
Sandy soil with mottled yellow clay subsoil (Dy5)  
Hard-setting loamy soil with red clay subsoil (Dr2).

The distribution of these soil associations is shown in the accompanying map.

## Pasture sowing methods

### Establishment cost

Much money has been spent and lost on the establishment of pastures in the area. The cost involved varies greatly with the seed cost and the amount of work required to prepare a seedbed. The average cost of establishing 1 ha of pasture or lucerne under the Dairy Pasture Subsidy Scheme in the South Burnett was \$60. Costs have risen substantially since then.

A number of methods have been used with varying degrees of success:

### Ash seedbed

Most of the South Burnett scrub areas have been cleared for cultivation and only a limited area has been cleared for pasture. Scrub country for pasture is usually too steep for cultivation and is sown by air.

The scrub after being pushed, is allowed to dry before burning. From 3 to 4 days after burning, the ash has cooled and the area is seeded. Most grasses and legumes will establish well on an ash seedbed.

To minimize erosion on steep country, a cover crop of forage sorghum is usually incorporated in the seeding mixture at 2 kg per ha.

Very little of the area which can be sown by this method remains unsown in the South Burnett.

### Fully-prepared seedbed

The amount of cultivation necessary will vary with soil type, situation, weeds and weather. The main requirement is early land preparation to ensure good weed control and moisture conservation. The seedbed for small pasture seeds should be firm.

Old cultivation areas should be cultivated to a fine tilth and should be free of weeds before sowing pasture seed. Soils which repel moisture or crust after rain should be left slightly coarser.

The pasture seed should be broadcast or drilled very shallowly and the ground lightly harrowed. At no time should pasture seed other than lucerne be buried to a depth greater than 15 mm. Lucerne may be planted slightly deeper.

Rolling is recommended after seeding. Pasture seeds sown on sandy soils derive most benefit from rolling.

Companion crops have been widely used in the establishment of pastures in the South Burnett. Maize, grain sorghum, forage sorghum and millets are sown at half their normal seeding rates. There are four main reasons for the use of companion crops:

- Shading to protect young pasture seedlings on sandy soils.
- To suppress weeds.
- To provide grazing or some return in the event of the pasture failing to establish.
- To minimize erosion on steep country.

Minimizing erosion on steep country is the only valid reason for planting pastures with a companion crop. Planting in early spring or autumn will avoid seedlings being burnt in the sandy soils. Planting a companion crop thickly enough to suppress weeds would also suppress the pasture species. The moisture stress induced by the companion crop in the initial growing stage can greatly reduce the chances of the pasture establishing. To plant a companion crop as a source of grazing often leads to the companion crop being grazed before the pasture has fully established.

### Semi-prepared seedbed

Something less than a fully-prepared seedbed is usually sufficient for introducing a legume such as siratro into native pasture areas. As little as one chiselling or discing can give good results with minimum timber treatment. The main requirements of this system are to loosen the ground surface and reduce competitive plant growth.



### No seedbed

This method is the least likely to succeed. Establishment of pasture without seedbed preparation has been tried where the natural vegetation has been overgrazed and stock numbers have caused the soil surface to be disturbed. On occasions seed has been lightly incorporated with harrows. Some degree of success has been achieved on loose, sandy soils, especially with siratro.

Experimental plantings of fine-stemmed stylo (*Stylosanthes guianensis* var. *intermedia*) have shown promise in the coarse sands in the drier western area. Townsville stylo (*Stylosanthes humilis*) sometimes shows promise in its first year of growth but it does not persist because of the short growing season experienced in this area.

### Fertilizer for establishment

Worthwhile results can only be expected if the pasture is sown on to a seedbed adequately supplied with plant nutrients. Individual recommendations are based on soil tests and local experience.

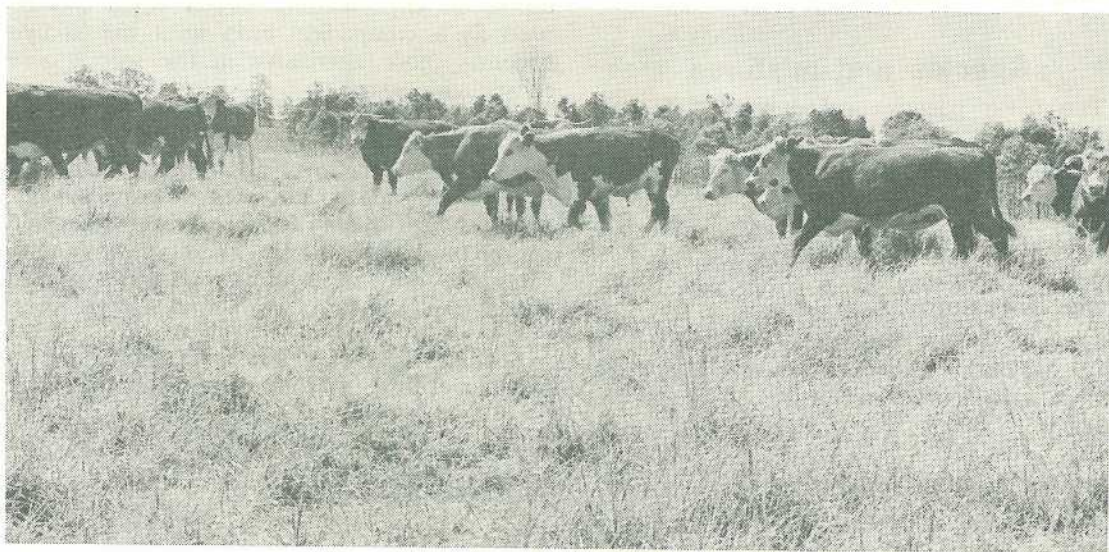
Most 'black' soils have adequate phosphorus while other soils are usually deficient. All soils in the region, except Group 3 (see soils section) will require phosphatic fertilizer application for establishment.

Potassium deficiency is more likely to be found in the sandier soils (Groups 1 and 7) but can also occur in areas with a long history of lucerne growing.

Areas which have a long history of cultivation can be deficient in nitrogen and sulphur.

Nitrogen, phosphorus, potassium and sulphur deficiencies can be corrected by applying a fertilizer containing 20 to 25 kg per ha nitrogen, 10 to 20 kg per ha phosphorus, 10 to 65 kg per ha potassium or 20 to 60 kg per ha sulphur respectively.

Where there is a molybdenum deficiency, 125 to 250 kg per ha of superphosphate with  $Mo_{24}$  (0.04% Mo) should be applied. Molybdenum deficiency can be suspected in red soils (Groups 4 and 5) with pH of less than 6.0.



A group of steers fattening on Rhodes grass and siratro near Nanango.

## Pasture seed quality

Pasture seed should be of good quality and have the required level of germination and purity. Seed which does not reach the quality required should either be discarded or re-cleaned.

Recommended seeding rates are based on the following germination and purity values for the various species:

Species	Purity	Germination
	%	%
Buffel ( <i>Cenchrus ciliaris</i> ) ..	90	20
Green panic ( <i>Panicum maximum</i> , var. <i>trichoglume</i> cv. Petrie) .. .. .	70	20
Kikuyu ( <i>Pennisetum clandestinum</i> ) .. .. .	93	60
Makarikari ( <i>Panicum coloratum</i> , var. <i>makarikariense</i> ) ..	80	20
Paspalum ( <i>Paspalum dilatatum</i> ) .. .. .	60	60
Prairie ( <i>Bromus catharticus</i> )	95	65
Rhodes ( <i>Chloris gayana</i> ) ..	90	20
Ryegrass ( <i>Lolium</i> spp.) ..	97	65
Setaria ( <i>Setaria anceps</i> ) ..	60	20
Lotononis ( <i>Lotononis bainesii</i> ) .. .. .	93	50
Lucerne ( <i>Medicago sativa</i> )	98	80
Medic ( <i>Medicago</i> spp.) ..	95	75
Siratro ( <i>Macroptilium atropurpureum</i> ) .. ..	97	70

Seed of poorer quality can be used but the seeding rates should be increased.

## Species and mixtures

The sown pastures recommended for the South Burnett can be divided into three types:

- Summer-growing grass without legume
- Lucerne
- Grass-legume mixture

### Lucerne pasture

Lucerne is an important pasture in the South Burnett. Planting rates are 4 to 11 kg per ha rain-grown and 8 to 14 kg per ha irrigated.

### Pastures without legume

Straight grass pastures are usually planted in situations where there are weed or regrowth problems such as lantana (*Lantana camara*).

Establishing a pasture without a legume allows for herbicide spraying for weed control. Legumes can be sod-seeded into the grass after the weed has been controlled.

### Grass-legume mixture

The most economical dryland pastures usually contain both a grass and a legume component.

In the early development of pastures in the South Burnett there was a trend to use 'shot-gun' mixtures with as many as three grasses and three legumes. These mixtures usually quickly settled out into the most unpalatable grass and legume, the more palatable species being selectively grazed out. To simplify management, mixtures are now generally recommended to contain only one grass.

Since the growing season is somewhat short for siratro, there is scope on suitable soils for adding a winter-growing legume such as medic. This will take advantage of any winter rainfall to extend the period of high quality grazing. Lucerne is sometimes used for the same purpose. However, because of soil acidity and/or poor drainage of many pasture soils it rarely survives for more than 2 or 3 years.

Kikuyu sown by seed is very slow-growing during its first season. Green panic can be used as a companion crop until the kikuyu becomes more aggressive in the second and subsequent years.

Irrigated pastures can contain lucerne only or lucerne, white clover and ryegrass. Mixtures of ryegrass varieties are used to provide high-yielding, high quality fodder during winter and spring under irrigation. These ryegrass mixtures are only used on an annual basis so cannot be thought of as permanent pastures.

Seeding rates vary but there should be no need to exceed the following maximum rates:

	Rain-grown (kg/ha)	Irrigated (kg/ha)
Total legume seed ..	6	8
Total grass seed ..	6	10
Total seed .. ..	10	16

Mixtures may be selected from the following list:

Legumes						Seeding rate (kg/ha)	Suitable soil types and short comments
Lucerne	..	..	..	..	..	2-6	All soils except very acid or poorly drained. pH above 5.5. Lime pellet seed if pH below 6.5.
Siratro	..	..	..	..	..	0.5-2	Almost all non-irrigated well drained areas 2,3,4
Medics (Jemalong, Cyprus, snail, Harbinger, burr)	..	..	..	..	..	1-4	
White clover	..	..	..	..	..	1-3	2,3,4. Wetter areas or irrigation
Strawberry clover	..	..	..	..	..	1-2	2,3,4. Swampy or salt seepage areas
Lotononis	..	..	..	..	..	0.5-1	1,2,6,7. Granite ridges
Fine stemmed stylo	..	..	..	..	..	1-2	1,2,6,7. Well drained granite areas

Grasses						As only grass (kg/ha)	With other grasses (kg/ha)	Suitable soil types and short comments
Gatton panic	..	..	..	..	..	3-6	2-3	Soil groups 2,4,5. Does best on friable soils
Green panic	..	..	..	..	..	3-6	2-3	Soil groups 2,4,5. Seed is cheap
Kikuyu	..	..	..	..	..	0.5-1	0.3-0.5	Established with no other grass except green panic
Rhodes Grass (Pioneer, Katambora, Callide)	..	..	..	..	..	2-5	1-2	Soil groups 1,2,3,4,5,6,7. A very aggressive species
Makarikari (Pollock, Bambatsi)	..	..	..	..	..	1-4		Soil groups 2,3,4. Suitable for wet clays and flood prone areas.
Buffel (Biloela, Gayndah, Molopo, Nunbank, Boorara)	..	..	..	..	..	2-5	1-3	Soil groups 1,2,6,7. A drought tolerant species
Setaria (Kazungula)	..	..	..	..	..	1-4	1-2	Soil groups 2,3,4,5. Suited to higher rainfall areas
Ryegrass (Kangaroo Valley) and/or H1*	..	..	..	..	..	4-10	3-6	For irrigated areas or moist creek flats
Prairie (Priebe Perennial)	..	..	..	..	..	6-10	2-4	Well drained creek flats, without other grasses

\* also known as Grasslands Manawa

## Seed treatment

The correct inoculum should be used on all legumes. Nodules may form on legumes which have not been inoculated but there is no guarantee that these nodules are active in fixing nitrogen.

Inoculated legume seed should not come into contact with grass seed treated with pesticide or with fertilizer. When this is not feasible, pelleting the legume seed after inoculation will help the inoculum to remain viable; lime is used for pelleting temperate legumes and bauxite for tropicals.

Inoculated seed should not be subjected to high temperatures or exposed to sunlight.

## Planting time

Grass seed and grass-legume mixtures can be sown from September onwards provided soil moisture is adequate. Spring plantings favour the grass in grass/lucerne plantings

as lucerne seedlings can be killed during the summer heat before deep roots can be established. December and January are usually unfavourable for pasture sowing due to periods of high temperatures. February and March plantings are more favourable to the establishment of lucerne and medics. Straight lucerne stands are best planted in April-May.

## Pasture management

### Maintenance fertilizer

Continued fertilizer applications will be required to maintain pasture production. Nitrogen fertilizer requirements for satisfactory pasture growth will vary greatly each season according to the type of pasture, the amount of nitrogen fixed by the legumes in a grass-legume pasture and growing conditions. Nitrogen at the rate of 30 kg per ha can be added to a grass pasture for additional growth provided there is adequate moisture. The amount of nitrogen fixed in a grass-legume pasture



*Lotononis can be hard to find. Here it is growing with Pioneer Rhodes grass on hard granite soils near Nanango.*

*Surplus green panic/siratro pasture being cut for hay.*



in the first year will be low. Nitrogen added to a grass-legume pasture can be used as a stop gap measure to boost the grass component. Continued application would be to the detriment of the legume component.

Phosphorus fertilizer will be necessary on all soils except Group 3 to encourage the legume component. The minimum annual fertilizer requirements would be 125 kg per ha of superphosphate. This application should supply sufficient sulphur for these soils as well as the phosphorus.

In Group 3 soils, it may be necessary to add sulphur if the legume has nodulated and still appears light green in colour. Sulphur fertilizer is available in various forms.

Potassium requirement is more likely on soils in Groups 1 and 7 or on areas with a long history of lucerne growing.

### **Grazing**

New pastures should not be grazed until the plants have begun to flower. As most grasses and legumes develop at different rates, it is better to graze later than earlier. If the stand is poor, the pasture should be allowed to set seed before grazing or mowing. Later grazings should not defoliate the pasture below 7 to 10 cm. Continued close grazing, particularly in summer, will reduce the root system. A

plant cover of 10 cm depth will control soil erosion by lessening the impact of raindrop action and increasing water infiltration.

Rotational grazing will help maintain pasture species, particularly lucerne and green panic. Heavy stocking for short periods on small areas reduces selective grazing.

Lucerne may disappear from a pasture in 12 months under continuous grazing. Rotational grazing can extend this period to 4 or 5 years.

### Other aspects

Renovation will increase moisture penetration on hard-setting soils. There is also a temporary response to nitrogen released from the soil organic matter. Repeated renovation will, however, seriously deplete soil nitrogen.

Renovation is not required for moisture absorption on cracking clays.

Mowing or slashing of dead pasture growth in spring makes young green shoots more accessible to the grazing animal. It can also be useful in controlling weeds, particularly during the establishment phase.

A rapidly-growing pasture will often suppress weeds. Persistent weeds may be spot sprayed with selective herbicides such as 2,4-D. The spray will damage and may even kill the legumes; however, a twining legume such as siratro will spread back into the sprayed area.

### Diseases

There are few diseases in sown pastures which are growing well and are managed correctly. Diseases are usually associated with excessively wet conditions and poor nutrition.

### Insects

These are seldom a problem in pastures in the South Burnett although when conditions are favourable there may be a major outbreak in a localized area.

Lucerne is the only pasture species regularly sprayed for insect control. Recently, the blue-green and spotted alfalfa aphids have infested South Burnett lucerne paddocks. If these aphids are not controlled, lucerne could disappear in 2 years even when rotationally grazed.

The most common pests and their control are listed in the following table:

Pest	Pesticide	Application rate active ingredient per ha	Withholding period (Days)
Blue-green lucerne aphid ( <i>Acyrtosiphon kondoi</i> )	demeton-S-methyl	37.5 g	3
Spotted alfalfa aspid ( <i>Therioaphis trifolii f. maculata</i> )	thiometon	37.5 g	7
	pirimicarb	50 g	3
Budworms ( <i>Heliothis</i> spp.)	carbaryl	1.1 kg	1
Lucerne leaf-roller ( <i>Merophyas divulsana</i> )	carbaryl	850 g	1
Lucerne jassids ( <i>Austroasca</i> spp.)	methidathion	340 g	7
Lucerne crown borers ( <i>Zygrita diva</i> )	dimethoate	150 g	7
( <i>Corrhenes stigmatica</i> )	carbaryl	850 g	7
Lucerne blue butterfly ( <i>Lampides boeticus</i> )	Not available		
Red spider or two-spotted mite ( <i>Tetranychus urticae</i> )	carbaryl	1.2 kg	1
	azinthos-ethyl	35 g	14
<i>Pasture</i>			
Armyworms ( <i>Pseudaletia convecta</i> , <i>Spodoptera exempta</i> )	maldison ULV*	700 ml	7
	chlorpyrifos	350-400 g	2
	diazinon	800 g	2
	methidathion	560 g	7
	trichlorfon	550 g	2
Grass caterpillar ( <i>Psara licarsialis</i> )	carbaryl	550 g	1
Blue oat mite ( <i>Penthaeus major</i> )	trichlorfon	550 g	2
	azinthos-ethyl	35 g	14

\* ultra low volume

# The Bursarias of South-eastern Queensland

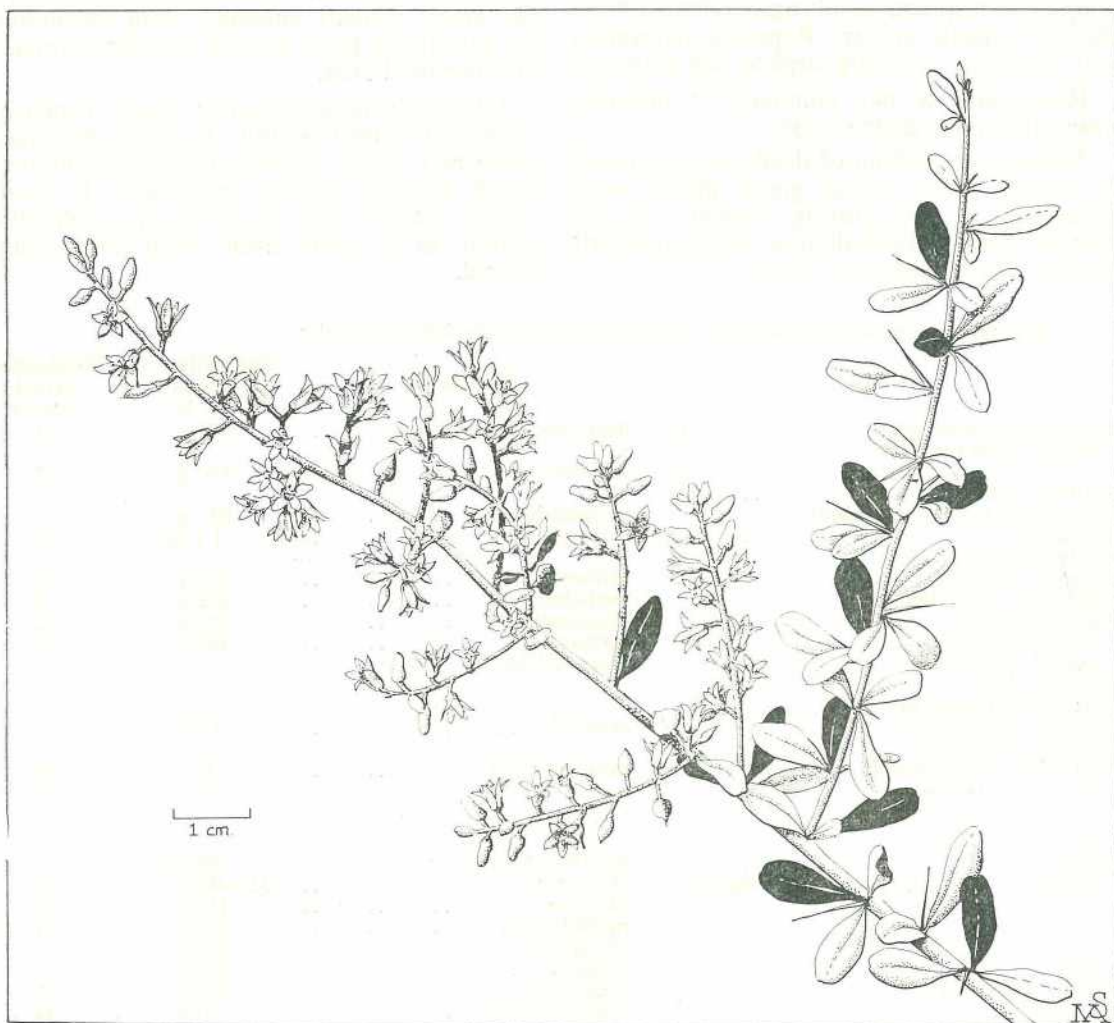
by Beryl A. Lebler, Botany Branch

MANY Australian plants were first described at the end of the eighteenth century from plants cultivated in Europe.

These were grown from seeds collected in Australia by the early explorers. *Bursaria spinosa* was one such plant and gave the genus its name.

The Latin word *bursa* means a purse, and the name describes the shape of the flattened fruits. Bursarias are found only in Australia and are woody, much-branched trees or shrubs. The leaves are alternate and have entire margins. Masses of small, creamy-white flowers are produced in terminal panicles.

Each flower has five sepals, five petals and five stamens, all completely free, and an ovary with two cells. The fruit is a flattened, dry



*Bursaria spinosa*

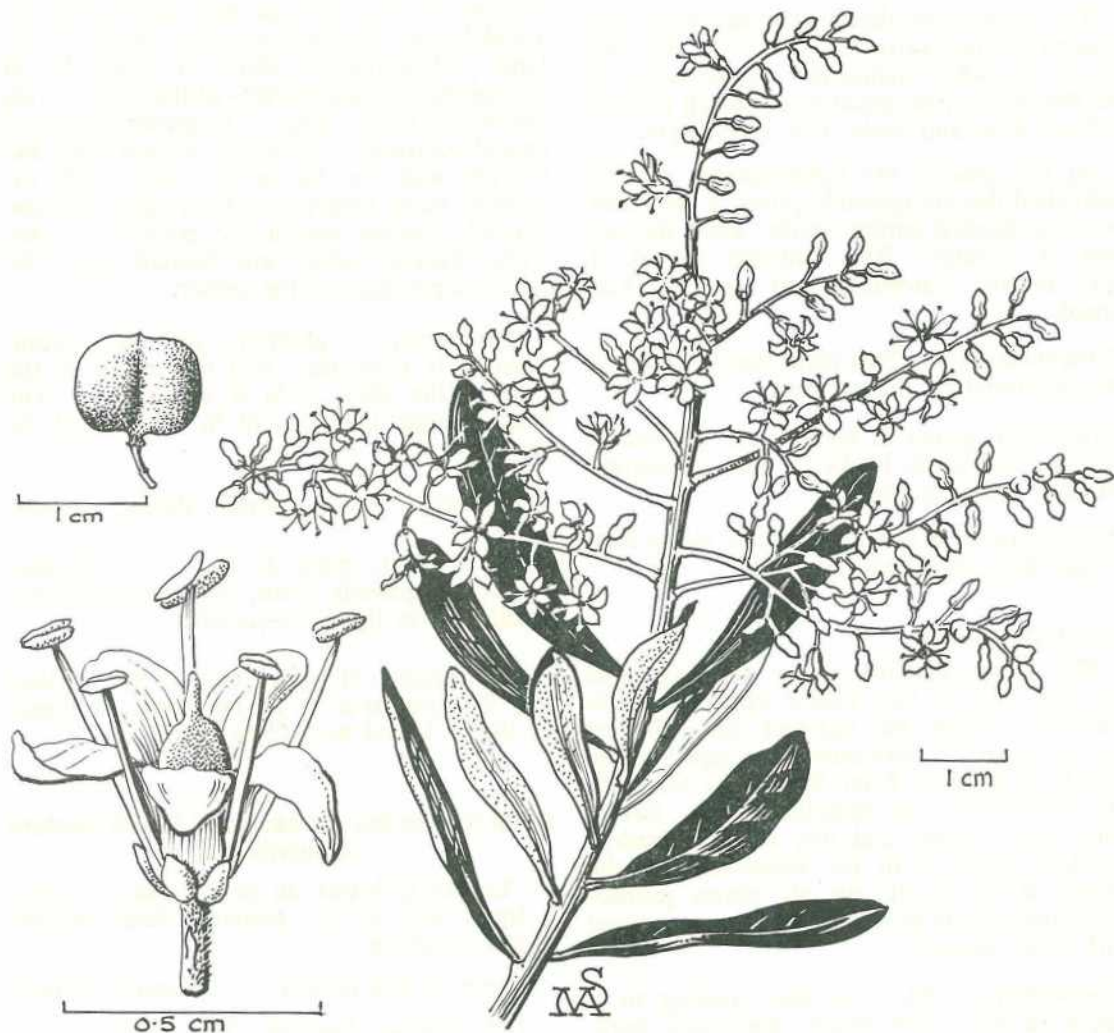
capsule with a notch at the top. It splits along the top to release two to six flat, kidney-shaped seeds.

Two bursarias are native to South-eastern Queensland—*Bursaria spinosa*, and *B. incana*. Both plants have been known as blackthorn, prickly pine, or mock orange.

*Bursaria spinosa*

The Latin adjective *spinosa* means spiny. It refers to the short pungent spines into which the lateral branches are often reduced.

DESCRIPTION. This is a shrub which, when young, is very bushy with many widely-spreading branches. In Queensland, it usually does not exceed 4 m in height. The leaves are very variable. On very young trees or on sterile branches in the lower parts of adult trees, leaves can be only 0.5 cm long, and almost as wide, and the shoots bearing them are very spiny. On older branches higher up on the plant, the leaves can be up to 4.5 cm long, and the branches less spiny. The leaves are in clusters of two or three along the stems usually with a short, rigid



*Bursaria incana*

spine projecting from the middle of the cluster. The leaves are obovate, with a blunt tip which is slightly notched. They are glabrous on both surfaces, dark green but not glossy. Sometimes a few scattered hairs can be found on the lower surface.

The flowers are white and very numerous and are massed in terminal panicles. Short, appressed, golden hairs cover the branches in the panicles and also the peduncles. They can only be seen under magnification. The sepals are triangular and pointed and are about 0.1 cm long. The spreading, narrow petals are 0.5 cm long and have rounded tips.

The stamens are shorter than the petals with lemon-coloured versatile anthers at the ends of slender, white filaments. In the centre of the flower is a pale green ovary which is about 0.2 cm long and ends in a short style.

At first glance, the inflorescences and the individual flowers resemble privet, a very commonly cultivated garden shrub. Even the perfume is similar. The flattened capsule is dark brown, thin-walled and up to 0.5 cm broad.

**FLOWERING TIME.** This plant can be found in flower throughout the summer.

**HABITAT.** It grows in coastal and sub-coastal districts near creek banks, in open eucalyptus forest or in light rain-forest.

**DISTRIBUTION.** It can be found in every Australian State including Tasmania.

### *Bursaria incana*

The Latin adjective *incana* meaning white or quite grey is the specific epithet for this *bursaria*. When the explorer Mitchell first saw this plant in 1846 during his expedition in search of a route from Sydney to the Gulf of Carpentaria, he described it as having 'long, hairy leaves and flat, round capsules'. He first found it in the headwaters of the Nogoia River. Later, on his return journey the plants on the Warrego River were covered with white flowers.

**DESCRIPTION.** This is a tree growing to a height of 6 m, with rough, dark grey bark. The leaves are alternate and arranged in a

close spiral along the branches. They are entire, obovate, up to 9 cm long and 1.2 cm wide. The upper surface is dark green and shiny. Short, white, crinkly hairs give a grey appearance to the lower surface. Since the leaves point along the branches towards the ends, the hairy lower surfaces are clearly seen.

The white flowers are massed in terminal, branched panicles. These can be up to 12 cm long and almost as wide. They are held up above the leaves. The perfume of the flowers is similar to that of privet.

Minute, white hairs are scattered over the branches of the inflorescences, but the flowers are glabrous. The peduncles are about 0.2 cm long. Magnification shows a scattering of minute hairs on the margins of the sepals which are about 0.1 cm long. The petals curve and spread outwards. They are 0.6 cm long and 0.2 cm wide in the upper part, with the stamens being longer than the petals. Yellow, versatile anthers are at the ends of slender, white filaments which are inserted above the heart-shaped base of the anther.

The ovary is glabrous and pale green. Since it is more than half the length of the corolla, the short style is easily seen. The fruit is larger than that of *B. spinosa* but the same shape.

**FLOWERING TIME.** It flowers during summer.

**HABITAT.** This plant is found in softwood scrubs, in gravelly loam, in open eucalyptus forest and in light rain-forest.

**DISTRIBUTION.** It grows only in Queensland and is widespread to as far north as Prince of Wales Island near Cape York.

### Field Key to the *Bursarias* in South-eastern Queensland

1. Leaves glabrous on both surfaces, sometimes with a few scattered hairs on the lower surface.

Shrub or tree to 4 m . . . *Bursaria spinosa*

Leaves hoary beneath. Tree to 6 m

*Bursaria incana*



# Motor bikes can save money

by J. Boorman, Beef Cattle Husbandry Branch.



MOTOR BIKES are gaining a place in the beef industry of Far North Queensland.

When motor bikes are mentioned thoughts often come to mind of unkempt individuals roaring around the countryside with equally unkempt females riding the pillion seat.

But the motor bike is changing the face of the beef industry. Property owners, managers and ringers are all riding bikes today.

Bikes save time and money—important considerations in an industry which cannot afford enough labour!

## Disagreement

Not all graziers agree on the place of the bike in the industry.

Graham Elmes of 'Olivevale', Laura, does not like to use bikes for mustering. He says he does not spend enough time with his cattle when he uses bikes.

When mustering with horses, Graham finds it necessary to hold cattle to spell the horses for a while after the cattle have been blocked up initially. He contends this is good education for his cattle and because it is not necessary to spell a bike the temptation is to keep going and so the cattle miss some valuable extra education.

Bikes suffer heavy damage where there are large surface stones. Gerry Collins said they cannot use bikes on 'Rosella Plains' because of the damage they suffer in the basalt.

## Advantages

There are other graziers and managers who have obtained advantages from using bikes.

Stan Ahlers from 'Bellvue', Chillagoe, finds bikes very effective to muster with. He says that they get wild cattle with bikes that would have to be 'thrown' if they were mustering on horses.

Stan also uses bikes effectively with horses. The horses are run every morning by a man on a bike and he has found that mares and foals and brumbies can be handled easily by men on bikes.

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*Motor bikes are proving useful on beef properties in the dry tropics of the Far North. Jack Lethbridge of 'Glenmore' uses motor bikes to check water and fences and to shift cattle when waterholes dry up.*

Gordon Arnold from 'Wrotham Park' had never ridden a bike before the start of 1976. But he sees a future for them in the grazing industry.

Gordon went so far as to say that one man on a bike would be as good as two horsemen in many mustering situations.

### Easier work

Another man who uses bikes extensively is Jack Lethbridge of 'Glenmore' station south of Kidston. Jack, who turned 66 last September, said he has done up to 150 kilometres in a day on a bike checking fences and waters and that he was still fresh at the end of the day.

How fresh would you feel after a trip like that in a four-wheel-drive vehicle? Would you have done it in a day? And how much petrol would a four-wheel-drive have used?

Jack also uses bikes to move cattle. He still likes to muster with horses because his country is too rough and broken to be able to manoeuvre a bike quickly, and the cattle would 'put it over us' easily.

But he uses bikes to shift cattle off water that is drying up at the end of the season. Then the cattle are mustered on the water and only have to be rounded up and driven away.

Jack has found he can go almost anywhere on a bike that he can take a horse. He says you have to go around most logs, and it might take a little while to find the right places to cross breakways, but these are only minor problems.

The following quote from Jack Lethbridge very neatly sums up the situation: 'We are all entitled to our opinions, and we know what we can and cannot do with our bikes. No two properties are the same; and what you could easily do on one property would be impossible on another.'

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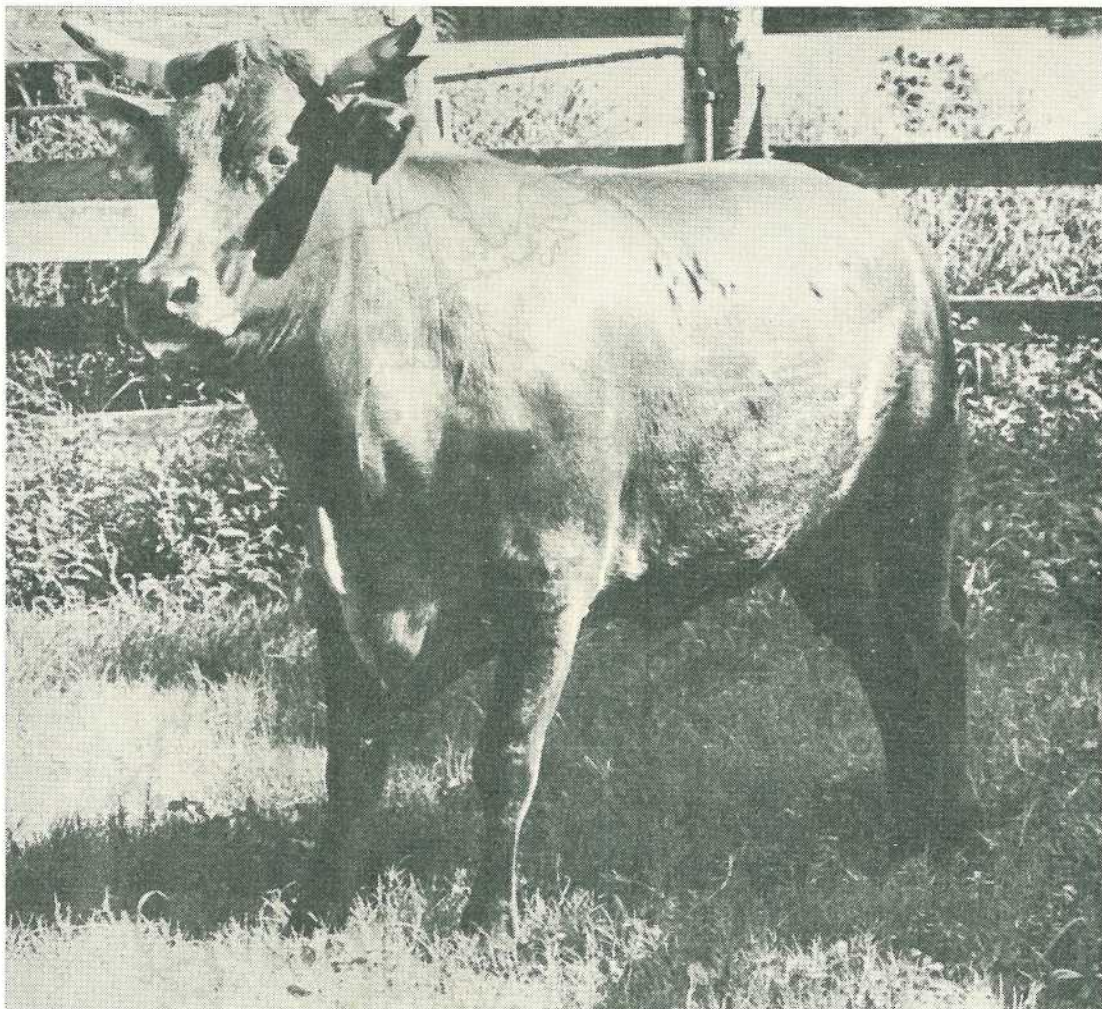
## Test your brucellosis I.Q.

BRUCELLOSIS, or contagious abortion, can be one of the greatest causes of loss to the cattle owner. How much do you know about Brucellosis? Answer the quiz below and find out.

Circle one or other of the choices given.

- True/False 1. Brucellosis is a respiratory ailment which eventually causes lesions in the lungs of affected animals.
- True/False 2. Cattle identification is a major way to detect disease.
- True/False 3. Tailtags should be placed just above the brush of the tail.
- True/False 4. Tailtags should be wrapped loosely around the tail in a spiral fashion.
- True/False 5. A brucellosis reactor looks extremely ill.
- True/False 6. You can benefit by hiding reactors—just keep them away from other animals.
- True/False 7. Milk pasteurization has eliminated the risk of human brucellosis.
- True/False 8. One milk ring test will be a sure indication of a dairy herd being either positive or negative.
- True/False 9. Breeding heifers with infected bulls is the main way the disease is spread.
- True/False 10. Vaccination is the only solution to brucellosis.
- True/False 11. It is best to vaccinate calves between 3 and 6 months of age.
- True/False 12. State departmental officers and private practitioners will help clean up an infected herd.
- True/False 13. Once a cow is tested, and found negative to one test, you know that she is clean.
- True/False 14. Cattle from infected or non-assessed herds in the protected area, may still move freely through safeyards.
- True/False 15. Brucellosis can and has been eradicated in many areas with the tools we have now, but there is still a need for continued research.

The answers are on page 432.



# Bovine ephemeral fever

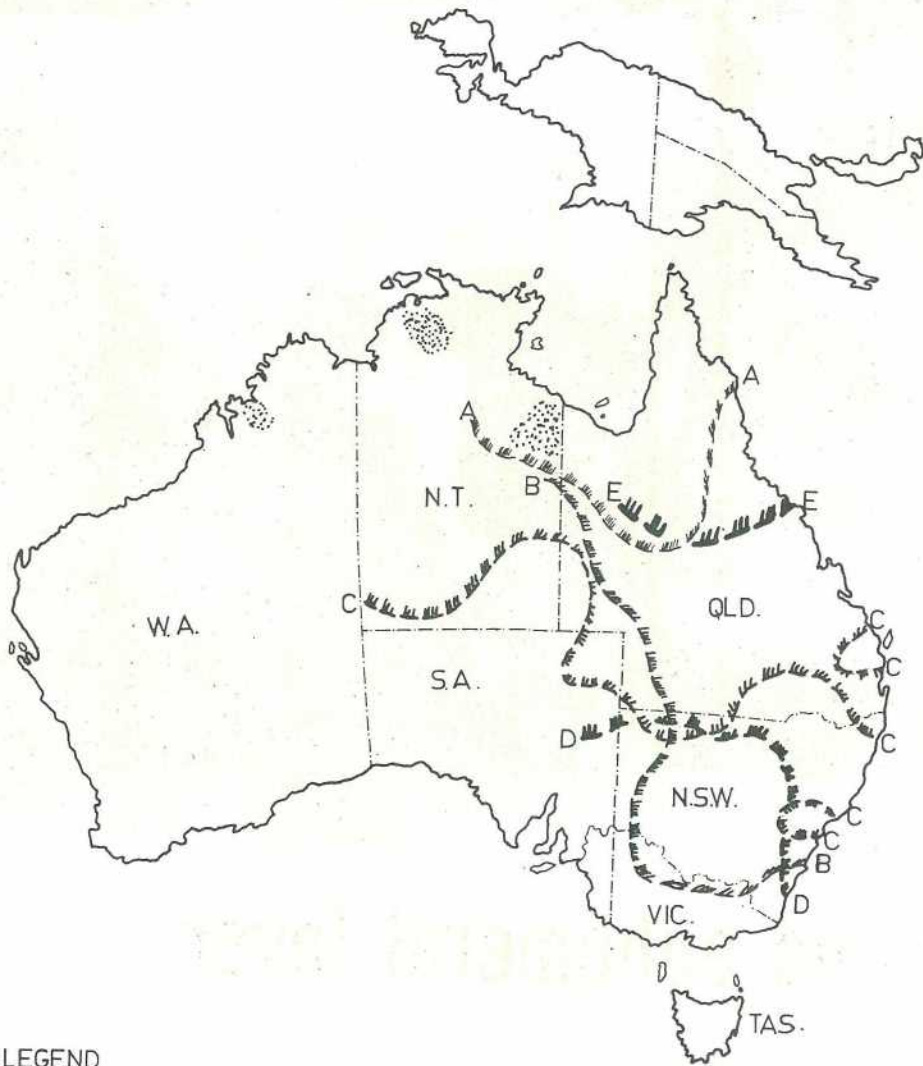
by N. I. Paull, Veterinary Services Branch.

THIS infectious disease of cattle and buffaloes, commonly known as 'three day sickness' has been recognized in Africa, India, Indonesia and Australia.

It is not present in Europe, northern Asia, North and South America and New Zealand.

In Australia, the first official reports of the disease came in 1936 from three widely separated areas in northern Australia—near the Kimberleys, the Northern Territory and Burketown in Queensland.

ABOVE. Plate 1. An animal showing hindleg incoordination.



LEGEND

- A  A 1969—1970
- B  B 1970—1971
- C  C 1972—1973
- D  D 1973—1974
- E  E 1975—1976
-  1971—1972 Sporadic Cases



Plate 2. 'Downer' animal with discharge.

Within 12 months, the disease spread across the Gulf Country area to the coast and southwards to the Victorian border.

Since 1936, epidemics have occurred in 1946/47, 1955/56, 1967/68, 1972/74 and 1975/77 (see map). Published and unpublished reports, however, indicate that the disease did not disappear entirely from the cattle herds during the intervening periods.

No evidence of the disease has been reported in Tasmania. The entry of ephemeral fever into South Australia and Victoria has been very limited and the disease has not occurred in the southern part of Western Australia. Clinical ephemeral fever has not occurred in Niugini since 1959.

### Clinical and post mortem signs

Usually the disease appears suddenly in a district. The affected animals show a high fever ( $40^{\circ}$  to  $42^{\circ}\text{C}$ ), muscle inco-ordination, tremors, and stiffness. The lameness becomes very severe and the animal is unable to stand (see plates 1 and 2).

The fever lasts about 24 hours and is accompanied by discharges from the eyes and nose. Stiffness and lameness usually last for another 1 to 2 days, but in some cases these may persist for a week or more. Bulls are commonly severely lame and may also be temporarily infertile.

In dairy herds, the farmer first notices a marked drop of varying duration in milk yield. Abortions may occur in the advance stages of pregnancy.

Young calves possess a high degree of immunity until about 6 months of age which wanes until they become fully susceptible before 12-months-old.

Work by CSIRO shows the virus can be excreted in the semen of an infected bull. This is a rare occurrence. Also, it has not been shown that the disease is transmitted in this way. Recovery is slower in those animals in poor condition. Valuable animals require special care during hot weather.

### **Treatment**

Treatment with anti-inflammatory drugs such as salicylates and phenylbutazone (BTZ) is useful in valuable animals. Care must be taken to ensure animals are drenched properly. 'Downer animals' should not be drenched. However, shade and water should be provided whenever possible. Death may result from complications associated with conditions of high temperature and lying on the ground in the sun. The great majority of affected animals will recover provided they are left alone and not disturbed and are in the shade and water is provided.

### **Post mortem examination**

Little of significance can be seen when the carcass is opened for examination. Usually, the peripheral lymph glands are enlarged. Congestion and swelling may be seen in the throat area, fore-quarters and in the lungs.

### **Causative agents**

A virus is responsible for the disease. Biting insects, 'sandflies' or midges, and mosquitoes are known to be the vectors or transmitting agents of the disease from animal to animal. After a long search, CSIRO researchers were able to isolate the ephemeral fever virus from mosquitoes trapped at Etna Creek, Queensland in 1974, and at Beatrice Hill, Northern Territory in 1975. (The virus was also isolated in Kenya in 1974.)

Sentinel herds were established throughout Australia by CSIRO to monitor the spread of bovine ephemeral fever.

From each herd, approximately 20 head were bled every 3 to 4 months and the blood tested for the presence of antibodies as evidence of the disease.

Later, in 1974, a joint Queensland DPI and CSIRO project was established to monitor the disease along the Flinders River Basin in Queensland. During the next 3 years, 10 to 12 weaners were bled monthly on seven widely-separated properties.

At the same time, insect collections were made with the aid of light traps. Sera and insects were forwarded to the CSIRO laboratories at Long Pocket, Indooroopilly. The work although not yet completed, has shown that the virus has been active and present (continuously) in Northern Australia.

### **Diagnosis**

It is based on the clinical signs and serological tests. Two blood samples are usually required to demonstrate a rise in the level of the antibodies (that is, titre) to the disease as one cannot relate recent infection with the level of titre. Some animals only produce antibody for a very short period.

### **Control and prevention**

Widely-separated groups of animals may be affected within a relatively short period.

To date, two vaccines have been produced. The one produced by CSIRO although capable of producing high titres, does not always protect the animal against a severe challenge. The Veterinary Faculty at the University of Queensland has produced a vaccine which has already undergone field trials. At present, it is being evaluated by a commercial manufacturer.

### **Summary**

Bovine ephemeral fever is a highly infectious disease of cattle and buffaloes. Biting insects such as mosquitoes and certain species of sandflies transmit the disease from animal to animal and are capable of rapidly spreading the disease over a wide area.

Although very few animals die, many are affected resulting in losses in milk and meat production. Limitations on overseas trade in livestock exports are also important.

Sentinel herds have been established to monitor the disease. It is important that this study continue. Farmers and graziers can assist in the understanding of how the disease spreads and where the reservoirs of infection occur by reporting the early occurrence of outbreaks to their nearest Stock Inspector.

# 100 years of wheat at Dalby

THE first commercial crop of wheat was harvested at Dalby in 1879. 100 years later, wheat is still the major winter grain crop in the district.

## History

The wheat industry developed slowly in the Dalby district despite its success in southern States and active promotion by early legislators who were anxious to provide selectors with a profitable crop and the Colony with an agricultural export.

The climate of the Dalby district was originally considered to be too harsh for cropping. This view ignored one of the district's most valuable attributes—its soil. The waterholding capacity of Dalby district soils is such that the moisture requirements of most crops can be maintained through normal dry spells.

The present substantial wheat growing industry in the Dalby district began modestly. The Dalby Herald of July 19, 1879 reported that the Hon. J. P. Bell steam winch ploughed 120 ha at Jimbour of which 80 ha was planted with wheat. However, serious problems were soon encountered. The November 1 edition of the Herald reported that although crops grown by Mr. Thompson at Mt. Victoria and Mr. Landy at Bowenville were in excellent condition the big Jimbour crop was stem rust infected. Subsequent returns for the year show that of the 101 ha sown for grain, 96 ha was affected by rust, 2 ha was mown and only 3 ha harvested for a yield of 3.2 t.

Wheat has been grown every year since except for 1883 and 1884 when no wheat was harvested for grain and possibly 1885 and 1888 when no returns were received from Dalby.



Mr John Condon standing in a 3.5 t per ha crop of Timgalen wheat on the family farm at Pirrinuan on the Jimbour Plain. Mr. Condon, aged 71, can remember his father growing wheat on this paddock when he was a small boy. The paddock has been regularly cropped since.

by W. Bott, Agriculture Branch.

Early development was slow mainly due to falling prices, unsuitable varieties and crop agronomy and the small size of the enterprise on most farms. Prices fell progressively from \$18 per t in 1885 to \$11 per t in 1905. The late-maturing, soft wheats grown in those early days were regularly ravaged by rust and early reports indicate that during the first 27 seasons only seven crops were rust free.

The farming practices used by the early growers were the same as their southern counterparts with their winter-dominant rainfall. Land was slowly broken up during January and February with horse-drawn implements. By this time, subsoil moisture was at least partly depleted so crops were largely dependent on growing period rainfall which is generally inadequate. Crop failures were frequent.

The small scale nature of the enterprise in those early days further retarded development as the more sophisticated labour and cost saving machinery becoming available to southern growers could not be justified.

Even the now-famed Jimbour Plain did not escape these early problems. In 1907, some 98 000 ha of the Jimbour lease was repurchased by the Crown for \$16 per ha to create 189 new agricultural farms. Despite high hopes and adequate and even over-investment in latest machinery, success was limited. By 1918 when about 10% of the area was regularly cultivated, the majority of the new settlers on Jimbour could not meet their financial commitments. Their plight became so precarious that a Royal Commission was ordered to investigate their position. Rental relief and a change to dairying and to a lesser extent to sheep and beef alleviated the situation.

The first minor surge of development of the industry occurred about the turn of the century when new varieties afforded some relief from the rust hazard. Varieties such as Allora Spring, (a Farrer introduction) and Budd's Early although susceptible to stem rust often escaped the disease by virtue of their early maturity. Others including, Belatourka and Ward's Prolific though mid to late-maturing, possessed some resistance to stem rust.

Industry milestones during the first quarter of the twentieth century included constitution of the Queensland State Wheat Board in 1920

which provided a measure of price stability and the advent of lightweight tractors and matched implements which enabled growers to store moisture in the soil through a summer fallow.

The appearance of the twin-disc cultivator-plough which permitted thorough shallow cultivation was another vital breakthrough as it allowed best use to be made of the normally light May and June planting rain.

Wheat growing really began to gain momentum, especially on the Jimbour Plain, about the mid 1930s. Maximum dairy production was also achieved about this time but the burgeoning grain-growing industry gained the upper hand during the next 20 years and went on to achieve its present dominance of the local farming scene.

Since that time, grain-growing has diversified to include a substantial proportion of summer as well as other winter grains. However, wheat is still the major crop of the Dalby district.

## Production

Early development of the wheat industry was very slow with a lapse of 20 years before the area grown exceeded 1 000 ha annually and the passing of another 36 years before the 10 000 ha milestone was reached. This was followed by 3 decades of rapid growth with district production reaching a peak of 266 000 t from 114 000 ha in 1966. Production fell during a run of dry winters in the late 1960s and has since stabilized at an annual planting of 80 to 90 000 ha.

Production statistics are summarized in table 1 which gives area, production and prices at 5-year intervals since the crop was first grown.

The average yield over the whole period is 1.45 t per ha. During the first 10 years, the yield averaged 0.92 t per ha then, during a run of dry seasons between 1905 and 1919, the average fell to 0.56 t per ha. The area planted, yield and grain quality all fluctuated violently in the early days. While the area planted has stabilized, the yields do show an upward trend and grain quality has improved. However, they are all still at the mercy of the weather. For example, the area fell from 3 000 ha in 1901 to 50 ha in 1902 and rose to 4 800 ha in 1903. Yield has ranged from 0.084 t per ha in 1915 to 2.33 t per ha in



TABLE 1  
WHEAT PRODUCTION AND PRICES—DALBY DISTRICT

Season	Dalby District			Old Yield (t/ha)	Prices Total Advances (\$/t)
	Area (ha)	Production (t)	Yield (t/ha)		
1879 .. .. .	3	3.4	1.2	0.143§	16.87
1884 .. .. .		Nil harvest for grain		1.087§	19.00
1889 .. .. .	4	6	1.449	1.086§	15.00
1894 .. .. .	243	280	1.154	1.310§	12.50
1899 .. .. .	1 594	910	0.571	0.787§	12.00
1904 .. .. .	5 980	4 896	0.819	0.957	11.00
1909 .. .. .	4 423	3 409	0.770	0.902	n.a.
1914 .. .. .	2 810	799	0.284	0.839	n.a.
1919 .. .. .	322	37	0.116	0.451	n.a.
1924 .. .. .	3 613	2 701	0.748	0.988	22.12†
1929 .. .. .	1 855	1 566	0.844	1.395	15.00
1934 .. .. .	6 049	7 581	1.253	1.236	11.62
1939* .. .. .	35 900	49 117	1.368	1.262	12.00
1944 .. .. .	30 338	48 667	1.604	1.412	19.12
1949 .. .. .	62 972	84 388	1.340	1.318	52.12
1954 .. .. .	79 342	136 380	1.719	1.614	47.25 (45.00)‡
1959 .. .. .	75 585	105 116	1.391	1.331	52.87 (52.25)‡
1964 .. .. .	101 626	186 615	1.836	1.499	53.85 (50.58)‡
1969 .. .. .	83 764	46 084	0.550	0.666	44.75 (44.75)‡
1974 .. .. .	76 843	150,094	1.953	1.449	(106.66)‡

Notes: \* The statistics are for the Wambo Shire after 1939.

† Wheat Board Total Advances used after 1920.

‡ The prices in brackets are those for bulk deliveries.

§ Yields prior to 1900 were calculated on area harvested and exclude unproductive areas.

Sources: Statistical Register of Queensland.

Annual Reports of the Department of Agriculture.

Australian Bureau of Statistics.

State Wheat Board (Prices 1924-1974).

Prices from 1885 to 1905 Camm: 'Australian Geographer' 13 (3) 1976.

1966. In more recent times, the proportion of the crop qualifying as top or prime hard grade has varied from 80% in 1968 to 2% in 1976.

### The Dalby district

The Wambo Shire covers 575 000 ha on the western slope of the Great Dividing Range, 180 km north-west of Brisbane. The Shire was proclaimed in 1903, 40 years after the Town of Dalby was proclaimed a municipality. It is now the State's main grain-growing district with 10% of the cultivated area of Queensland.

The Shire falls readily into three main production zones. The vast central plain of deep, fertile soils with good waterholding capacity is well suited to grain cropping. To the north and east is an extensive tract of upland soils with good fertility and fair waterholding ability which is used for mixed farming. These are

flanked to the north and west by an area of solodic soils with little agricultural potential. Annual average rainfall is 670 mm with a summer/winter distribution of 450 mm and 220 mm respectively.

### Soils

Wheat can be grown on soils ranging from sandy solodics, through the lighter scrub and forest loams and the clay loams of the brigalow plain to the heavy clays of the box forest and open plain.

However, wheat during winter and spring is grown on soils with good waterholding capacity although there is considerable erosion hazard when sloping soils are summer fallowed.

The occurrence of the district's six main land units are shown on the accompanying map and the average wheat yields expected from each of these units is shown in table II.

TABLE II

<i>Land Unit</i>	<i>Yield</i>
Plain	1.8 t/ha
Brigalow plain	1.6 t/ha
Box plain	1.4 t/ha
Basaltic uplands	1.3 t/ha
Undulating brigalow	1.2 t/ha
Solodics	Not recommended

### Crop rotations

In the early days, some crop rotation was practiced of necessity. Wheat was grown on mixed farms where some forage was needed for stock, particularly for the horse teams. This was a major cost and was usually home-grown.

As tractors displaced horse teams in the 1920s, a system of wheat monoculture developed especially on the Jimbour Plain. This system persisted for many years and, as recently as 1967, the winter grain crop was about seven times the size of the summer crop. Wheat dominated the winter plantings.

Predictably, weaknesses soon appeared in this system, the first being a quick build-up in incidence of wild oats.

Before the advent of suitable herbicides, the only practical control once the weed got beyond the hand picking stage was a winter fallow. This led to adoption of rotations such as wheat, wheat, fallow, wheat and wheat, fallow, wheat.

While these long fallows did provide acceptable wild oat control and tended to stabilize yields, another major problem, soil erosion, was highlighted. Intolerable soil losses occurred on sloping land and even on the plain, overland water caused soil movement in wet seasons. A zinc unavailability problem known as long fallow disorder was another sequel to the long fallow.

Strip cropping was promoted to minimize this soil erosion. This involved planting summer and winter crops in alternate, long, narrow strips across the slope and has now found wide acceptance on flatter agricultural land.

A swing to summer cropping during a run of good summers and poor winters following the 1969/70 drought eased, at least temporarily, the wild oat problem. It also gave impetus to adoption of strip cropping.

Ideally, the strip cropping system needs an even allocation of summer and winter crop area but is effective up to a ratio of two to one. Unfortunately, this ideal has been achieved only once in the district's recent agricultural history, 1974/75, when the winter crop was only double the size of the summer crop.

Another problem with crop rotations is that they are easily dislocated by droughts and dry spells.

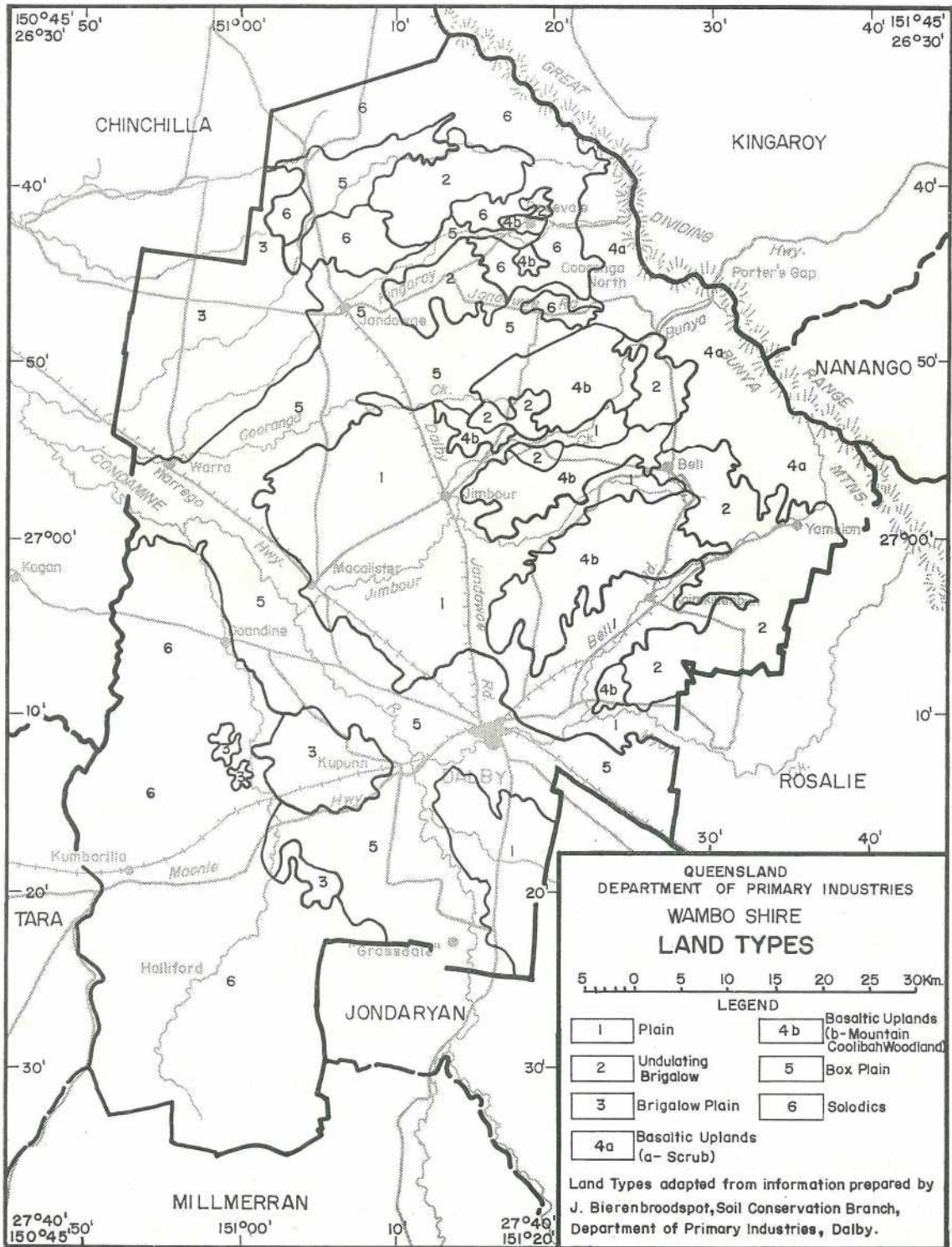
Conservative growers follow a grain sorghum, fallow, wheat, fallow, grain sorghum rotation while others plant two successive winter crops then fallow through to two successive summer crops. Less demanding crops such as barley in winter and millet or sunflower in summer are often used as a second crop in each sequence.

Double cropping, which is occasionally practised on the plain, is standard practice on the uplands where full summer fallows cause unacceptable soil erosion risks. Short-term crops such as barley and millets and mung beans are popular for double cropping.

### Land preparation

The priority attached to each aspect of land preparation as well as the method of achieving these ends have changed constantly during the long history of wheat growing in the district.

In the earliest days, the sole aim of land preparation was to prepare a suitable seedbed. As wild oats and other weeds became troublesome, weed control became the main objective. With the evolution of dry farming techniques, accumulation of an adequate reserve of soil moisture by planting time became the main concern. Later still when the appearance of mottling indicated declining nitrogen status of district soils, longer fallows were employed to build up soil nitrogen. The most recent trend is aimed at achieving all the objectives of land





This 44 kw Clayton Shuttleworth tractor bought by Mr. Bunny Ewing in 1912 was one of the first tractors used on the Jimbour Plain. It weighs 10 tonnes.

preparation while maintaining a layer of trash on the soil surface through most of the fallow period to improve water infiltration and minimize soil erosion.

Early growers did not begin land preparation until January or February following a November harvest and it was a slow process with the horse teams then used. A major problem with both horses and the early heavy tractors, was deep working which produced a deep, hard-to-wet seedbed. The appearance of lightweight tractors and twin disc ploughs capable of thorough shallow working eliminated this problem.

A gradual understanding of the role of the fallow in providing the water needs of the crop began early this century. This was first researched in Queensland with the initiation

of a series of fallowing trials at the Roma State Farm in 1907 when it was known as 'Campbell's Dry Soil System.'

The adoption of fallowing greatly improved crop yields and led to a sharp increase in the area planted in the 1930s. However, a tendency to overwork the land soon developed as reference to land preparation costs at the Roma State Farm in 1909 show:

Ploughing—four times at 59c acre	\$2.36
Cultivation—twice at 32c acre	64
Harrowing—seven times at 9c acre	63
Packing—once at 20c acre	20

\$3.83

Standard practice for many years was to burn stubble as soon as possible after harvest followed by immediate break up. Cultivation,

# ...and now



*Increasing numbers of large four-wheel-drive tractors are found on the larger grain farms. This machine is pulling a sweep plough through wheat stubble.*

first with a scarifier and later with harrows then followed each useful fall of rain, to reduce evaporation until planting time.

Cultivation frequency was later reduced to that necessary for weed control when the capillary theory of evaporation was discounted by research. The wisdom of stubble burning was then questioned by observant farmers who associated deterioration of structure of lighter soils with the practice.

The long fallow as a wild oats control measure came under pressure with the advent of herbicides and the rising popularity of summer crops. Its popularity for building soil nitrogen also fell as growers realized the benefits of nitrogen fertilizer where soils have lost their initial fertility.

The long-standing preference for disc implements, especially for primary tillage has recently come under close scrutiny due to the worsening soil structure of old farmed land. A general swing from disc ploughs to tined implements such as chisel ploughs and scarifiers for primary tillage has already occurred. Blade ploughs which break the soil and sever roots with minimal surface disturbance and trash burial are now being tried.

## **Planting**

The Dalby wheat crop is usually planted in June with traditionally colder areas such as the Jimbour Plain and valleys in undulating situations going in last. Planting depends on receipt of the necessary rain and can range from mid May to early August.

Research indicates a fall of 7% in yield for each week planting is delayed after June 23. Fortunately, planting moisture holds longer on the Jimbour Plain where good establishment has been achieved up to 40 days after rain during a cool autumn.

Early crops were planted by broadcasting seed on the soil surface and harrowing it in. The first seeding machines were of English origin and used a revolving cup mechanism for seed metering. They merely dropped the seed on the soil surface saving little time or work.

The first real breakthrough in planters came about in 1906 when the H.V. McKay Company manufactured seed and fertilizer drills. A further dramatic improvement came a decade later when this company marketed a cultivator drill which combined the seed drill with a

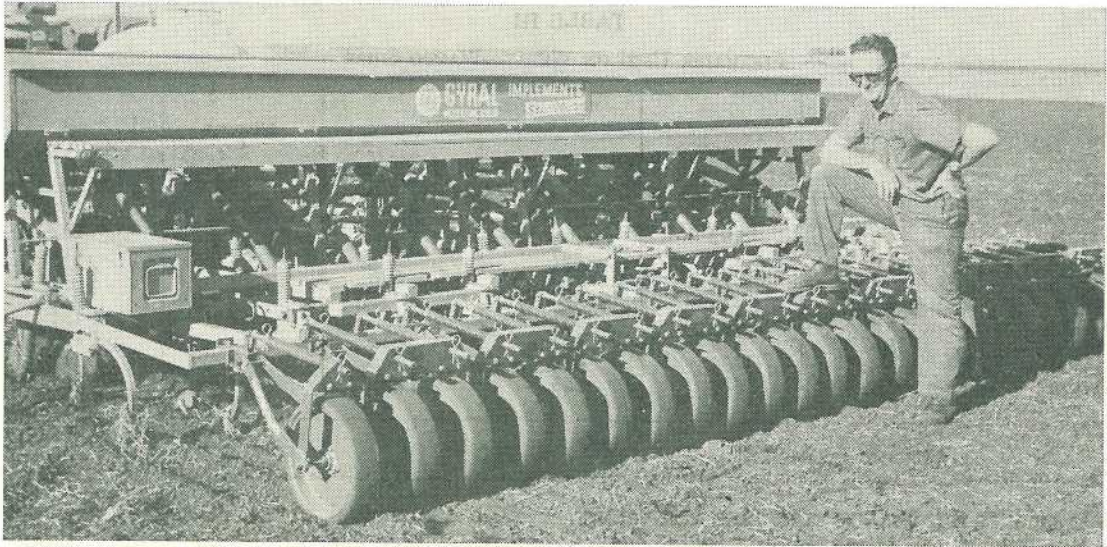
four rank cultivator with planting boots to take seed tubes on the two middle rows. This type of cultivator drill or combine with internal force grain feed and 7 inch spaced spring tyne or spring release tynes became, with minor modifications, the standard planter on district grain farms for half a century.

Apart from a steady increase in size, the first radical departure from the standard combine appeared with the local manufacture of a machine with wider-spaced rows and centrifugal seed metering gear. More recent innovations include the use of fluted roller seed mechanisms, changes of tyne design, spacing and disposition and special stubble combines with up to six ranks of tynes all of which plant.

Increasing use of fertilizers has caused a demand for machines equipped with fertilizer boxes.



*Stubble burning was standard practice in the past but it has fallen from favour due to mounting concern about soil fertility, structure and erosion hazard.*



A popular, locally-made combine fitted with press wheels to improve germination when planting rain is light.

The problem of tractor tracks which are more pronounced with wheel than crawler tractors has been a bugbear at planting under other than ideal conditions since the industry was first mechanized and has still not been satisfactorily eliminated.

Seed is generally planted 6 to 8 cm deep. Field rollers are used regularly after planting on heavy soils and on most soils when planting moisture is borderline.

Planting rate varies between 20 and 50 kg per ha with the lower end of the range most popular especially for early planting. Although researchers have been recommending lower rates for years (a *Queensland Agricultural Journal* article dated October, 1909 claimed it was far better to plant 20 lbs. per acre than one bushel), a pronounced downward swing has occurred only recently.

## Fertilizers

After nearly a century of pastoral production and half a century of grain-growing, the fertility of district soils is depleted to the stage where fertilizers are needed to maintain crop yield and quality. These fertilizer inputs must increase until inputs match outgoings as farm produce.

Increasing areas of wheat were receiving fertilizer until the 1969/70 drought when consumption fell. Usage increased sharply following that drought and about 75% of the district wheat crop is now fertilized.

Nitrogen was the first plant nutrient to become deficient on most district soils. Phosphorus deficiency has shown up more recently, mainly in the Jandowae area. Potash deficiency has not been detected. Zinc is the only minor element known to be in short supply for wheat production. This is mainly an availability problem associated with long fallows. This disorder is decreasing with stubble farming and fewer long fallows.

Growers rely on their knowledge of the cropping history of the land and field trials and to a lesser extent on soil analysis in estimating their fertilizer needs. These empirical assessments generally prove adequate.

Dressings of from 30 to 50 kg per ha of elemental nitrogen are common with anhydrous ammonia from Dalby and Jimbour depots the popular form because of cost and convenience. The fleet of applicator rigs initially provided has not kept pace with increasing demand so growers are acquiring their own equipment. Syndicates and bigger growers are buying rigs

TABLE III  
FERTILIZER USED ON WHEAT—WAMBO SHIRE

Year	Area ha	Superphosphate tonnes	Nitrogenous		Mixtures t	Total t
			Urea t	Other N t		
1970-71 ..	4 291	192	(a)	88	7	287
1971-72 ..	11 020	298	297	168	55	818
1972-73 ..	20 288	395	336	526	36	1 293
1973-74 ..	7 912	259	84	477	..	820
1974-75 ..	15 857	452	151	526	2	1 131
1975-76 ..	21 372	290	207	654	..	1 151
1976-77 ..	33 210	408	489	1 806	12	2 715
1977-78 ..	34 562	423	543	1 823	50	2 839

(a) Included in Other N.  
Source: Australian Bureau of Statistics.

while smaller farmers are equipping cultivators for application and jointly buying trailed tanks and metering gear.

As standard superphosphate still provides the cheapest phosphorus, it is most widely used though the high-analysis form is occasionally preferred to ease the load at planting. Dressings of from 5 to 10 kg per ha of P are normal.

Compound fertilizers containing both nitrogen and phosphorus are sometimes used.

Table III gives a breakdown of fertilizers applied to the district wheat crop in recent years.

### Harvesting

Early records are sketchy but because of the small areas of crop grown in the district during the first decade of wheat growing, harvesting would almost certainly have been done by the laborious use of scythe and flail.

Later, crops were cut at the dough stage with the reaper and binder and the sheaves stocked in the paddock to dry out. Sheaves were then carried to centrally situated stacks to await the threshing team.

The first harvest break-through came with the McKay stripper which appeared in Warwick in 1895. The district's oldest resident, Mr J. Duncan Snr., of Kaimkillenbun can recall having used a hand-operated winnowing machine into which the mass of heads, grain and chaff from such a stripper was shovelled for cleaning.

With the arrival of the 'Sunshine' stripper harvester about the turn of the century, standing crops were harvested in the paddock with only very heavy, storm-flattened or weedy crops bound, stacked and threshed later.

The next break-through in grain harvesting machinery was the development of the header-harvester by H. S. Taylor of Henty, N.S.W. in 1914. Production was begun 2 years later and this machine whose sickle front and rasp-bar drum could handle all the straw from lodged crops introduced a new grain harvesting era. Other milestones in the evolution of headers were the engine functioned machine and, with the wider use of tractors, the power-take-off drive. Self-propelled or auto-headers and the open front machines appeared in the district during the 1930s.

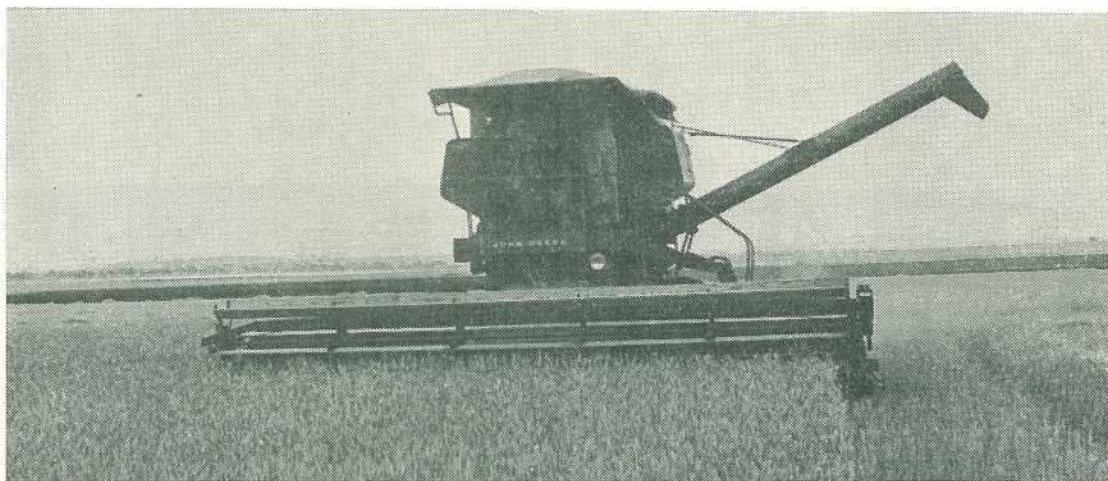
Despite problems with the canvas crop elevator fitted to early models, it was the reel or open-front machine capable of handling any harvestable crop which finally eliminated the reaper and binder from the district. The swing to open fronts was accentuated about that time by appearance of dwarf grain sorghums which were best handled by these machines.

The open-front auto-header which has grown in both size and sophistication since the Second World War is now the standard harvester. However, the rapid escalation in cost of these machines to between \$60 000 and \$70,000 is tending to restrict them to the larger farms and is increasing the scope of contractors. The most recent innovation in headers is

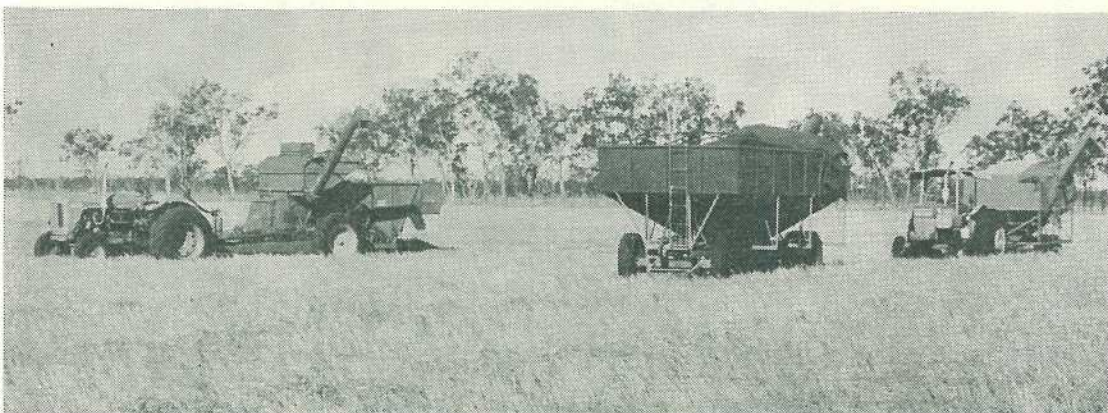




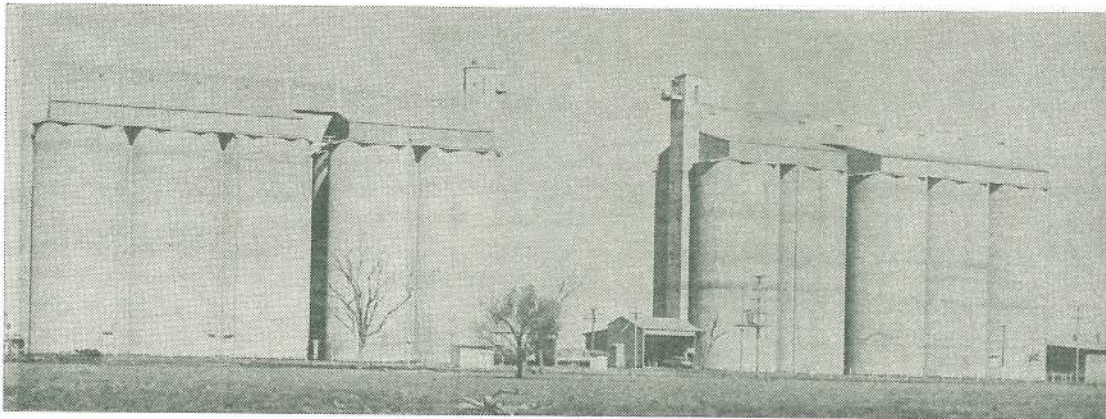
*Applying nitrogenous fertilizer in the form of anhydrous ammonia to crop land in the Dalby district.*



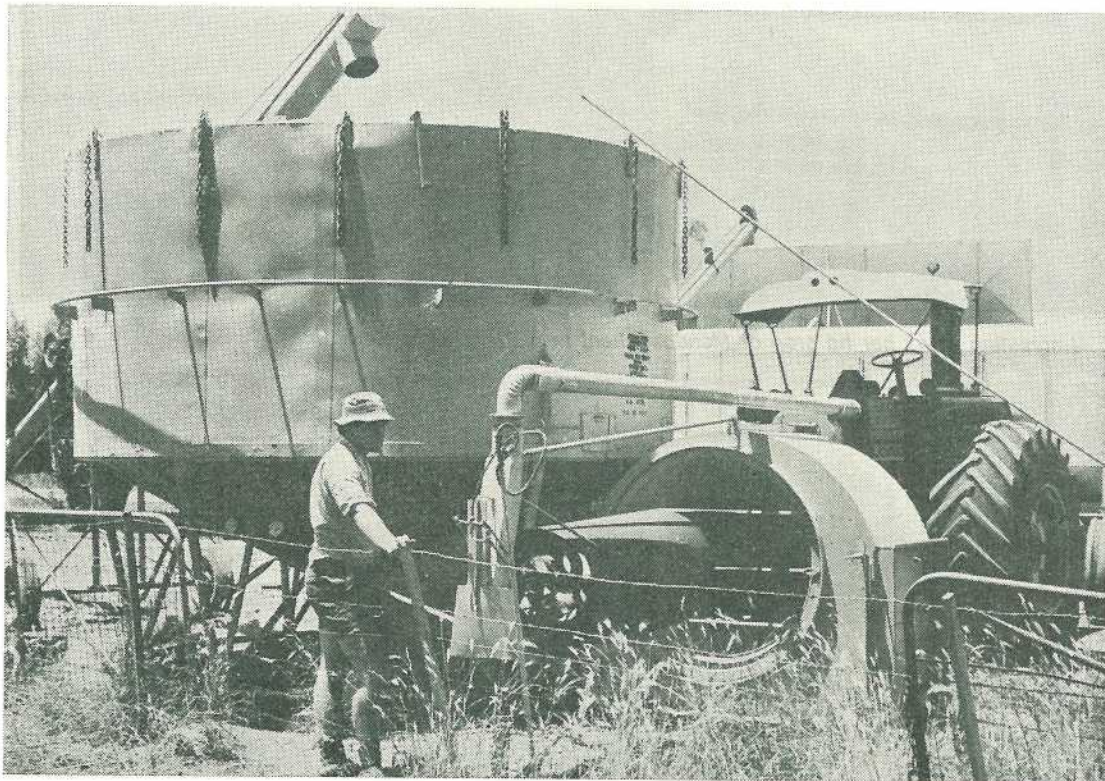
*Harvesting at 4 t per ha crop of Mendos wheat in the Irvingdale district.*



*Small, tractor-drawn, p.t.o.—driven headers such as this are now seldom seen on district wheat farms.*



*20 × 2 000 tonne concrete silos at the State Wheat Board's West Dalby depot.*



*Grain dryers have become more popular in the district since the introduction of high-power, high-heat machines such as this one working near Haystack.*

the complete rearrangement of threshing and separating gear to permit axial rather than radial flow of crop through the machine.

Although there have been a few grain dryers in the district for many years it was not until the recent advent of high-power, high-heat machines capable of drying under all conditions that the idea has caught the interest of growers. The heavy outlay at a time of shrinking margins has tended to restrict installations to larger farmers, group ownership and contractors.

### Marketing

The crop faced marketing problems as soon as it was grown in quantity. The early growers supplied millers whose markets were restricted by costly rail freights. Both faced strong competition from southern growers whose land was cheaper and whose production costs were lower due to size of operation, better harvest weather and lower freights.

The imposition of a long sought after wheat and flour duty in 1892 did little to improve the industry's economic base and pessimists of the day predicted that it would collapse completely when tariffs were removed on Federation in 1901. This accentuated the swing to mixed farming and caused a downturn in the total State crop.

The institution of the State Wheat Board in 1920 conferred a measure of price stability but did not result in an increase in production. It did, however, prevent a recurrence of the disaster which befell the big 1916/17 crop of 5 400 tonnes, much of which could not be sold and was destroyed by mice and weevils.

The State Wheat Board continued to operate as the Statutory Marketing Authority until the Australian Wheat Board assumed this role on its formation in 1939. The State Board has continued to act as the handling authority on behalf of the A.W.B. since then. In addition, it handles barley, grain sorghum and oilseeds on behalf of other organisations so its extensive storage and handling facilities are in use for most of the year. Seed selection, storage and distribution as well as hail and fire insurance are other concerns of the State Wheat Board.

Early Board storages were a far cry from recent installations. Bagged wheat was received from growers' drays or wagons, weighed five at a time on portable scales, stacked on sleepers beside the railway line, and covered with galvanised iron. The next step was provision of partly open-walled galvanised iron sheds equipped with bag elevators which appeared first at Pirrinuan in 1936, at Jimbour in 1940 and all Dalby district depots by 1950.

The acceptance by the Board of its first bulk receipt from the 1951 crop heralded a new era in grain handling. The Board officially switched to bulk handling with the completion of multibin silos at Dalby (Natcha) and Jimbour (Baigin) in 1957, but continued to accept bagged deliveries until 1972. Not only did this innovation remove much of the hard work from grain growing, but harvest security was improved as turning or rebagging of wet wheat in the paddock was eliminated. The capacities of the Board's permanent bulk installations at its eleven depots in the Dalby district are shown in table IV. The main seed storage and handling facility is also now located at Dalby.

TABLE IV

STATE WHEAT BOARD STORAGE CAPACITIES IN WAMBO SHIRE AND DALBY TOWN AT JULY 1978

Depot	Capacity (t)
Natcha .. .. .	25 857
Dalby West .. .. .	52 988
Baigin .. .. .	17 147
Marnhull .. .. .	10 233
Jandowae .. .. .	34 158
Bell .. .. .	17 267
Kaimkillenbun .. .. .	11 867
Kommamura .. .. .	6 206
Kupunn .. .. .	20 577
Macalister .. .. .	32 662
Warra .. .. .	36 473
Total Permanent Grain Storage	265 435
Seed Storage—Jimbour ..	1 770
Dalby .. .. .	5 442
Total Permanent Storage ..	272 647
Temporary Storage .. ..	2 750
Total Storage .. .. .	275 397

Source: State Wheat Board

The Board adopted metric measures from the 1972 crop, and changed grades to the current Prime Hard, Hard No. 1, Australian Standard White, Hard No. 2 and General Purpose classifications for the 1973 crop. Specifications for this grading system are available from Board offices.

Because of problems with marketing the 1968 crop, quotas restricting the quantity of wheat delivered which attracted immediate first advance were introduced for the 1969 crop. Owing to poor subsequent seasons, State quotas were never filled and were suspended in 1974 due to a world-wide wheat shortage.

### Wheat for grazing and hay

Except for the first decade of the infant industry, wheat has never been a popular crop for haymaking. Since then, big hay cuts have been made only when occasional crops have been ruined by frost such as in 1969 when 4 769 ha were cut for hay. Depressed pastoral conditions in recent years further reduced interest in wheaten hay.

Although substantial areas have been grazed during the history of the crop in the district, the nexus between sheep and wheat so common in southern States has never developed. Oats is a more productive grazing crop than wheat so that grain crops are seldom grazed. Occasionally, wheat will be grazed on mixed farms or in droughts when yields are poor and feed is urgently needed.

The dual-purpose varieties, Lawrence and Hopps, and mid-season varieties, Festiguay and Tarsa, and more recently, Oxley, are occasionally planted early for grazing and harvested later for grain if the season permits. Festiguay also found wide favour with green lot-feeders when that enterprise was popular in the 1960s.

### Irrigated wheat

Wheat finds favour with local irrigators only when supplementary rather than full irrigation will suffice. Yields from irrigated wheat crops seldom exceed those from good rain-grown crops.

A single irrigation at the boot stage needing about 125 mm of water is most profitable as this can lift yields by 25 to 30%. Another

watering of 100 mm at flowering can boost yields by a further 10%. Irrigated yields above 4 t per ha were hard to get with older varieties, but Oxley shows promise of breaking this barrier. Water is usually applied in widely-spaced (1.5 m) furrows.

Seeding rates of 45 to 55 kg per ha are adequate under irrigation. While phosphate requirements approximate those of the dryland crop, some 50 to 100 kg per ha N depending on paddock history and fallow length is required. 25 kg per ha of zinc oxide is a general recommendation in areas with a known zinc deficiency. Such a dressing of zinc will suffice for several years.

### Weeds

Wild oats (*Avena sterilis* sub spp. *ludoviciana* and *A. fatua*) with the former species most common, have been wheatgrowers' most troublesome weeds from earliest times. A writer in the December 1898 *Queensland Agricultural Journal* complained that some Downs crops were so studded with wild oats that it was hard to tell whether wheat or oats predominated. Nevertheless, a few vigilant growers have kept regularly cropped paddocks free of the pest to this day by regular hand picking.

Once neglected, an infestation is soon out of hand, and recourse to such measures as summer cropping with winter and spring fallows or chemicals is necessary. During the 1960s about 10% of district wheat land was regularly treated with herbicides, mainly the pre-emergence product 'Avadex BW' (trialate). A swing to summer crops during the early 1970s eased the problem, but the pest is again increasing. Despite the recent release of new herbicides, mainly post-emergence types, chemical control is at best an expensive stop-gap.

Climbing buckwheat or black bindweed (*Polygonum convolvulus*) ranks second among weeds of wheat, and wireweed (*P. aviculare*) is also troublesome. Both are adequately controlled by mixtures of 2,4-D amine plus picloram or dicamba when growing actively, but results can be poor under other than ideal conditions.

The turnip group which includes wild radish (*Raphanus raphanistrum*), turnip weed (*Raphistrum rugosum*), London rocket (*Sisymbrium*

*irio*), Indian hedge mustard (*S. orientale*) and African turnip weed (*S. thellungii*) have, with the exception of the wild radish, been relegated to minor pest status with the advent of phenoxy herbicides. However, their incidence in oats paddocks, along roadsides and waste places, and even in grass paddocks throughout the district ensures a continuing supply of seed. Wild radish, which is on the increase on lighter soils is less affected by phenoxy herbicides needing doses up to maximum crop tolerance for control. Indeed, the whole turnip group appear to be broadening their seasonal growth pattern and becoming year-round rather than winter crop pests.

Paradoxa grass (*Phalaris paradoxa*), Hexham scent (*Melilotus indica*) and Mexican poppy (*Argemone mexicana* and *A. ochroleuca*) are other weeds which appear to be increasing. New Zealand spinach (*Tetragonia tetragonioides*), variegated thistle (*Silybum marianum*), spiny emex (*Emex australis*), fat hen (*Chenopodium album*) and Maltese cockspur (*Centaurea melitensis*) occasionally require treatment.

### Insect pests and vermin

Insect pests are not routine problems of wheat in the Dalby district. Mice are responsible for minor stem damage and head loss in

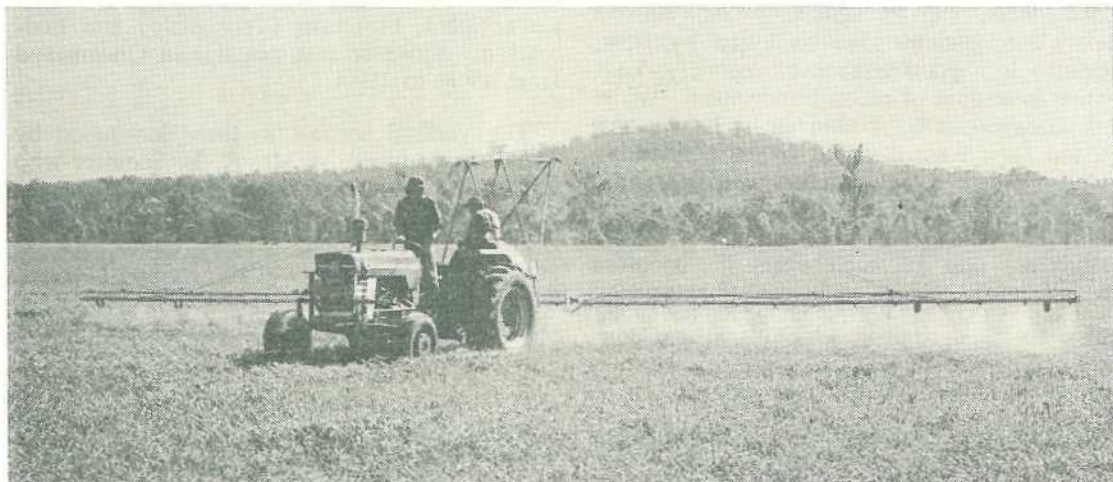
many crops, but their depredations are seldom as severe or widespread as they were during the 1971 plague.

Cutworms, armyworms, brown wheat mites, blue oat mites, aphids, locusts, ants, false wireworms and pasture grubs can all attack wheat. All except aphids and pasture grubs have occasionally needed chemical control measures. The only pest which seems to be increasing in numbers is the false wireworm which may build up with increasing acceptance of stubble mulching.

### Diseases

Rusts and root rots are the diseases most important to district wheatgrowers. Although loose smut, mildew, glume blotch, yellow spot, black point and genetic black chaff all occur, they are, with the exception of the black point which caused heavy down-grading of the 1976 crop, of minor importance to date.

Stem rust is potentially the most damaging disease to which the crop is exposed. For the first half-century of wheat growing, protective strategies included growing early-maturing crops early to avoid rust-inducing hot, humid weather. Later emphasis changed to



Boom spraying a wheat crop in the Jandowae district with hormone herbicides for weed control.

breeding resistant varieties, and this technique which depends on the constant vigilance of plant breeders, continues to be the main defence against the disease. Leaf rust is less spectacular, but is capable of causing significant yield loss.

The seed-borne disease, bunt or stinking smut is virtually unknown in the district as seed treatment is routinely practised. Loose smut is frequently seen in susceptible varieties such as Kenora and Gatcher, but has never assumed disturbing proportions.

Crown rot which usually shows itself by premature ripening of heads of affected plants is caused by a fungus (*Gibberella zeae*) which attacks the base of the stem. It is most severe on heavy soils, but has not yet caused heavy yield loss in the district. The less-conspicuous common root rot (*Cochliobolus sativus*) is possibly more widespread and capable of greater losses. It can be recognised by dark brown discoloration of lower internodes and underground parts of the stem. Yellow spot is a relatively recent problem which like false wireworm appears to be linked with the practice of stubble farming.

The physiological conditions, frost injury, mottling and dry weather tipping are probably of more concern to district wheatgrowers than pests or diseases are at present.

Some frost damage occurs in most years. Head frosting is the most damaging form as a few frosts during flowering can ruin a crop. Young stems can be killed by frost, but there is a good chance of recovery. Leaf frosting is seldom of much importance. While frost damage can be minimized by later planting, the frost hazard posed by early planting must be weighed against the yield potential losses of late plantings. Moreover, it is usually the unseasonably late frosts which are most destructive, and in such cases it is often the midseason planting which suffer most.

Dry weather tipping which is often confused with frost damage can appear when a good early season finishes very dry.

Mottling is an indication of low soil nitrogen status, though some varieties are more prone to the problem than others. It is most prevalent in old-farmed paddocks in good seasons.

The problem can be reduced by nitrogen fertilizer applications. However, corrective strategies are complicated by the plant maximizing yield before grain protein is raised.

## Varieties

Little precise information on varietal preferences became available until the State Wheat Board began collecting statistics on a district basis 20 years ago. It is assumed that Dalby experienced the same problem of unsuitable varieties as the rest of the Downs during the early days of the industry. The original varieties grown were the soft, late-maturing varieties. White Iamas, Purple Straw and Steinwedel were prolific, easily harvested and favoured by millers but were regular targets for stem rust. Early adversity stimulated trials by farmers as little research was done by Public Institutions at that time.

The first success came with introduction of early-maturing wheats which often escaped rust by virtue of their earliness. Foremost among these were Talavera and Allora Spring—a '90 day' wheat from California obtained from William Farrer whose systematic experimental work was beginning to attract attention late last century. Canning Downs, a very early variety introduced from India which possessed drought and some stem rust resistance and Belatourka, mid-late in maturity and having some stem rust resistance, were both popular. Then came the Farrer varieties—Comeback (early but rust susceptible), Florence, (very early) and Federation. Florence was popular in Queensland from 1904 to 1934.

The varietal scene was then dominated by varieties produced by Mr. R. E. Scutter who worked at the Roma State Farm outside the State's main wheat belt. He produced five good wheats—Seafoam, Flora, Puora, Puseas and Puglu. Seafoam was the leading Queensland variety for a few years up until 1941 and with Puroa, Puseas and Puglu made up the bulk of plantings until 1948.

New South Wales releases—Charter, Gabo and Festival, all rust resistant for a few years after release, were popular through the 1950s with Festival the top variety at Dalby from 1958 to 1961. Spica which was selected from



A 3.7 t per ha crop of Gamut wheat growing on brigalow soil near Warra.

a Scouter cross and released by Mr. D. Rosser in 1952, quickly came into prominence at Dalby and was the leading variety from 1963 to 1965.

Dalby's varietal scene was then dominated for a decade by releases from the University of Sydney's North-west Wheat Research Institute at Narrabri. These included Mengavi, Mendos, Gamut, Tingalen and Gatcher. After a long reign as leading Dalby variety, Gamut slowly fell from favour when it succumbed to rust in the mid 1970s. Its place was taken by Oxley which was released in 1974 by Dr. J. Syme of the Queensland Wheat Research Institute at Toowoomba and like Gamut enjoyed a meteoric rise in popularity to become the district's leading variety in very few years.

The main wheat varieties grown in the Dalby District during the last 20 years are shown in table V. The most widely grown variety each year has been italicized in the table.

## Future industry trends

Wheat has been the Dalby district's main crop for a century and no great change in the crop's future status is expected. As the foremost human food crop, its future market prospects are assured and its adaptability to the district's climate and soils has been proven. Of course, there will be years such as 1973/74 when, depending on season or price, the size and value of the wheat crop will be eclipsed by that of other crops, particularly grain sorghum, but the long-term importance of the crop is unlikely to be threatened.

Factors which could affect the key position of wheat-growing in the district's economy can be offset by cultural means. As the district has limited irrigation potential the crop is free from competition by crops favoured for irrigation. Furthermore, up to 100 years' cropping



A 5 t per ha crop of Oxley wheat growing on the Jimbour Plain.

TABLE V  
MAIN WHEAT VARIETIES—DALBY DISTRICT  
(HECTARES)

Year	Charter	Gabo	Festival	Spica	Mengavi	Mendos	Gala	Gamenya	Festigny	Gamut	Timgalen	Gatcher	Oxley	Kite
1958	20 542	12 962	33 929	13 090										
1959	6 847	1 438	43 592	25 615										
1960	4 830	1 086	49 528	27 480			572							
1961	3 369	978	41 657	25 890	4 411		4 790	8						
1962	1 388	84	15 573	26 021	37 656		13 248	431						
1963	1 783	305	16 411	33 198	11 092		22 438	1 520						
1964	2 390	179	13 293	40 375	11 778	1 004	24 677	3 527						
1965	1 513	48	7 926	36 697	1 550	25 678	24 763	3 884	2 347	433				
1966	805	12	2 044	30 747	500	47 539	16 470	2 044	7 316	14 942				
1967		85	1 306	15 260	329	44 172	9 851	9 851	16 044	37 294	1 163			
1968			464	11 543	178	35 818	6 514	404	17 563	35 867	17 849			
1969		120	160	7 430		23 469	4 209	104	15 937	29 046	24 511	3		
1970				2 898		8 272	1 051	454	6 396	10 090	9 495	874		
1971		40		7 234		15 077	2 727	116	10 705	30 662	19 697	10 750		
1972				8 455		5 598	1 606		7 338	30 433	18 935	26 363		
1973				4 829		5 032	298		2 602	16 208	5 677	11 645	6	
1974				6 435		7 595	360		2 356	34 080	14 340	17 727	495	
1975				5 975		3 922			1 665	39 216	13 364	18 860	9 347	
1976				3 877		3 146			667	21 357	15 775	16 707	45 932	
1977				2 062		2 474				10 687	9 716	12 509	45 403	15 509

Source: State Wheat Board.

experience suggests that district soils are suitable for permanent agriculture or mixed farming with wheat a major component of rotations. Soil fertility is being maintained at a level adequate for wheat growing and soil erosion is generally held to acceptable levels by farmer initiative complemented by supporting legislation. Soil salinity is a minor problem in some undulating situations but, with judicious timber clearing, is not expected to escalate.

Crop agronomy is not expected to change dramatically in the foreseeable future. The summer fallow remains the cornerstone of the enterprise despite recent criticism of the technique on the grounds of inefficient water use. The subject of fallow management especially with reference to stubble handling, is being actively researched and this is expected to lead to improved water use efficiency.

Steady increases in yields can be foreshadowed due to the efforts of plant breeders and to improved rainfall use. Although immediate prospects are not optimistic, a time could well

come when wheat will be inoculated at planting time with nitrogen-fixing bacteria to make it self-sufficient in nitrogen as is now the case with legumes.

Wheat growing machinery has generally kept pace with grower needs except, perhaps in the realm of planting. Planters of the future will cope with increasing amounts of surface trash, will have better moisture seeking ability and will overcome the persistent problem of tractor wheel tracks. Perhaps the latter problem will be solved by pushing rather than pulling these machines?

In 1979, 100 years after wheat was first grown at Dalby, wheat growers in Queensland have recorded their biggest crop ever. Preliminary estimates of production from Wambo Shire are 230 000 tonnes from an area of 82 000 ha.

Wheat-growing has a sound future in the district and a review of the industry a century hence should find it in the same strong position as it enjoys today.



# Making felt is easy

by J. G. Nation, Sheep and Wool Branch.

FELT making is an ancient art which preceded weaving in the early civilisations of Asia.

It is simply the matting together of wool or fur fibres. Wool fibres are covered with tiny scales that can easily be forced together to become matted.

## Simple equipment

To make a piece of felt about 30 cm x 50 cm all you need is:

- A quantity of short-stapled greasy Merino wool about 18 to 35 mm long (lambs' wool is best).

- A piece of unbleached calico 45 cm x 60 cm.
- A tin tray 37 cm x 30 cm.
- A piece of round stick slightly longer than the width of the felt, for example, a broom handle.
- An electric jug or kettle.
- 100 cm of string.

Comb, tease or card the greasy wool and place it very evenly on the calico to a depth of about 3 to 6 cm. Do not attempt to keep the fibres parallel to each other. They should lie at random on the calico. Keep the wool about 8 cm in from the sides and the end of the calico nearest to you so that these edges can be folded over the wool.

## Rolling the felt

When you have the wool evenly distributed, damp it well with warm water as you would for dampening clothes, then fold the 8 cm sides of the calico in over the wool. Starting at the end closest to you, roll it very tightly round

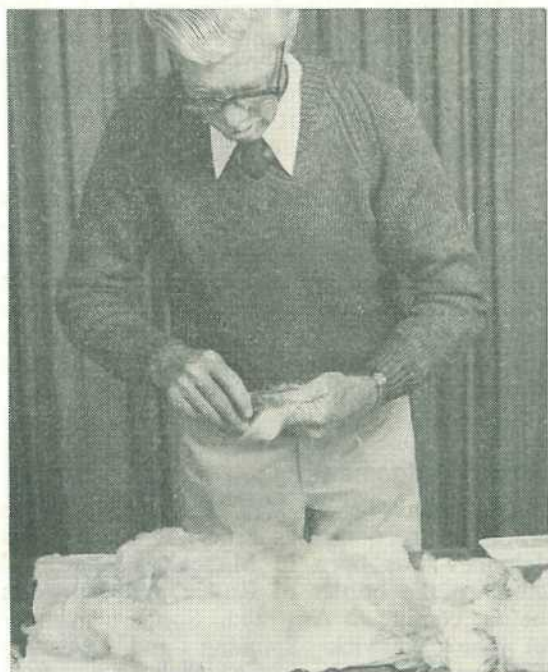


Plate 1. The greasy wool is combed, carded or teased before being placed on the calico.



Plate 2. Arrange the prepared wool evenly on the calico to a depth of about 5cm, and about 8cm in from the edges.



Plate 3. Dampen the wool, then fold the three edges of the calico over it.

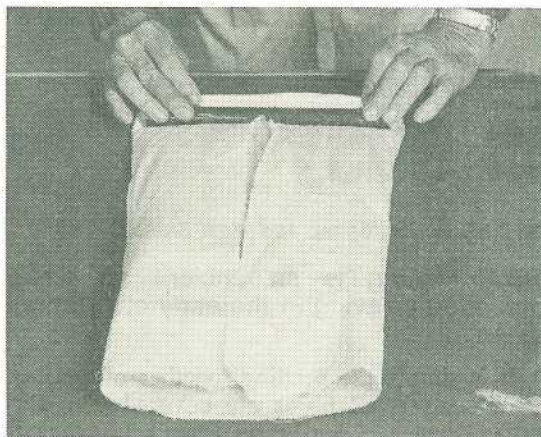


Plate 4. Now roll the wool around the stick, starting at the end nearest to you.

the broom handle like a sponge roll, and fasten it securely by winding the string lightly round and round and tying at one end.

Place the roll in a tray and pour a cup or two of almost boiling water over it to soak well in, then roll it under your hands up and down the tray. **BE SURE TO ROLL LIGHTLY.** Do not use a lot of pressure—it is not weight but the agitation and hot water within the roll that make the felt.

Pour more hot water frequently over the roll, emptying the tray from time to time as the water begins to spill. However, it will not harm the felt if the roll is fully immersed. Note that the tray is used merely to save the table and floor from spilled water. Rolling can be done directly on the table in the yard or over a concrete floor where spilling does not matter. This would mean that the size of the felt is not restricted by the size of the tray.

After 15 to 20 minutes, the wool should be felted and can be unrolled. You will find that the felting has penetrated the calico and you have to tear them gently apart when unrolling. If the felt is not firm enough or finished to your liking, it can be rolled up again and the process repeated.

### Washing

To clean the felt, soap it thoroughly on both sides with a bar of soap and wash it gently

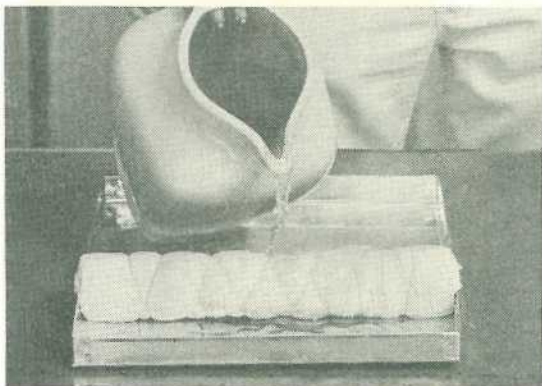
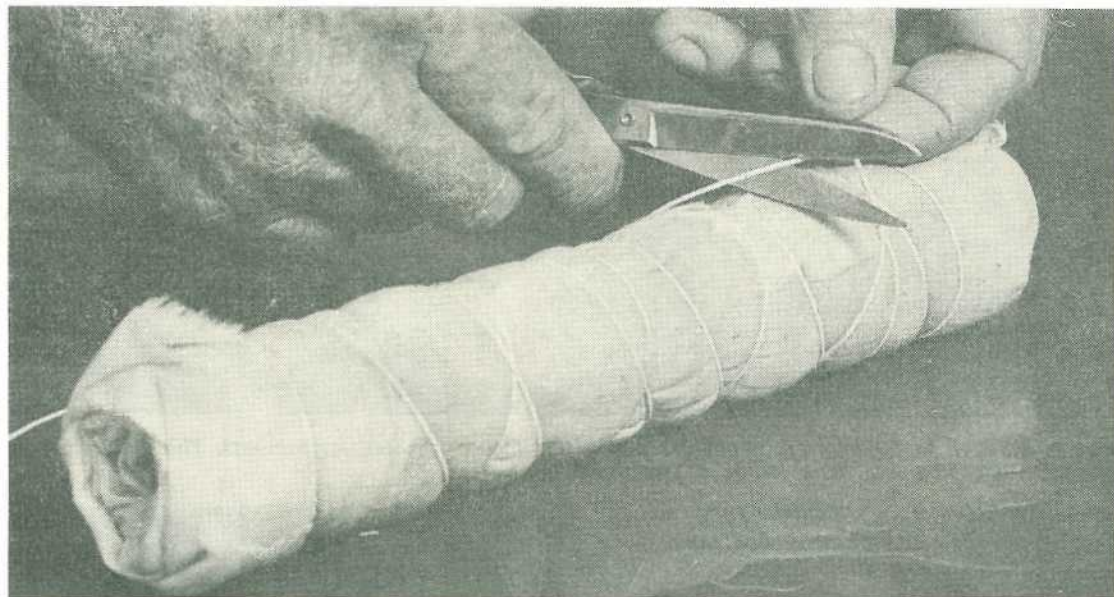
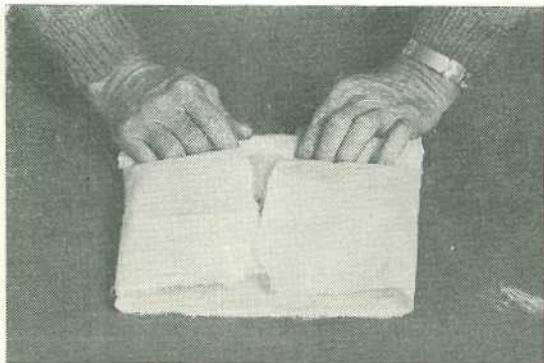
on a flat surface, using a soaping action with the palm of your hand. Keep washing and rinsing until all dirt and the smell of grease have disappeared. Hang the felt up or lay it flat to dry.

Holding the finished article up to the light will reveal any unevenness in the texture. Light or dark patches are caused by placing the greasy wool unevenly on the calico. After a little practice, the art of producing a smooth, even fabric will come quite readily.

The list of articles that can be made from your felt is endless and includes toys, moccasins, place mats, wall hangings, handbags, book covers and book marks. It can be used as a base on bowls, vases and ash trays, and for upholstery and floor coverings. Felt in the piece or as squares joined together makes warm and attractive vests and jackets.

### Acknowledgement

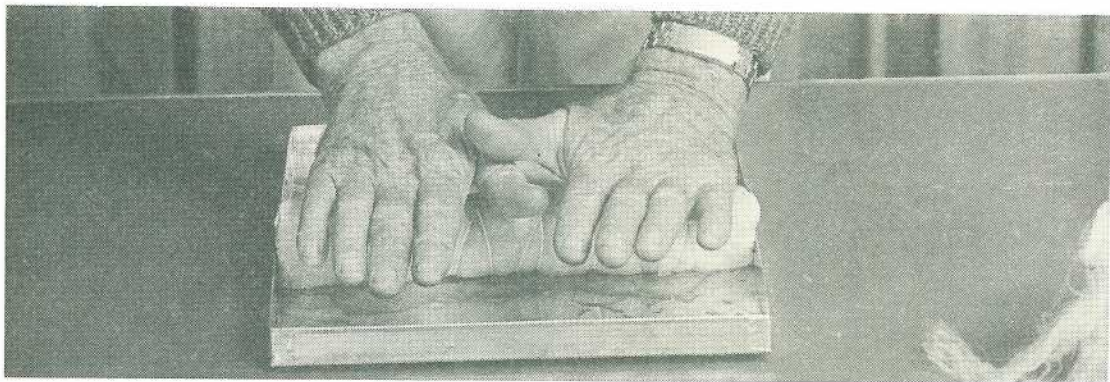
Our thanks go to Mrs Maria Jeloudev on whose instructions this article is based. Mrs Jeloudev was born in Manchuria and lived close to the border of Russia and Mongolia before coming to Australia. She is a member of the Warwick Spinning and Weaving Group—the members of which have benefited from her lessons on the crafts she brought with her from China.



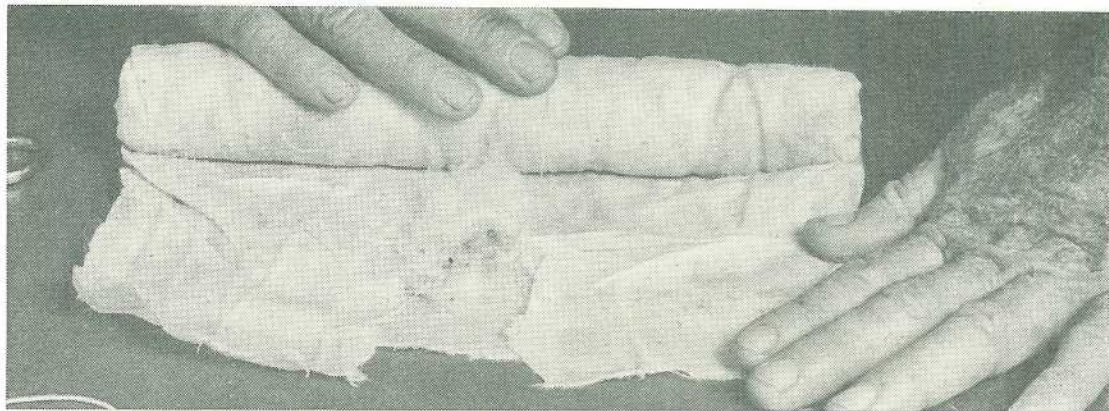
*TOP. Plate 5. The wool must be rolled very tightly.*

*ABOVE. Plate 6. Wrap the string lightly around the roll a couple of times and tie it off. The wool is now ready for rolling in hot water to mat the fibres.*

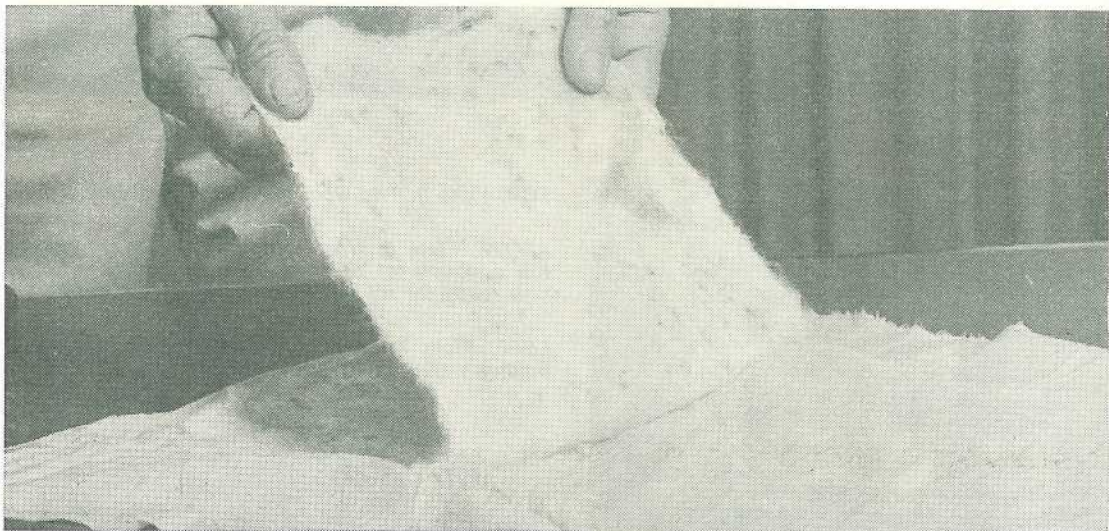
*LEFT. Plate 7. Pour one or two cups of almost boiling water on to the roll.*



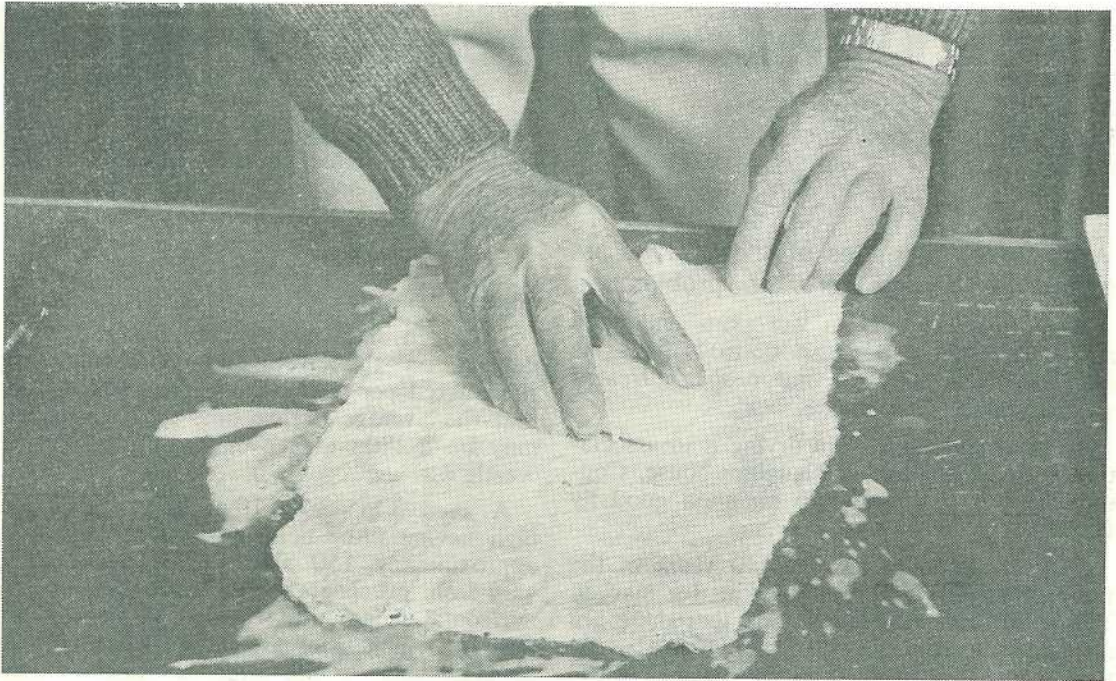
*Plate 8. Roll lightly. It is not pressure but agitation and hot water within the roll that mat the fibres.*



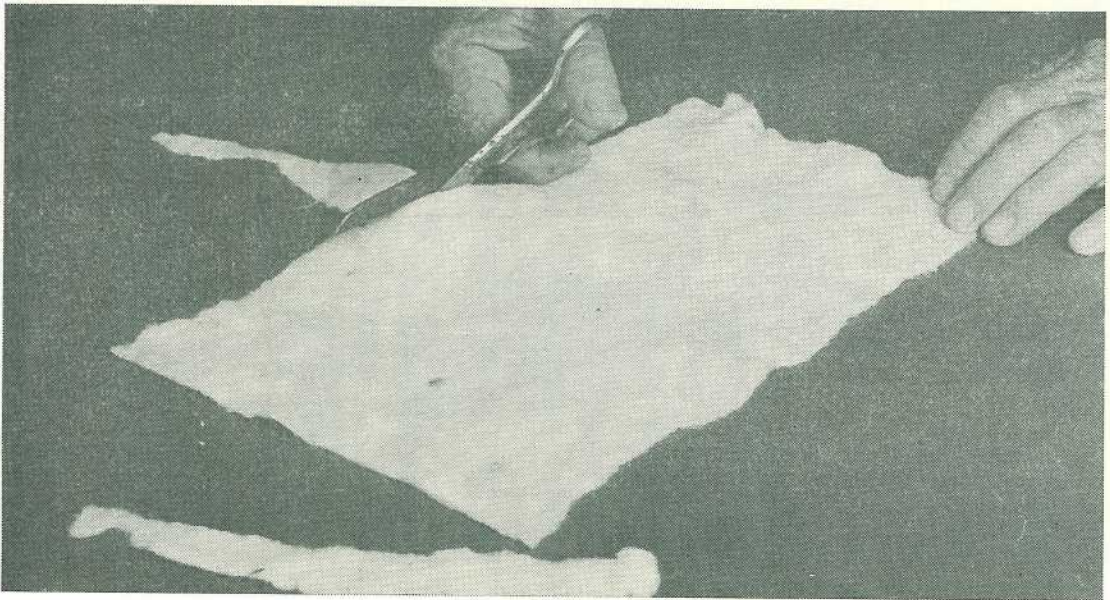
*Plate 9. After 15 to 20 minutes, unroll the calico and inspect the felt for firmness. The fluffy wool in the centre indicates that more rolling is necessary.*



*Plate 10. The felt has acquired a good, firm texture. As the calico is penetrated by wool fibres, it has to be torn gently from the felt.*



*Plate 11. Soap the felt and wash it on both sides gently but thoroughly with the palm of your hand. Rinse well.*



*Plate 12. Trimming the felt.*

# Control flies and weevils

by H. L. S. Vance, Slaughtering and Meat Inspection Branch.

WHEREVER quantities of sheep skins are stored for drying there are problems.

Flies breed rapidly in wet skins and wool and dermestid beetles can destroy the skins after drying if they are not properly treated with a suitable insecticide.

In most situations, skin drying is in association with an abattoir or slaughter-house. Consequently, it is essential to maintain good fly control.

Richard Bauman has had 40 years in the trade of treating and grading skins for market. This experience has taught him that there are no short cuts where good fly control together with top value for skins is desired. Mr. Bauman who has been associated with a Rockhampton firm during all of the 40 years is

confident that although a little more time may be involved in treating skins in the described manner, there are the rewards of minimal fly problems and increased value for skins.

## Facilities

### Shed

An open shed is required. Its size would depend on the average number of sheep slaughtered per week taking into consideration that the average drying time is 10 days and may be a little longer during prolonged wet weather.

A shed 3 m wide, 10 m long and 3.3 m high having three tiers of skins should house approximately 150 skins. This again could vary from off shears to full wool skins. Three horizontal ledges are required to support the rails on which skins are hung; these may be of angle-iron 75 mm wide or timber bolted horizontally to the shed uprights. The bottom ledges should be approximately 70 cm from the

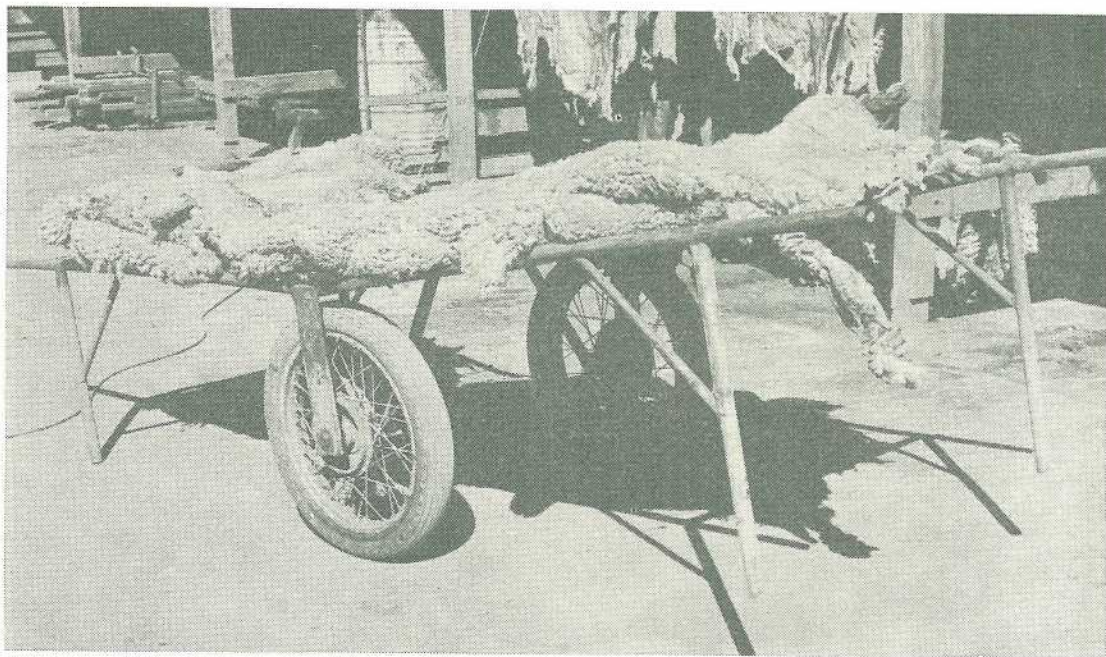


Plate 1. The barrow can be operated from either end.

# while drying sheep skins

floor with about the same distance between bottom and second ledges and second and top ledges.

## Floor

The floor should be of concrete, well-drained to an external pit. Where there is more than one bay in a shed it is desirable to have the floor of each bay separated by a concrete upstand approximately 15 cm high.

## Equipment

The equipment required where skins are transported manually from slaughter floor to drying shed and where distance is minimal is:

- Two rubber-tyred barrows each 1 m wide and 2.4 m long constructed of galvanized pipe frame and covered on top with a light weld mesh. Legs on both ends of the barrow

should have about 10 cm clearance of the ground when the barrow is held in a horizontal position see plate 1.

- An elevated platform on which the skins are spread for spraying should be about 1.5 m square, 0.6 m high at one end and 0.4 m high at the other to allow quick drainage. The frame may be constructed of wood or galvanized pipe covered on top with corrugated iron sloped into a gutter drain on the low end which in turn drains into a container at one corner. See plate 2.
- A container of approximately 4 L, fitted with a handle, to catch all excess insecticide fluid which runs off the skin during spraying.
- A 200 L drum or similar vessel to hold the liquid insecticide and fitted with a close-fitting lid. The drum can be mounted on a rubber-tyred trolley for manoeuvrability.

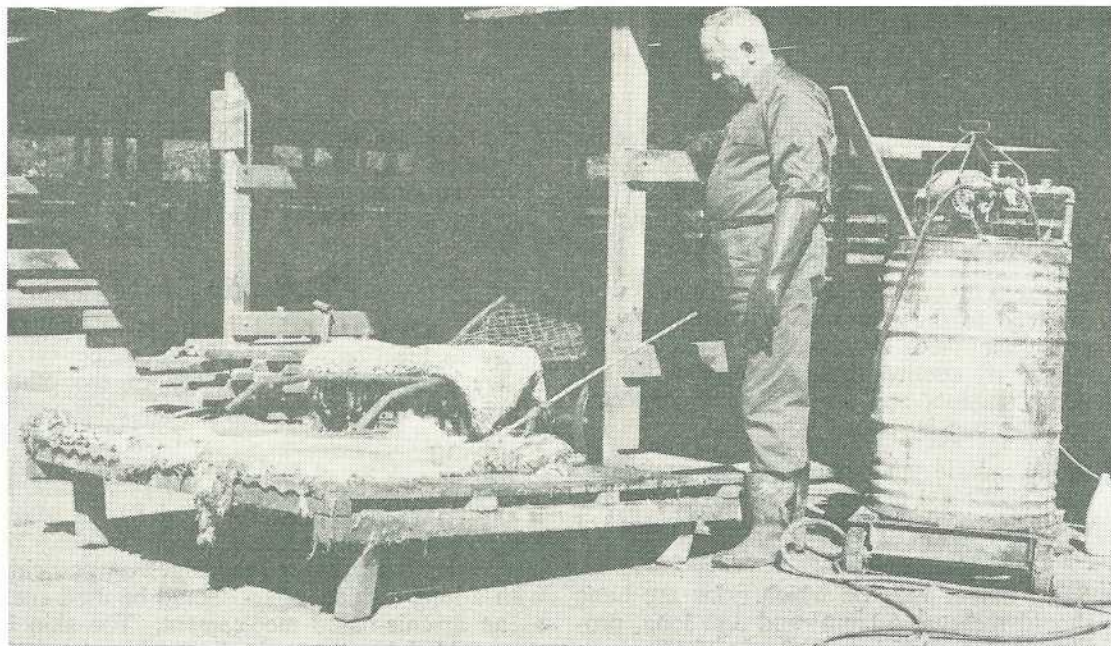


Plate 2. Constructing the platform low to the floor prevents fine spray from blowing into the operator's face.

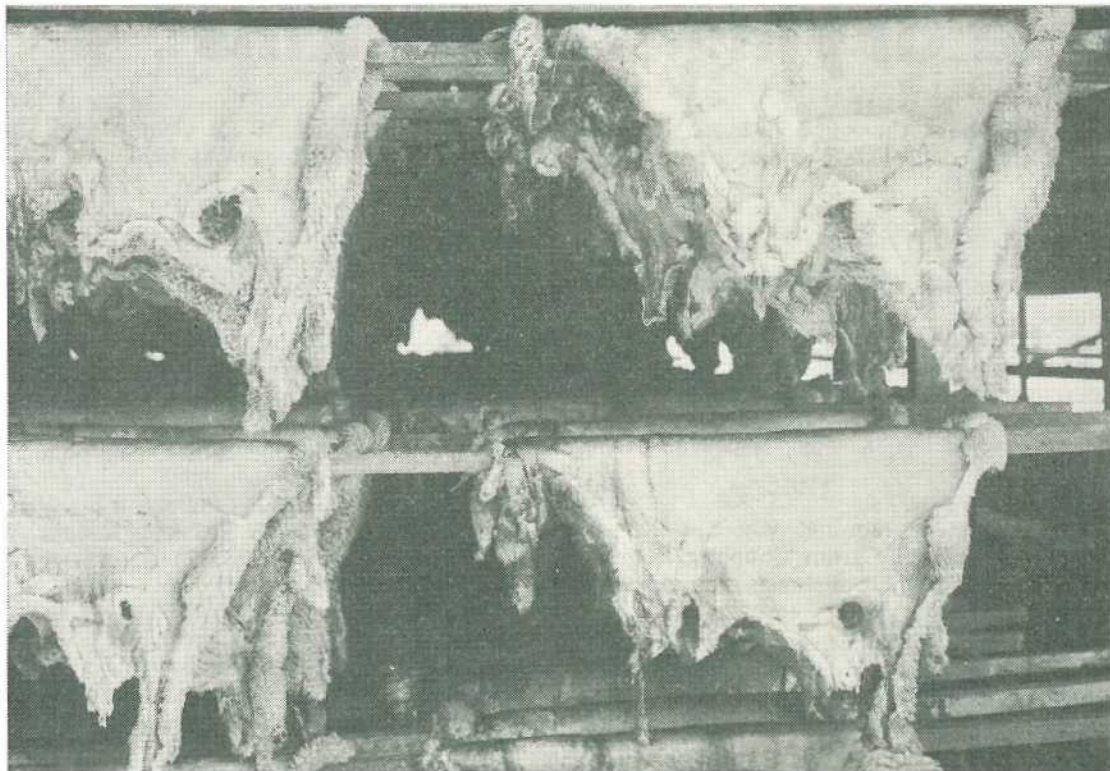


Plate 3. Positioning the skins neck to tail creates a good air tunnel through the shed.

- A half horsepower (0.37 kW) electric motor and three-quarter horsepower (0.56 kw) centrifugal pump is mounted on top of the drum. Note: The pump should be fitted with a by-pass into the drum.
- About 5 m of hose which is connected at one end to the pump discharge and to the spray handpiece at the other. Also, a short length of suction hose connected to the pump suction, and another hose connected to the pump by-pass.
- Spray nozzle and hand piece, preferably with about a 1 m brass tube to connect the spray nozzle and handpiece for ease of operation.
- Sawn timber rails on which skins are hung should measure 50 mm<sup>2</sup> and 3 m long, providing that each bay is 3 m wide between ledges.
- Personal safety equipment should include a long plastic apron, elbow length heavy-duty rubber gloves, and rubber knee boots. A safety chart should always be in view of users.

### Methods

Skins are transported from the slaughterhouse to the drying shed on the rubber-tired trolley and spread one on top of the other (flesh side up) on the elevated platform.

### Spraying

When spraying skins with the insecticide, it is most important that the total flesh surface be treated and in particular under all folds of skin which occur around the edges. A pesticide with a long residual effect should be used such as an arsenic-based medicament. The skin is then folded lengthwise and transferred to the other trolley ready for hanging on the rails.



## Hanging

Skins should be hung over the rail along the mid-line of the skin and position neck to tail (see plate 3). This allows a good ventilation tunnel through the entire length of each bay. Note the skin fold at the edges (plate 3) when hung. This creates an excellent fly breeding area if skins are not thoroughly treated with insecticide.

A gap of approximately 10 to 15 cm is necessary between rails to allow free circulation of air on all sides of the skins.

## Grading

When skins are thoroughly dry, they are firstly graded according to the length of wool and then the texture of the wool.

For example, there may be at least four grades according to the length of wool; 'shorn

and up to 12 mm', '25 mm', '50 mm' and '76 mm'.

Then, excepting the shorn and up to 25 mm grade, they are graded according to texture; 'coarse wool', 'fine wool' and 'comeback' (in this case, from sheep over 6 years of age).

## Bailing

Each grade is pressed individually into bales, but in a case where there is insufficient skins of one grade to make a bale they may be pressed with a different grade using a piece of bagging to separate them.

The number of skins per bale will differ according to the length of wool. 40 to 50 full wool skins should weigh approximately 180 to 220 kg, whereas it may take 140 shorn skins to reach the same weight.

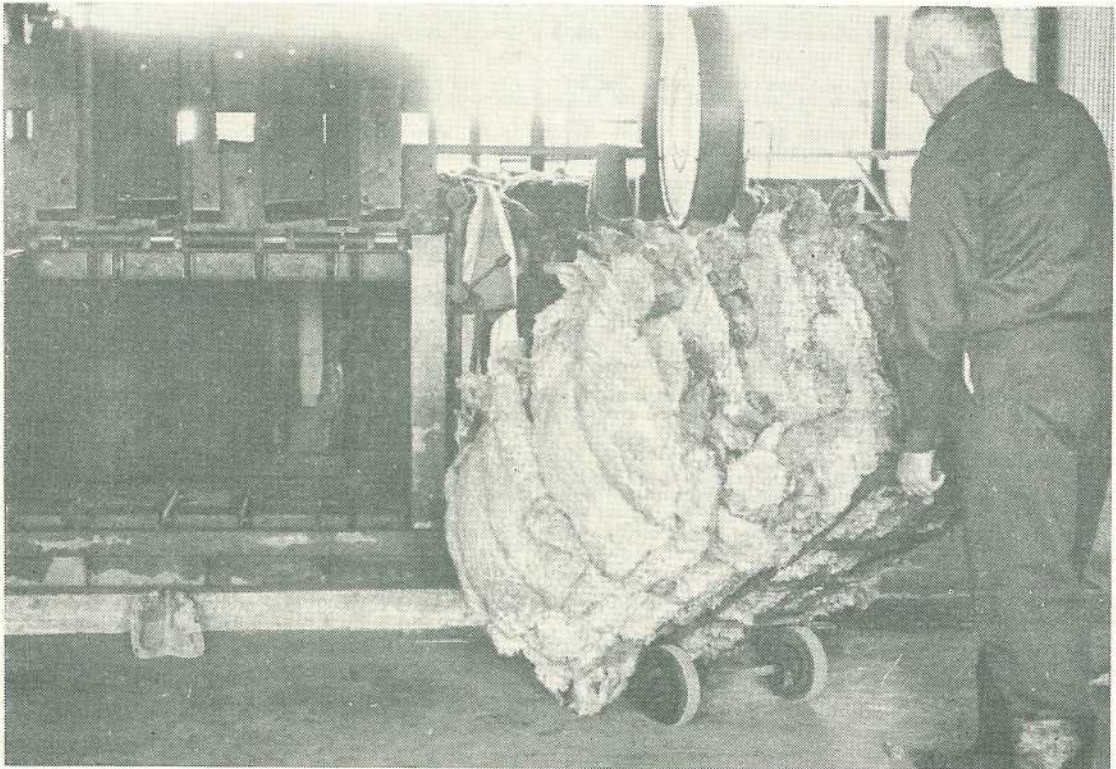


Plate 4. When skins are graded they are pressed into bales of approximately 200 kg.

## Safety precautions

Because most medicaments used in the treatment of skins are poisonous, handlers should read the precautions label carefully and carry out safety instructions.

## Important points

The main points as Richard Bauman sees them are:

- Always abide by the safety precautions as the label directs.

- Be sure that all folded edges are treated with insecticide.
- Hang skins neck to tail and allow space between rails to minimize drying time.
- Use an insecticide which has a long residual effect.
- Insecticide which drips to the floor also kills flies, therefore sweep but do not hose the floor, unless really necessary.
- Grading is important for top value.

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## Answers to brucellosis quiz

1. **False**—Brucellosis is a reproductive disease which can cause abortions, weak calves, reduced milk yield and sterility.
2. **True**—The taitag put on by the owner prior to sale is taken off the animal after slaughter and attached to a blood sample from the animal. After going through the inspection process, the blood sample and tag is sent to the laboratory for testing for brucellosis.
3. **True**—A taitag must be tightly wrapped around on itself just above the brush so that it does not slip off.
4. **False**—The tag must be wrapped on itself in order that the adhesive backing will work efficiently. (Squeezing the attached tag on to the tail also helps adhesion under damp conditions, as it squeezes moisture out from the tag thus enabling the adhesive to work.) Wrapping the tag in a spiral manner, or too loosely, will cause the tag to drop off long before the animal reaches its destination.
5. **False**—An infected cow does not look sick; in fact, the first sign of brucellosis is often the discovery of an aborted foetus.
6. **False**—Retaining reactors is a sure way to lose! The longer you wait, the harder it will be to eradicate the disease from your herd. Total separation for any period of time is impractical and seldom successful if attempted.
7. **False**—Although pasteurization destroys the disease-causing bacteria, most cases of human brucellosis (undulant fever) result from contact with infected animals or aborted calves on the farm and the uterus and udder of carcasses in the abattoir.
8. **False**—The milk ring test is a mass screening test of dairy herds which when viewed in conjunction with the results of previous tests indicates the likely brucellosis status of a herd. A single test could be misleading for a number of reasons.
9. **False**—Cattle pick up the disease mainly by ingestion of contaminated material emanating from aborted foetuses and infected animals.
10. **False**—Many calves are vaccinated to reduce the risk of infection. The Department of Primary Industries recommends vaccination for infected and high risk herds. Vaccination is no substitute for care in purchasing replacements and sound herd management.
11. **True**—The best time for Strain 19 vaccination is while the calf is between 2 to 6 months of age. Over-age vaccination carries a greater risk of post-vaccination test reactions. Such results make diagnosis more difficult.
12. **True**—The State D.P.I. and Veterinary practitioners bleed and test cattle in infected herds in Queensland without any charge to the owner. The owner, however, bears the cost of mustering. All efforts will be made to eradicate the disease from the property as quickly as possible.
13. **False**—When purchasing replacements, it is best to buy from tested clean herds. If you must buy from an untested or infected herd you should ensure that the animal is tested and found negative to two tests 60 to 120 days apart, the second test within 30 days of introduction into your herd. If the disease was in the incubation stage at the time of the first test, it will be more likely to be discovered at the second test before entry into the herd.  
For eradication purposes, repeat tests are necessary to maintain the disease-free status in case the disease was dormant at the first test.
14. **False**—Cattle from infected or non-assessed herds within the protected area are prohibited from movement within the area except for immediate slaughter or to saleyards outside the area for sale for slaughter. These cattle are eligible for unrestricted sale outside the area after two clean tests.
15. **True**—It is hoped that research will discover more efficient and effective techniques for detection, diagnosis and control of brucellosis.

### SCORE

- 13 to 15—Cow college scholar
- 10 to 12—Top cow hand
- 7 to 9—You had better brush up
- 5 to 6—Novice cow cocky
- less than 5—Queen Street cow cocky

# Insect pests of grain sorghum—part 2

## Corn ear worm

The corn ear worm (*Heliothis armigera* (Hübner), Family Noctuidae) attacks grain sorghum at all stages of growth to the maturing grain, but it is primarily a pest of the flower heads and developing grain. It occurs in all grain sorghum growing areas of Queensland.

### SEASONAL INCIDENCE

In the northern parts of the State, the insect is capable of year-round development but adult and larval numbers are lower during the winter. In south-east Queensland, it survives the winter in the pupal stage.

Insect numbers increase rapidly in spring with the highest levels usually occurring during the period from January to March. Successive flowerings of sorghum plantings or other host crops such as sunflower, soybeans or navy beans can promote a build up of corn ear worm populations.

### LIFE HISTORY

**ADULT.** The adult is a drab night-flying moth with a 35 to 40 mm wing span. In daylight hours, they are often seen resting on crop plants. They are attracted to light and traps employing mercury vapour light bulbs or 'black light' fluorescent tubes can be used to monitor moth numbers.

**EGG.** Eggs are deposited singly on the head shortly after it emerges from the flag leaf and during flowering. Few eggs are laid on either the leaves or maturing grain. Individual moths have been known to lay over 3 000 eggs, but the average is approximately 1 200.

The small, globular, upright eggs are pearly white when first laid, but later develop an encircling, irregular brown band. The dark head capsule and grey body of the developing larvae become visible prior to hatching.

**LARVA.** Newly-hatched larvae are about 1.2 mm in length with a greyish-white body and a black head capsule. As they develop, the larvae (5 to 10 mm in length) are often a basic brown colour with indistinct white striations along the body. Superimposed are a series of dark, spiky hairs which sometimes obscure the underlying pattern. Larger larvae have distinct, longitudinal stripes and the overall colour may be either green, fawn, pink, yellow or brown. Larvae attain lengths up to 35 mm.

The larvae may be cannibalistic particularly when a number are feeding in a confined space. This and other controlling factors such as disease and insect enemies often reduce numbers per head. For example, wet weather during the development of young larvae may result in an infestation being almost completely eliminated by naturally occurring insect diseases.

**PUPA.** Fully grown larvae leave the plant and transform into pupae in specially constructed chambers in the soil.

Pupal development is usually completed after a short period but can take several months during a cold winter. The moths then emerge, tunnel to the soil surface, expand their wings and disperse to recommence the cycle.

The minimum time from the egg stage to adulthood is only 23 to 24 days. Regular field surveys are therefore necessary for early detection of corn ear worm larval infestations.

### DAMAGE

When the eggs are laid on young sorghum plants, the larvae feed mainly on the developing leaves in the growing tip.

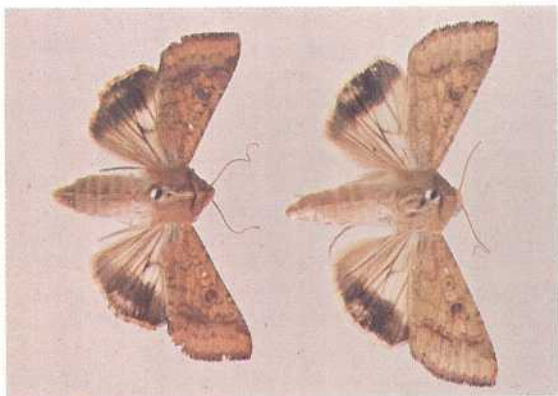
By far the most significant damage, however, results from infestation of the sorghum head. Young larvae feed on flowers and grain up to the firm dough stage, mature grain being generally unsuited for larval growth. Close-headed varieties appear to be more susceptible to attack than open-headed ones.

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by D. A. Ironside, Entomology Branch

# Insect pests of

Photographs by D. A. Ironside and J. Wessels.



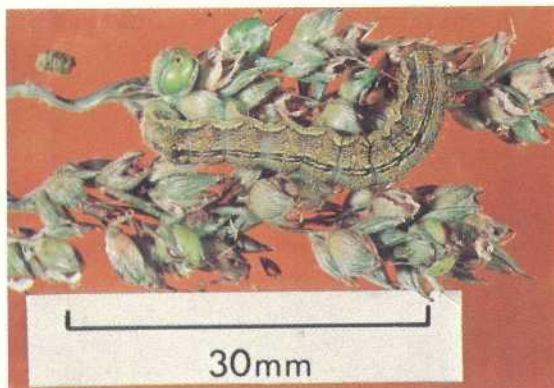
Corn ear worm moths. Right—male; left—female.



Corn ear worm eggs on sorghum florets.



A young corn ear worm larva on sorghum.



A fully grown corn ear worm larva on sorghum.

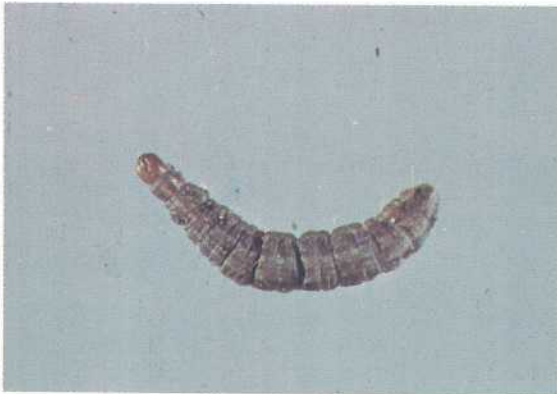


Virus infected corn ear worm larva on sorghum.



Typical damage to sorghum heart leaves by corn ear worm larvae.

# grain sorghum—part 2



*Sorghum-head caterpillar larva (x 2).*



*Sorghum-head caterpillar pupa (x 2).*



*Typical sorghum-head caterpillar damage (x 1).*



*Northern armyworm moth (x 1).*



*Northern armyworm larva on sorghum.*



*Northern armyworm—typical foliage damage (on maize).*

## Sorghum-head caterpillar

The sorghum-head caterpillar (*Cryptoblabes adoceta* Turner, Family Pyralidae) normally occurs in damaging numbers only in the wetter, more humid areas of the State. In the drier inland areas, however, extensive damage sometimes occurs after above average summer rainfall has been experienced. It attacks both grain and fodder sorghums.

### LIFE HISTORY AND HABITS

In the adult stage, the sorghum head caterpillar is a mottled grey-brown moth with a wing span of about 14 mm. During the day, it can be seen resting on the outside of the heads.

Eggs are laid in the head from when it emerges from the shot blade until after flowering has been completed. The eggs are oblong, 0.5 mm in length and pale yellow.

The newly hatched larvae, which are yellow and about 1 mm long may first feed on pollen sacs. As they grow, feeding continues on the developing grain. When large numbers of larvae occur in a head, it becomes fouled with webbing and debris. Late infestations may continue until the crop is harvested.

Fully grown larvae measure about 13 mm long, and range in colour from yellowish-brown to greyish-green with a darker line on each side of the back. Pupation occurs inside the sorghum head in light silken cocoons from which the moths emerge. The life cycle can be completed in 3 to 4 weeks depending on the time of the year.

### DAMAGE

The most severe damage usually occurs during the milky soft dough stage. Larvae consume portions of the grain and erode grain surfaces in addition to fouling the heads with webbing and excrement.

Close-headed varieties are more prone to damage, but open-headed varieties may also be attacked, particularly during severe infestations.

## Armyworms

Armyworms occur commonly in grain sorghum crops in Queensland and from time to time there are severe outbreaks. The most important species are the day-feeding armyworm (*Spodoptera exempta* (Walker), Family

Noctuidae) in north Queensland and the northern armyworm (*Pseudaletia separata* (Walker), Family Noctuidae) in southern Queensland.

### LIFE HISTORY AND HABITS

The term armyworm is derived from the occasional mass movement of large numbers of the larvae. The northern armyworm feeds mainly at night but the day-feeding armyworm, as its name implies, feeds in the daytime.

The adult stages are drab, stout-bodied, night-flying moths. They lay eggs in clusters covered with fine scales on the lower section of the leaf blade, on the sheathing leaf or on the ground. Individual moths may lay as many as 1 000 eggs.

Newly hatched larvae are pale in colour and about 1 mm long. As they develop, longitudinal stripes on the body become more clearly defined. When fully mature they are about 35 mm long and possess conspicuous white, pink and brown stripes which are about 1 mm wide. Depending on which colour is predominant, they appear pinkish, brown or green. Larvae living under crowded conditions tend to be somewhat darker than their solitary counterparts.

Headcapsules of mature larvae are mottled orange in colour with a prominent Y-shaped marking.

Pupation occurs in earthen cells below the soil surface and from there the moths emerge to recommence the life cycle. During summer, the total life cycle can be completed in about 4 weeks, but this period is lengthened by cold conditions.

### DAMAGE

Armyworms prefer to feed on succulent leaf tissue ignoring the mid ribs and stems. Extensive seedling loss can occur when large populations are present. In sorghum, a single larva may often be found in the throat of each plant before flowering. Feeding may perforate the coiled developing leaves in several places, giving rise to symmetrical damage patterns as the leaves unfold. Armyworms are often seen on sorghum heads and are sometimes mistaken for corn ear worms, but unlike the latter they cause little damage to the head.

# Armyworms in south Queensland field crops

SEVERAL armyworm species have been recorded as agricultural pests in Queensland.

Articles on two of these, the day-feeding armyworm and the lawn armyworm, have appeared in previous issues of the *Queensland Agricultural Journal* (January–February 1978, and May–June 1978 respectively). This article is concerned with a further three species of armyworms which occur in field crops—the common armyworm, the northern armyworm and the sugar-cane armyworm.

The term armyworm is derived from the spectacular movement of large numbers of larvae (worms), usually to or from cultivated areas. This movement of larvae en masse may be a direct search for new food sources, but more commonly is the result of excessive contact between individual larvae. A similar process causes swarming in locusts. It is wrong to infer that army type movement is an essential feature of armyworm behaviour, as numbers of relatively sedentary larvae are regularly encountered in crops such as sorghum and barley.

## Species identification

The striped larvae of the northern, common and sugar-cane armyworms are virtually indistinguishable from one another. However, larvae of the common and northern armyworms can be separated from the day-feeding and lawn armyworms with the aid of a microscope. The larvae of the latter two species lack tubercles (darkened, raised areas) around the setae (body hairs) of the first seven abdominal segments. Tubercles are found in northern and common armyworm larvae.

---

by R. H. Broadley, Entomology Branch.

In instances where positive identification is required, larvae should be reared to the adult forms. Photographs and descriptions of each armyworm are given in this article.

## Life cycle

The life cycle is essentially similar in all three species, with egg, larval, pupal and adult stages.

## Adult

Moths, which emerge from pupae (chrysalides) formed in the soil, are nocturnal, with feeding, mating and egg-laying occurring after sunset. Since they feed only on nectar, they do not cause any economic damage during their short life span of about 7 to 14 days. A supply of flower nectar substantially increases the total number of eggs laid. Individual moths have been recorded laying 1 000 eggs.

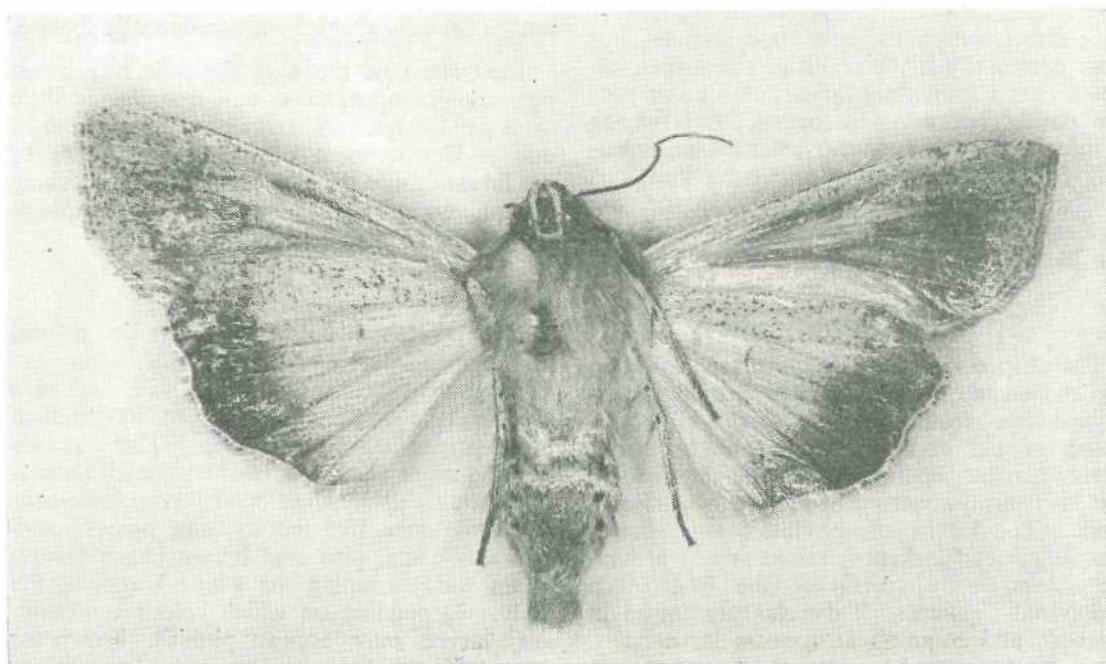
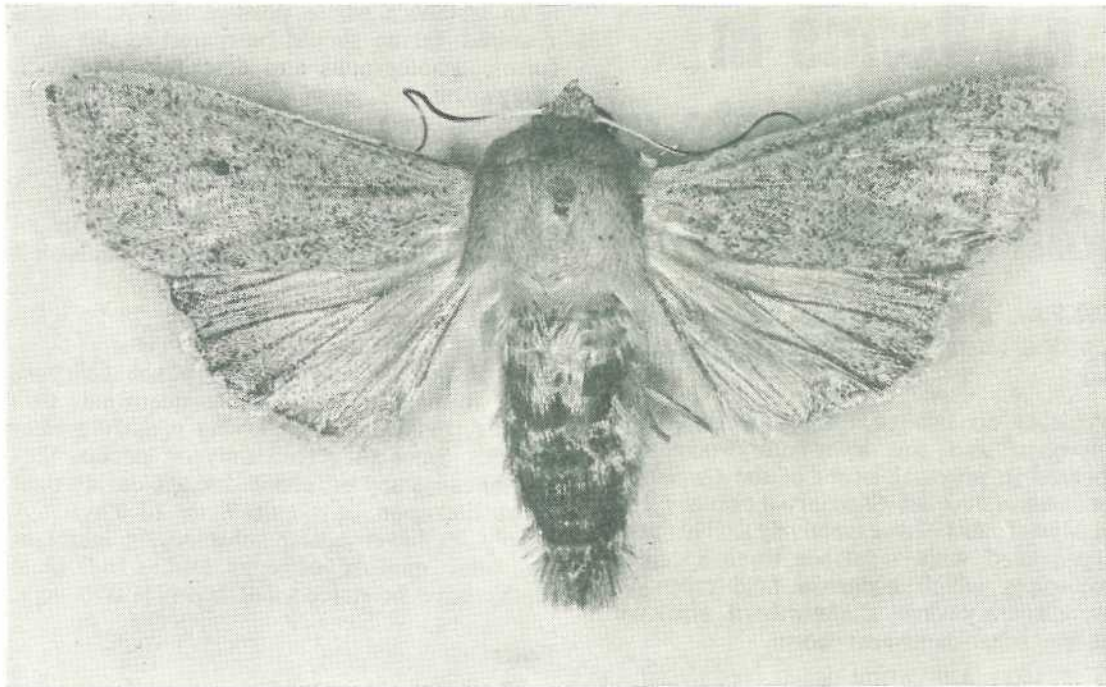
## Eggs

The small, shiny white, spherical eggs are usually deposited in irregularly-shaped masses in leaf folds. Eggs are cemented to each other, and to the host plant, by a translucent adhesive.

Incubation of the eggs depends largely on prevailing temperatures, and may be as little as 3 or 4 days. A darkening in egg colour, due to development of the head capsule of the larvae inside the egg, signifies that hatching is imminent. Larvae exit by chewing through the confining egg shell.

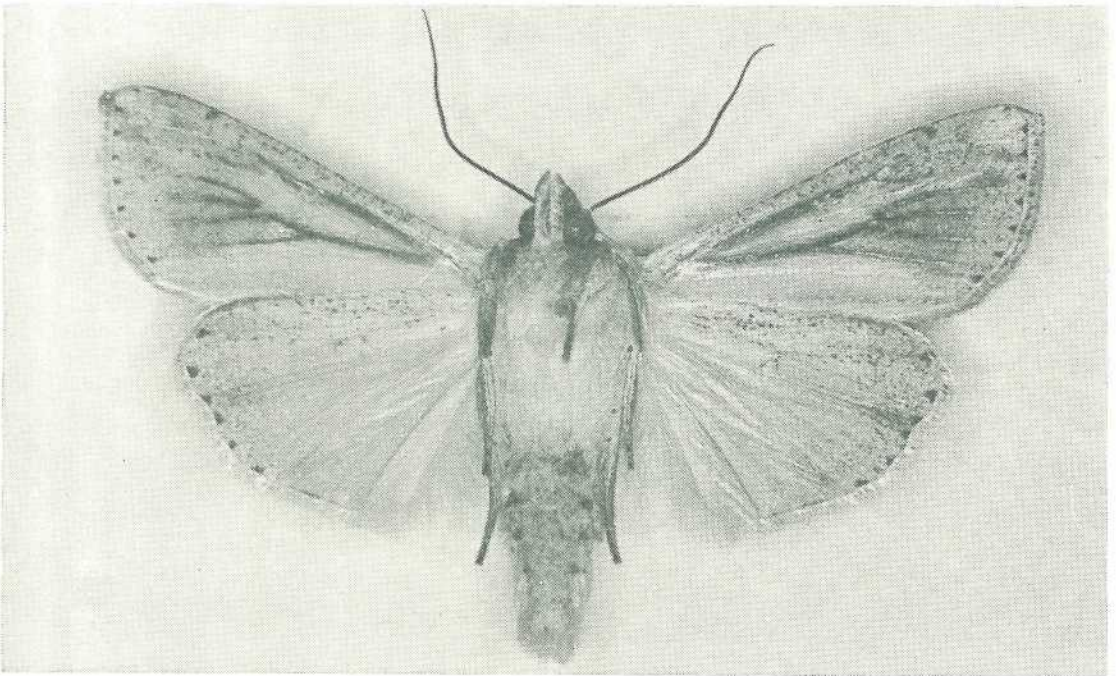
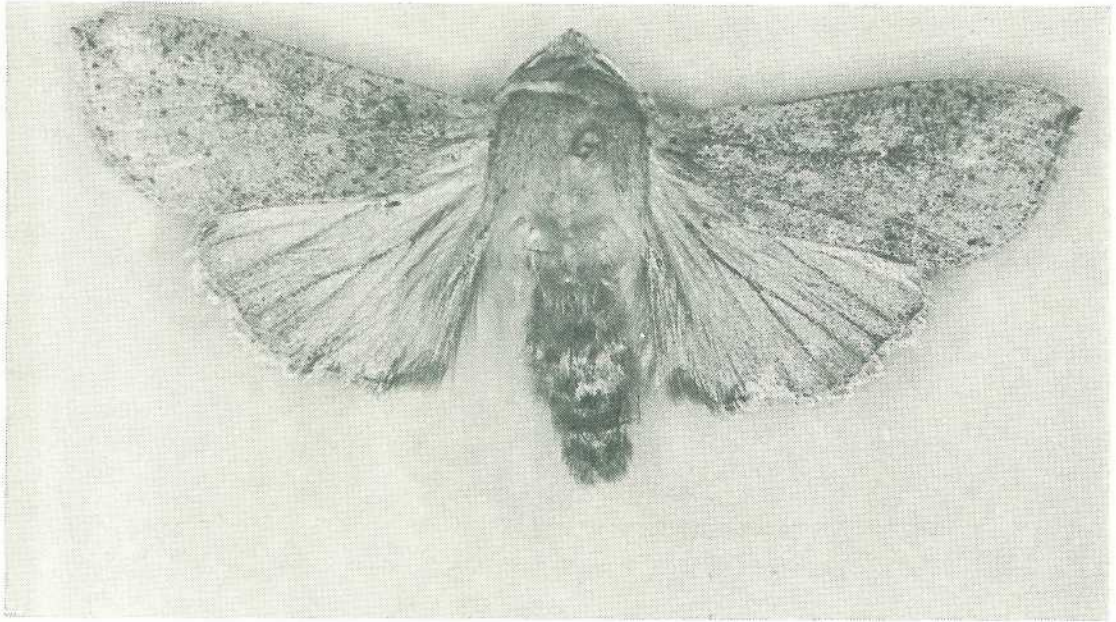
## Larvae

Newly-hatched larvae are pale in colour, and approximately 1 mm long. After the first moult (both the head capsule and skin are shed at each moult), faint longitudinal body stripes begin to develop. These stripes become more clearly defined with each successive moult. Fully developed larvae have usually undergone five moults, and possess conspicuous white, pink and brown bands (about 1 mm wide) running the whole length of the body. Depending on which colour is dominant, larvae may appear pinkish, brown or green. Larvae living under crowded conditions tend to be somewhat darker than their solitary counterparts.

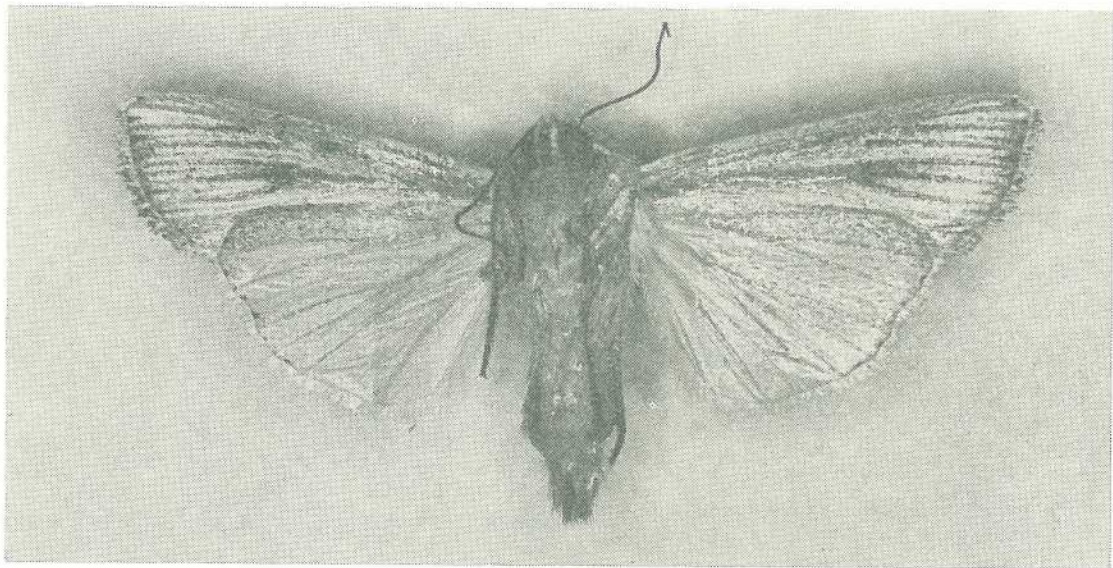
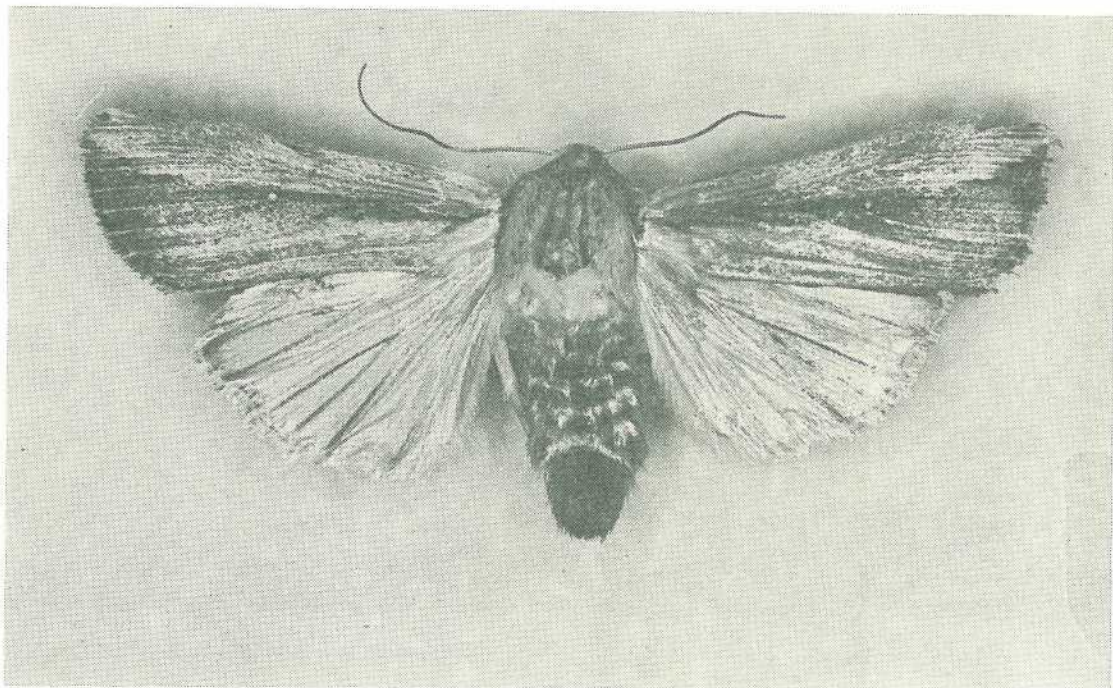


*Dorsal and ventral view—common armyworm moth. These moths have speckled grey-brown forewings with an orange-brown marking. Hind wings are pale-coloured with a characteristic black band.*





*Dorsal and ventral view—northern armyworm moth. These moths are similar to those of the common armyworm but they lack the diagnostic black band on the hind wings.*



Dorsal and ventral view—sugar-cane armyworm moth. These moths have smoky brown forewings with a distinctive black line (interrupted by a white dot) down each wing. Hind wings are pale and devoid of banding. Two black stripes are present on the underside of the abdomen.



*Northern armyworm larva feeding on a sorghum plant.*

Head capsules of mature larvae are mottled orange in colour with a prominent Y-shaped marking. Larvae grow to 35 mm in length, and 7 mm in width. Each possesses three pairs of thoracic legs, and five pairs of fleshy prolegs on the abdomen.

Feeding occurs chiefly after sunset, and larvae spend most of the day concealed in the throats of the host plants or in the soil. Feeding larvae can often be detected by the presence of ragged leaves and 'frass' or larval excreta on the plants or soil. This semi-digested plant tissue often lodges in or near the throat of the plant.

Unlike some other moth species, armyworm larvae are not cannibalistic, and can co-exist together. Younger larvae tend to aggregate, but older larvae are more dispersed.

### **Pupa**

Mature larvae leave the plant and burrow below the soil surface, where they transform into pupae in earthen cells. Pupae are light green-brown at first, but rapidly tan into a chestnut brown colour. Moths emerge from pupae to recommence the life cycle.

The total life cycle from egg to moth can be completed in about 4 weeks, but this period may be lengthened considerably by cool conditions.



*Sorghum plant damaged by northern armyworms.*

## Host plants

Armyworms tend to feed on members of the family Gramineae (grasses). It is unusual to find them damaging dicotyledonous crops such as sunflower, soybeans and navybeans.

The common armyworm regularly attacks barley, oats and wheat (winter cereals), and has a preference for the first mentioned crop. It has also been recorded from sorghum, maize, millets and panicum.

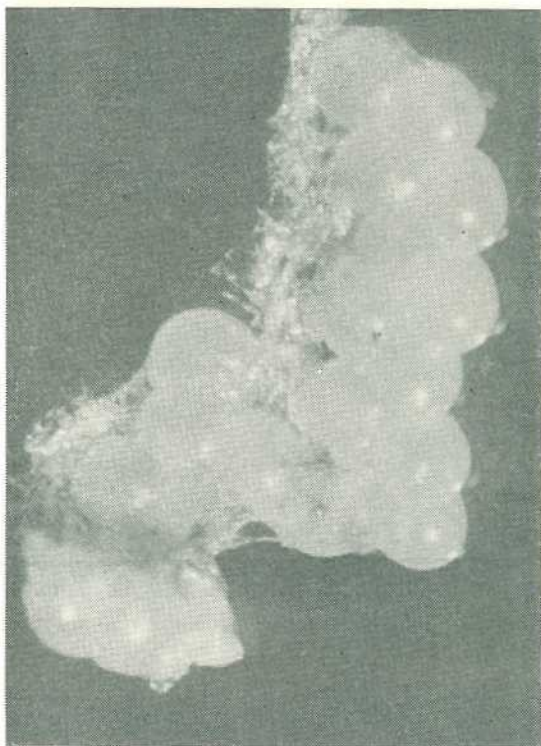
In Queensland, the northern armyworm has been recorded from sorghum, maize, barley, wheat and rice. In New Zealand, pastures and maize are commonly attacked by this pest.

The sugar-cane armyworm appears to be of minor importance, and has been found feeding on sugar-cane, canary, white French millet and sorghum.

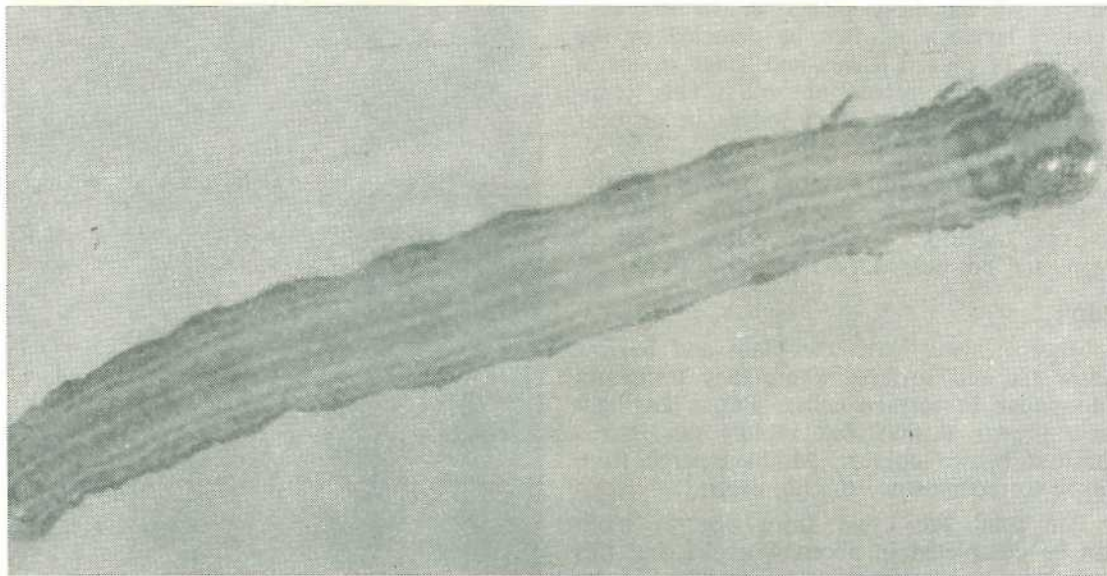
## Damage

All plant damage is caused by larval feeding. Older armyworms (10 mm to 30 mm long) present the most serious threat in this respect because they are voracious feeders. Younger larvae do not have the extensive appetites of their older counterparts.

Two types of damage are common—leaf feeding and head cutting. The latter can be very serious.



*Sugar-cane armyworm eggs. Northern and common armyworm eggs are similar.*



*Young northern armyworm larva.*

TABLE 1  
ECONOMICS OF SPRAYING FOR ARMYWORMS IN  
CLIPPER BARLEY

Estimated Price per Tonne (\$)	Total Insecticide and Application Costs per Hectare (\$)	Spraying is economically justifiable if anticipated Head Loss per Square Metre is greater than that shown below
80	5	7.1
	10	14.2
	15	21.3
90	5	6.3
	10	12.6
	15	18.9
100	5	5.6
	10	11.2
	15	17.0

### Leaf injury

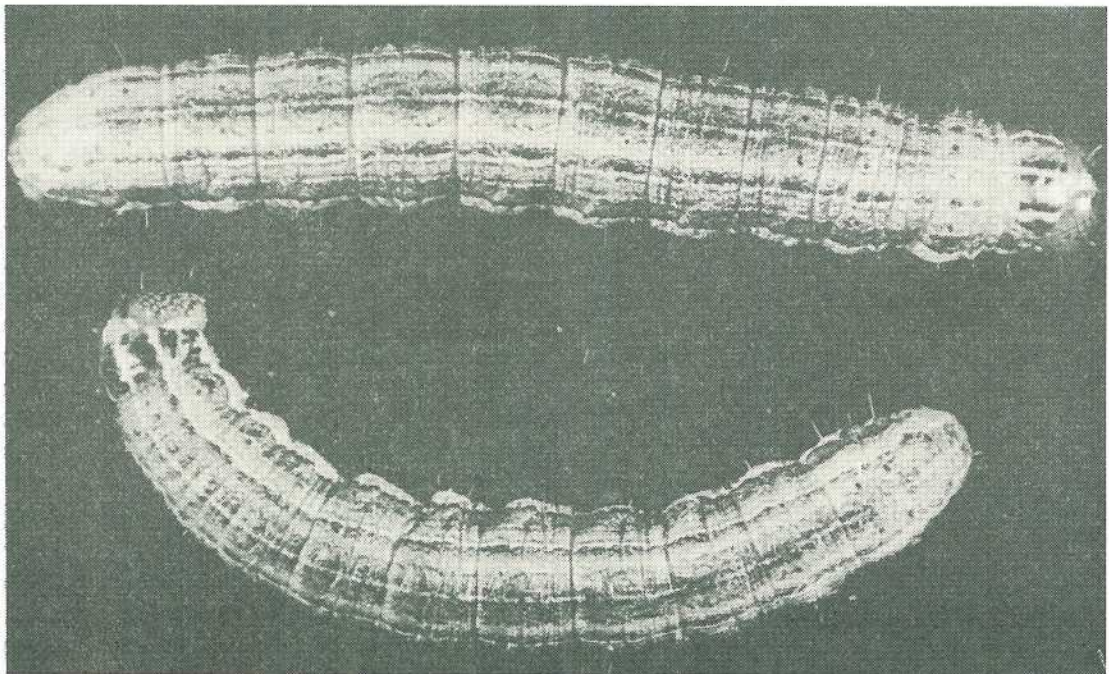
Armyworms prefer to feed on succulent leaf tissue, ignoring leaf midribs and stems. Consequently, leaves often assume a tattered appearance with ragged margins indicating feeding sites. Damage to sorghum and maize

is slightly different to that of freely-tillering winter cereals. In the former crops, it is usual to find a single larva in the throat of each plant before flowering. A feeding excavation may perforate coiled developing leaves in several places, giving rise to symmetrical damage patterns.

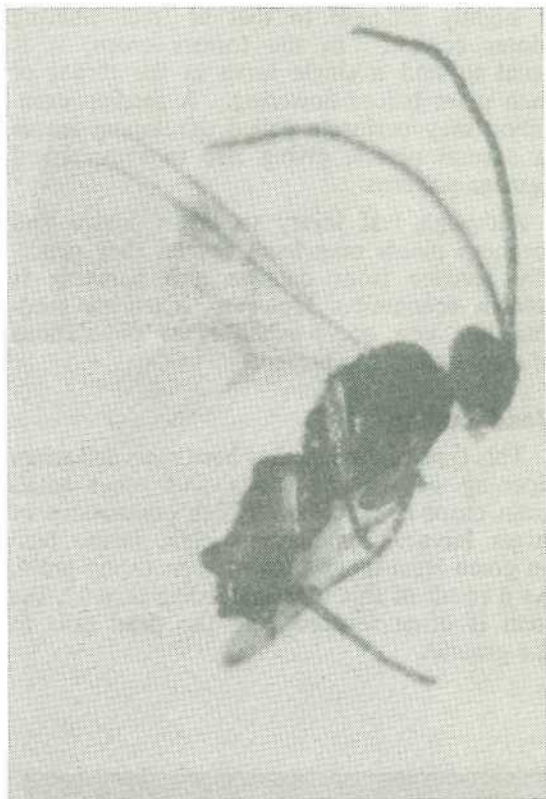
Although leaf injury to larger maize and sorghum plants may seem severe, they generally recover from damage and spraying is seldom economic. However, extensive seedling loss can occur when large populations of armyworms are present.

### Head cutting

This type of damage has been recorded when ripening of winter cereals and other small grain crops coincides with high populations of larger larvae. As leaves wither, larvae feed on green stem tissue below the maturing grain. As a result of this type of feeding activity, the stem is often severed, and the head falls to the ground.



Mature northern armyworm larvae.



*The adult Apanteles wasp parasite.*



*Emergence holes of Apanteles larvae in the skin of a northern armyworm larva.*

The head losses per square metre that can be sustained by Clipper barley at various insecticide and application costs and for different prices per tonne are shown in table 1. For the purposes of calculation it has been assumed that the plants do not compensate for any head losses, and that damage is evenly distributed throughout the paddock. This, of course, does not always occur and each situation must be considered carefully.

It is important to realize that action must be initiated at an early stage if economic losses are anticipated, and that the figures in table 1 are not greatly affected by estimated yield. In other words, head loss per square metre (table 1) which can be tolerated does not change with yields of 1 or more tonnes per hectare. It is fixed basically by grain prices, and insecticide and application costs.

### **Seasonal incidence**

The common armyworm is most active during late winter-spring, while the northern armyworm is most abundant in summer. Armyworm incidence is apparently related to climatic conditions, rainfall patterns which also govern the planting and growth of host crops, and the presence of natural enemies. Armyworms are active in northern Australia during the winter months.

Armyworm infestations typically last for one (occasionally two) generations in a particular crop, after which the host plants become unattractive to ovipositing moths. For example, northern armyworm moths lay eggs on young sorghum plants prior to flowering but rarely after flowering has occurred.

## Parasites, predators and diseases

Survival of armyworm larvae is often affected by adverse environmental conditions such as excessive heat or cold, and heavy rainfall. In addition, a number of naturally occurring organisms are capable of checking increases in armyworm populations. When these cannot regulate armyworm build-up, as does occur under certain circumstances, and when other conditions are optimal, the result is an armyworm outbreak.

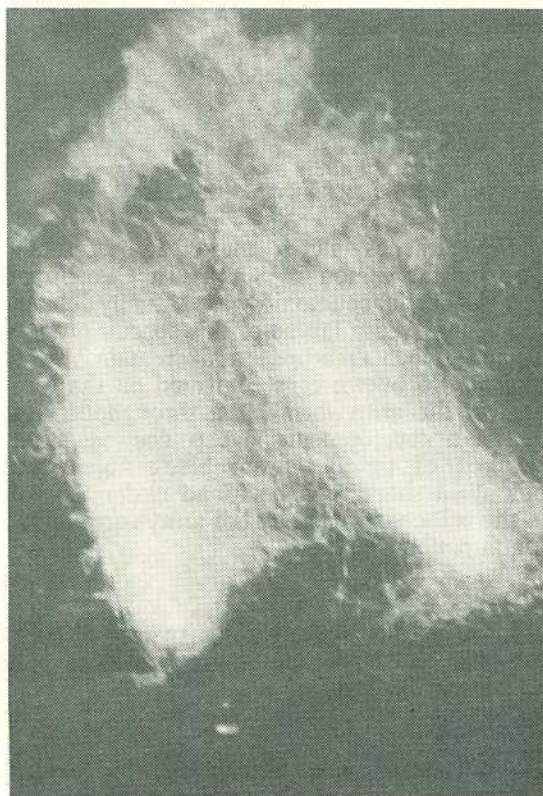
A brief discussion of armyworm natural enemies is given below.

### Parasites

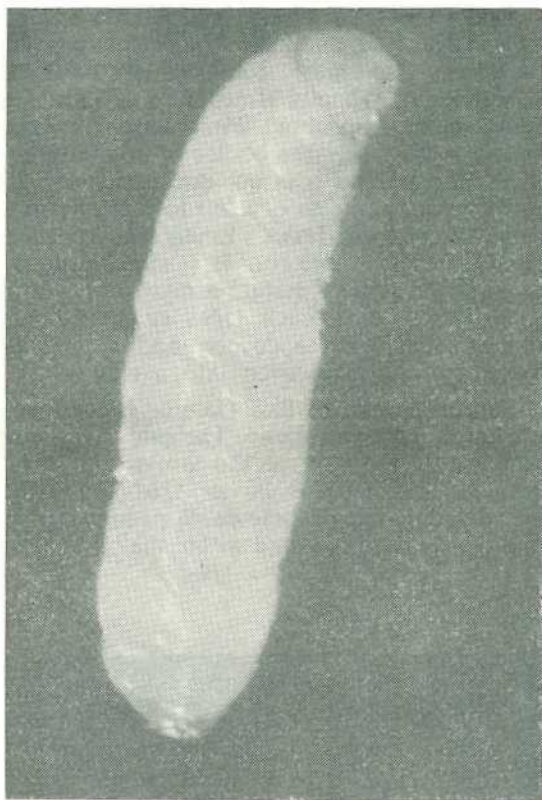
Armyworm parasites are readily divided into two groups—the endoparasites and the ectoparasites.

Endoparasites feed on internal tissues and organs of larvae, and hence are seldom seen by farmers. The most common of these is *Apanteles* sp. (family Braconidae). This is a small, dark wasp about 2 mm long. Females deposit eggs inside the bodies of young armyworm larvae, and it is not uncommon for 20 to 30 wasp larvae to develop to maturity in a single armyworm larva. Emergence of wasp larvae occurs more or less simultaneously through the skin of mature armyworms, which subsequently die. Each larva spins a small, oblong, fluffy, white cocoon and several of these may be interwoven into a cluster.

Several species of flies (family Tachinidae) are also endoparasites. Tachinid eggs are attached to the skin of the armyworm larva, and the maggot-like larvae feed internally. Usually, only one of these develops to maturity, and the fly pupa is found within the host pupa.



The legless *Apanteles* wasp larva after emergence. Pupal cocoons of the *Apanteles* wasp parasite.



An ectoparasitic Ichneumonid wasp larva.

Ectoparasites attach and feed externally. The most common in South-east Queensland is a slender ichneumonid wasp (family Ichneumonidae). Wasp larvae of this species grow to 10 mm when mature, and remain firmly attached to brown eggs cemented on the forepart of the armyworm larva throughout most of their development. Wasp cocoons, constructed of tightly woven black fibres, and oblong in shape, can be found under the soil in the cell constructed by the armyworm larvae for pupation.

#### Predators

Insectivorous birds, various species of sucking bugs and larger wasps are known to prey on armyworm larvae.

#### Diseases

Armyworms are susceptible to several diseases, which can play major roles in decimating armyworm populations, when atmos-

pheric conditions are suitable for disease transmission. The diseases include a fungus, *Nomuraea rileyi*, and virus diseases.

#### Other species encountered

*Heliothis* larvae are often found on plants simultaneously with armyworm larvae. They are quite variable, and overall colour patterns may be green, fawn, orange, yellow or brown. They can be distinguished from striped armyworm larvae by appearance and feeding habits. *Heliothis* prefer to feed on flowers and developing grain, but will also feed on green leaf tissue.

Armyworms (except when 'head cutting') almost invariably feed on succulent leaf tissues. Armyworm and *Heliothis* damage, particularly on sorghum prior to flowering, is superficially similar. As insecticides required for *Heliothis* and armyworm control are different, it is important to verify which species are present.



A common armyworm moth at rest on foliage—The northern armyworm moth at rest is similar.



## Control

Chemicals for armyworm control are given in table 2. Day-feeding armyworm—*Spodoptera exempta* (Walk.)

Scientific names of insects mentioned in this article are as follows: Lawn armyworm—*Spodoptera mauritia* (Boisd.)

Common armyworm—*Pseudaletia convecta* (Walk.) Heliothis—probably only *Heliothis armigera* (Hübner.)

Northern armyworm—*Pseudaletia separata* (Walk.) Tachinid flies—includes *Goniophthalmus australis* Bar., *Cuphocera* sp., *Compsilura* sp., *Peribaea* sp.

Sugar-cane armyworm—*Mythimna loreyimima* (Rungs.) Apanteles—*Apanteles ruficrus* Haliday

TABLE 2  
INSECTICIDES FOR ARMYWORM CONTROL

Chemical Name	Some Trade Names	Application Rate		Withholding Periods (Days) to	
		Active Ingredient	Product	Cereal Harvest	Grazing
Chlorpyrifos ..	Lorsban .. .. Nabsol	350-450 g/ha	700-900 ml/ha of 50% product ..	10	2
Trichlorfon ..	Klorfon .. .. Lepidex Dipterex Liquid Dipterex S.P. 80	550 g/ha	1 000-1 100 ml/ha of 60% product 900 ml/ha of 62.5% product .. 700 g/ha of 80% product ..	14	2
Maldison U.L.V.	Malathion U.L.V.	..	700 ml/ha of 116% product ..	7	7

\* Trichlorfon is toxic to several varieties of sorghum including Alpha, Pioneer 846 and Texas 610. Chlorpyrifos may also be phytotoxic to Alpha and related sorghums.

\* Maldison U.L.V. should only be applied via aeroplane.

## Tips on full use of insecticide

FARMERS could literally be throwing away many dollars of insecticides each year with supposedly empty containers.

The Department of Primary Industries' Standards Branch recommends that pesticide containers be rinsed thoroughly before disposal.

It has been shown that a 20-litre drum could retain as much as 24 millilitres of pesticide on disposal. This was measured after normal draining.

Quantities of emulsifiable concentrates, solutions and miscible oils being mixed with water for spraying could be saved by following a simple draining procedure.

The contents of the drum should be emptied into the spray tank and allowed to drain for at least 30 seconds. The drum should then be quarter-filled with water and drained into the spray tank for a further 30 seconds. The last step should be repeated twice more to rinse the drum thoroughly.

The rinse water should always be added to the spray tank. Ground areas could be contaminated if it is carelessly poured out. To avoid any risk of poisoning, pesticide drums must never be re-used.

# Ryegrass/clover pastures boost

by G. B. Spackman, Agriculture Branch and L. A. Cook, Dairy Field Services Branch.

WINTER and spring milk production on Atherton Tableland dairy farms has been boosted considerably by including subterranean and white clovers in irrigated nitrogen-fertilized ryegrass pastures.

The interest in subterranean and white clovers follows trials at Ayr Research Station where both ryegrass and clover mixtures and pure clover pastures produced more milk than pure ryegrass pastures.

In 1978, 12 Atherton Tableland dairy farmers planted subterranean clover and white clover with ryegrass. Their pastures provided

more feed and significantly lifted milk production in winter, spring and early summer. They were able to minimize the winter milk production decline that normally occurs due to frosts and poor winter growth from tropical pastures. Furthermore, the usual milk composition problems were not encountered.

Figure 1 indicates the 1978 Malanda factory milk intake pattern and also the 1978 milk production pattern on Mr Frank Cuda's Atherton Tableland dairy farm which used clover and ryegrass pastures for winter feed. The boost to production in winter and spring from this pasture is obvious.



*Ryegrass/clover has provided adequate feed from June to December for the dairy herd of Clarence and Ernie Stonehouse of East Barron.*

# Tableland winter milk production

## Species

Price and availability of seed and agronomic characteristics limited the farmers' choice of ryegrass and clover varieties. The varieties planted in 1978 included:

- Subterranean clover (*Trifolium subterraneum*): Clare, Seaton Park, Mount Barker, Woogenellup and Bacchus Marsh.
- White clover (*T. repens*): Ladino, Haifa and New Zealand White clover.
- Ryegrass (*Lolium* spp.): Tama, Ariki, Wimmera, Kangaroo Valley.

Planting rates were normally 35 to 40 kg seed per ha. Ryegrass was normally sown at

about 25 kg per ha, subterranean clover at around 10 kg per ha, and white clover up to 3 kg per ha.

Clare subterranean clover, and Ladino and Haifa white clover persisted better than the other clovers. Of the ryegrasses, Tama and Ariki were the most productive. Wimmera and Kangaroo Valley tended to go to seed too freely and were more susceptible to rust.

## Dry matter production

Mr Clarence Stonehouse of East Barron sowed Ariki ryegrass, Ladino white clover, and Seaton Park and Clare subterranean clover in 1978. The dry matter production from this



'Following a heavy frost and a dry year, I was without feed from tropical pastures. However, my cows maintained production on irrigated ryegrass and clover.'—Frank Cuda, East Barron.

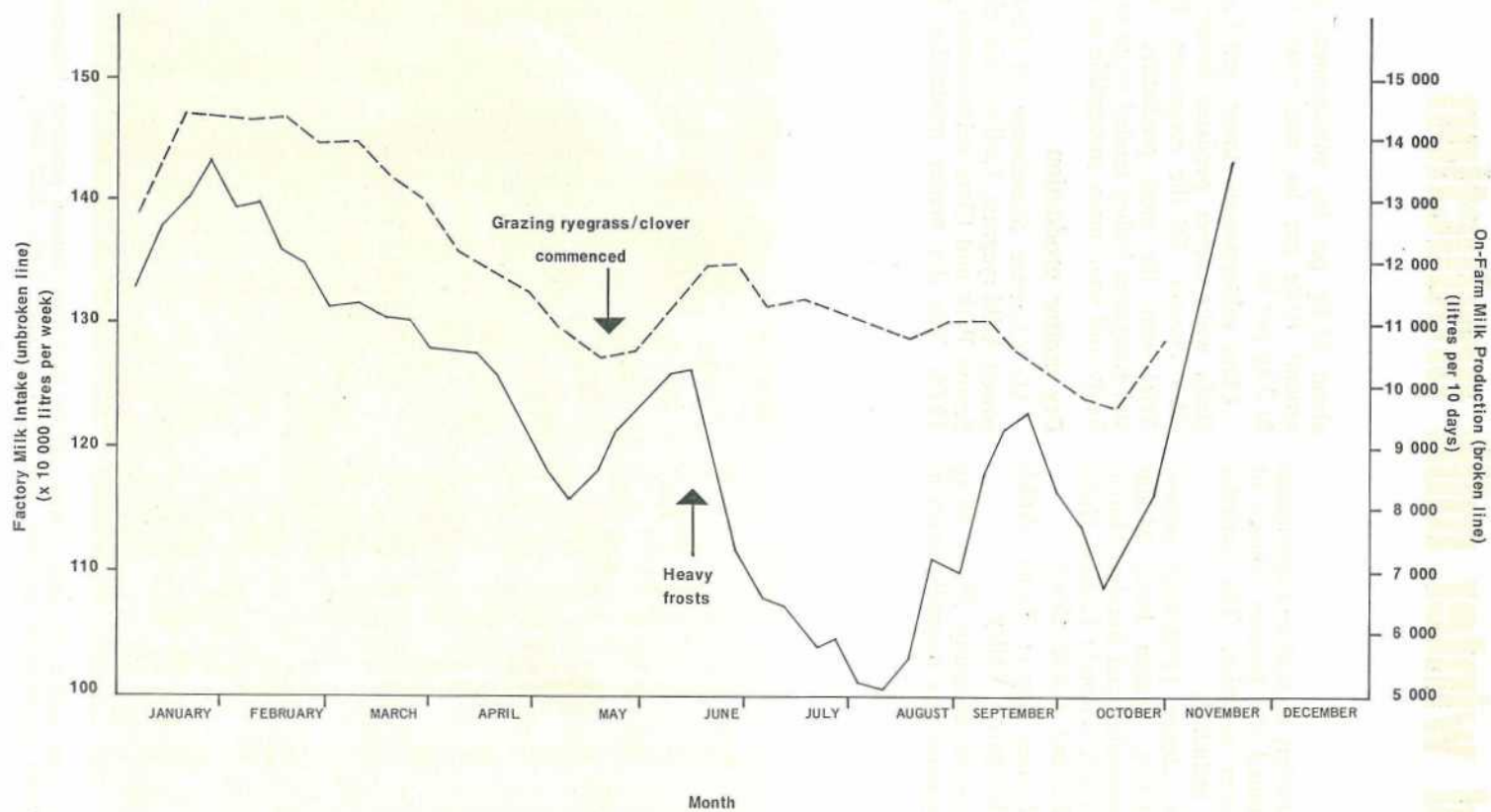


Figure 1. Atherton Tableland seasonal patterns of factory milk intake and on-farm milk production with ryegrass/clover for winter feed.

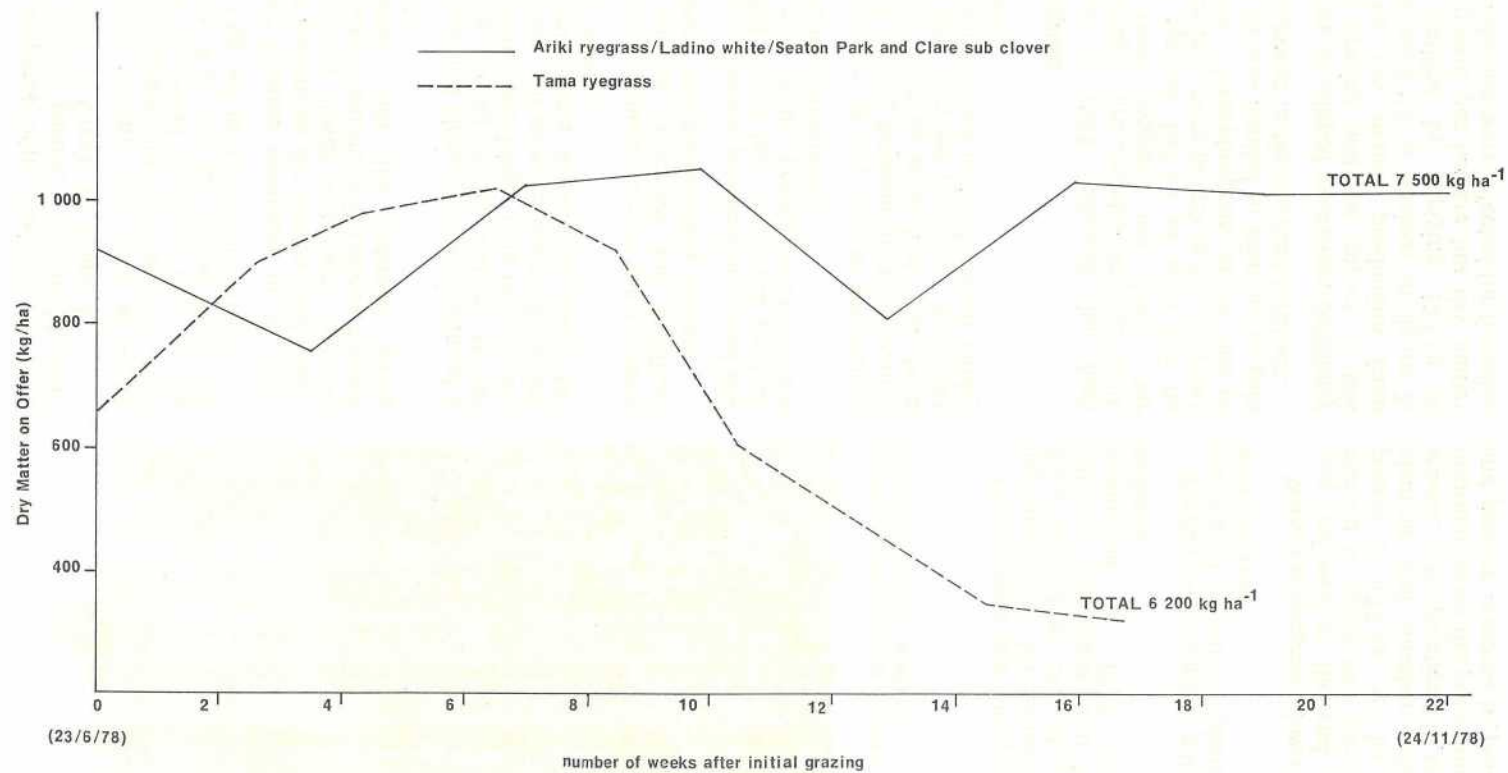


Figure 2. Dry matter production 1978.

pasture is compared with production from a pure Tama ryegrass pasture grown by Mr John Lilley of Butcher's Creek, in figure 2.

The ryegrass pasture was sown at 40 kg per ha. The ryegrass/clover pasture was sown at 28 kg per ha Arika ryegrass, 1 kg per ha Ladino white, 4 kg per ha Seaton Park sub clover and 4 kg per ha Clare sub clover.

The clover became dominant in the ryegrass/clover pasture as the season progressed. The subterranean clover was more vigorous early in the season but the white clover became more vigorous with the warmer spring temperatures.

The ryegrass and clover pasture produced a total 7 500 kg per ha of dry matter. It was productive for 6 weeks longer than the ryegrass pasture and was still growing vigorously at the end of November when it had been grazed for more than 5 months.

The pasture continued to grow for a further 3 months without irrigation and fertilizer, although growth was considerably slower.

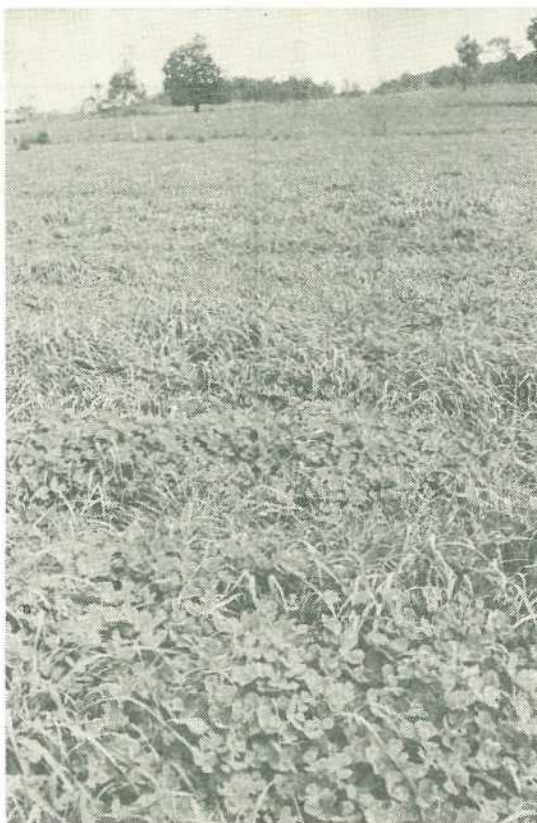
The ryegrass pasture produced less total dry matter (6 200 kg per ha) but it did produce more feed early in the growing season when it was grazed more frequently.

The differences in dry matter production and length of grazing between the two pastures may not have been as great had Arika been used in the pure ryegrass pasture as Arika has a longer growing season under Atherton Tableland conditions.

### Fertilizer inputs

Experience in 1978 indicated that high inputs of nitrogen are essential for high milk production from ryegrass and clover. Mr Stonehouse applied 187 kg of urea per ha (86 kg N per ha) every month to his ryegrass/clover pasture. Superphosphate at the rate of 500 kg per ha was applied at planting to gain maximum response to the nitrogen fertilizer.

The pasture developed potassium deficiency at the fifth grazing and the impact of this deficiency on dry matter production from week 10 to week 16 is obvious in figure 2. This was rectified by applying 187 kg of muriate of potash per hectare but dry matter and milk production were affected for 6 weeks.



*A close-up of irrigated ryegrass, subterranean clover and white clover pasture.*

The nitrogen and phosphate fertilizer dressings applied by Mr Stonehouse are typical of those applied by the other dairymen on the Atherton Tableland who based their winter production in 1978 on ryegrass/clover pastures.

Farmers who applied only 125 kg per ha of muriate of potash at planting were unhappy with this rate.

When the ryegrass/clover winter feed system was reviewed at the end of grazing, it was decided to apply two dressings of muriate of potash at 125 kg per ha in 1979—one at planting and another midway through the season. This practice will be reviewed as more information on the potassium status of the soils and pasture response to potash becomes avail-

able. The system does appear more dependent on potassium than other forage systems in use on the Tableland.

It may be possible to reduce nitrogen fertilizer inputs in this system because of the inclusion of the legumes. This will be studied this year.

### Irrigation inputs

This ryegrass/clover forage system is dependent upon adequate and timely irrigation. At least 25 to 30 mm of irrigation every week is essential. The pasture should not suffer any moisture stress or both dry matter and milk production will decline.

### Economics

Mr Stonehouse's 71 milking cows rotationally grazed 12 ha of ryegrass and clover for 160 days in 1978.

The average daily milk production was 15.7 L per cow—a gross value of \$2.12. This produced a margin above feed costs of \$1.44 per cow per grazing day or more than \$1 300 for the grazing period.

The cost of growing the ryegrass and clover was \$458 per ha, or \$0.48 per cow per grazing day. This includes costs incurred between planting and first grazing such as land preparation, seed, etc.

Every milking cow was supplemented with 1.8 kg maize meal per day, costing an additional \$0.20 per day, making the total daily cost of feed during the grazing period \$0.68 per cow. Feed costs amounted to only 32% of the gross value of milk produced.

The margin above feed costs could have been greater if molasses, a cheaper supplement, had been used instead of grain.

Although the costs of the ryegrass/clover system vary from farm to farm, Mr Stonehouse's costs can still be a guide.

	\$/ha
Seed-bed preparation (double discing)	9.77
Planting, double-rolling, fertilizing ..	2.021
Seed:	
Ryegrass: 28 kg @ 90c/kg ..	\$25.20
Sub. clover: 8 kg @ 90c/kg ..	7.20
White clover: 1 kg @ \$4.00/kg	4.00
Total seed cost .. ..	36.40
Fertilizer:	
500 kg superphosphate @ \$90.60/tonne .. ..	44.80
187 kg muriate of potash @ \$141.20/tonne .. ..	26.40
1 185 kg urea @ \$181/tonne .. ..	214.49
Total fertilizer cost .. ..	285.69
Irrigation (fuel and oil only); @ 31 mm per week—hand-shift ..	114.12
<b>TOTAL .. ..</b>	<b>\$458.00</b>

This method of winter feeding is attractive because it ensures continuity of feed for up to 6 months of the year. However, it does require a considerable cash outlay and approximately 35% of costs must be met before the pasture is grazed. The remaining costs—irrigation and nitrogen and potassium fertilizer—are spread throughout the growing season.

### Points to remember

- A fully prepared seedbed and heavy rolling at planting significantly improve germination and establishment.
- Superphosphate at rates around 500 kg per ha ensures full use of the nitrogen inputs.
- The system appears to use high levels of potassium. 125 kg per ha of muriate of potash should be applied at planting and again midway through the growing season until the issue is better understood.
- At least 25 to 30 mm of irrigation should be applied each week.
- The pasture must be well utilized to maximize returns.



# Molasses in the Queensland

## dairying industry

Compiled by P. J. Goodwin and Anne Chamberlain,  
Dairy Field Services Branch.

SINCE the turn of the century, dairy farmers in Queensland have used molasses as a supplement, a carrier, and to stimulate appetite in their herds.

Despite this long association with molasses, some people still have many confused and wrong ideas about it.

The aim of this article is to present the most up-to-date information on molasses.

### General characteristics

The interest in molasses is justified when its analysis reveals the high nutritive values it contains.

### Nutritive values

In 1977, molasses from different sugar mills throughout Queensland was analysed to give the following nutritive values on a dry matter basis. The results are shown in table 1.

This is an impressive list of nutrients and compares favourably with grain, the main alternative energy supplement. Maize has the highest energy concentration of the grains and its comparison to molasses is shown in table 2.

Molasses is very low in protein compared to other sources of feed. Of the protein present, approximately one-third is true protein and the remainder is non-protein nitrogen. However, protein is not as important as energy in limiting milk production in Queensland.

TABLE 1  
NUTRITIVE VALUE OF MOLASSES (ON DRY MATTER BASIS)

	Average for All Queensland Mills	Average for South-east Queensland Mills
Dry Matter % ..	76.4	76.4
Total Digestible Nutrients (Energy) %	78-92	78-92
Nitrogen .. ..	0.9 (equivalent to 5.6% crude protein)	0.83 (5.1 % C.P.)
Phosphorus % ..	0.07	0.07
Calcium % .. ..	1.15	1.11
Magnesium % ..	0.61	0.79
Sodium % .. ..	0.103	0.126
Potassium % ..	5.19	5.82
Chlorine % .. ..	2.98	4.04
Sulphur % .. ..	0.73	0.99
Copper p.p.m. ..	11.0	14.0
Zinc p.p.m. .. ..	11.6	14.0
Iron p.p.m. .. ..	247.0	229.0
Manganese p.p.m. ..	82.4	81.0
Iron p.p.m. .. ..	<6.5	..

TABLE 2  
COMPARISON OF MAJOR NUTRIENTS IN MOLASSES AND MAIZE

	Molasses	Maize
Water .. ..	20-25%	10%
Crude protein ..	0.6% on DM basis	10% on DM basis
Total digestible nutrients	81% on DM basis	83% on DM basis
Metabolizable energy	3.2 M cal/kg on DM basis	3.3 M cal/kg on DM basis
Crude fibre .. ..	..	2.2
Phosphorus .. ..	0.05-0.1	0.3-0.35
Calcium .. ..	1.0-1.2	0.02
Total minerals (ash)	10-15	1.0

There is virtually no fibre in molasses and consequently it has a laxative effect on cows if fed in large amounts. The lack of fibre may also affect the milk fat percentage if the ration is not balanced correctly.

In short, molasses is an excellent energy source. It is high in potassium and calcium and is adequate in many trace elements. It is low in protein, phosphorus, sodium and fibre. Therefore, these nutrients should be added to molasses when feeding.



Protein can be supplemented by using meat meal or any vegetable protein source and non-protein nitrogen (for example, urea). If urea is being added to balance molasses, it should be in the ratio of 3 parts of urea to 100 parts of molasses.

Research at the Kairi Research Station showed that there was no value in adding urea to molasses if cows were grazing a grass/legume pasture. This is because the cows selected their pasture diet to give adequate protein.

Trials at Ayr Research Station showed that on irrigated nitrogen fertilized pastures when urea at 0, 1, 2 and 3% of the diet was added to 3.6 kg molasses per cow per day, there was no response in milk production. It is possible that in the absence of nitrogen fertilizer or legumes there may be a use for urea in molasses.

Phosphorus can be supplied in various forms. Popular forms of phosphorus are: Mono ammonium phosphate (22% P) at 60 to 120 gms per cow per day.

Bone char (if available) (20% P, 35% Ca) at 60 to 90 gms per cow per day.

Bone char is not suitable in drum lickers as it sinks to the bottom.

Christmas Island rock phosphate (15% P, 30% Ca) at 90 to 120 gms per cow per day.

Because of the high fluorine level (15%) in Chrisphos it should be fed to animals at this rate for only 6 months of the year.

Sodium can be supplied as coarse salt with animals having free access, or by mixing at the rate of 30 gms of salt per cow per day in the daily molasses ration.

### Physical properties

Molasses is approximately one and a half times the weight of water. That is, 1 L will weigh 1.3 to 1.4 kg.

It is a black, thick, viscous fluid—difficult to mix but highly palatable.

It ferments quickly when mixed with water, especially in summer. Unmixed molasses can also ferment—the rate of fermentation depends on the temperature and the moisture content. High density molasses ferments less readily.

Once mixed with water, molasses becomes like a mild acid and will corrode metal and concrete. This is important when considering troughing and floors.

## Justification for using molasses

### Place in dairy cattle feeding

In early 1979 there were approximately 840 dairy farmers in Queensland using molasses. Because of the placement of sugar mills along the coast and in northern New South Wales there is a big potential for further use by the dairying industry.

Most farmers who are using molasses use it as an energy supplement. It can be fed either in the bails or outside in troughs. The most common period for feeding it in large quantities is during winter when paddock feed is least. During the summer months when production is easily maintained, it is used as a contentment ration in the bails.

### Disguising unpalatable feed

The intake of unpalatable feed has been successful by disguising the taste with molasses (for example, poured over dry hay during drought). Again, it has been used as a carrier as well as an aid to intake (for example, urea or mono ammonium phosphate).

Under conditions of poor quality feed, molasses will increase feed intake, stimulate the fermentation process, improve digestibility and provide a readily available source of energy.

### Comparison with grain

The reason for the interest in molasses is that up to certain levels of feeding it will give a similar response to grain while being cheaper. If grain is fed for most of a lactation, the response will average 1 kg milk per kg grain fed. Molasses on the other hand, will give 0.7 kg milk per kg fed.

That is, molasses will give 70% the milk production that grain gives on a weight for weight basis. Therefore, if molasses costs are less than 70% of grain costs, then it could be economical.

### Intake limitations

There are some limitations with feeding molasses. The maximum intake to give maximum response is 3.6 kg of molasses per cow per day. Greater than this level of intake will alter rumen fermentation and could lead to digestive upsets. Molasses alone will not give peak yields of production. Some grain must be added.

Where animals are grazing reasonable pastures it is physically difficult for the cow to consume more than 3 to 4 kg of molasses per day. This is particularly so when feeding in the bails where time is the limiting factor.

Experiments at the Biloela and Ayr Research Stations have shown that milk production responses to molasses fall sharply once molasses constitutes more than 25% of the dry matter intake. At 4 kg of molasses per day, molasses is providing approximately 25% of daily intake.

## **Responses to molasses feeding**

### **Why does molasses increase milk production?**

On most Queensland dairy farms, a shortage of food energy is the main limit to high milk production. On both tropical and temperate pastures, grazing cows find it difficult to eat enough to satisfy their energy requirements. Tropical pastures are high in fibre and their digestibility is low. Temperate pastures may have a high moisture content. Filling a cow's gut with feed containing more water than solids (rye grass could be 90% water) will reduce her intake of energy. High energy supplements like molasses will allow a cow to increase her energy intake without taxing her stomach capacity.

When pastures are in short supply (during a dry season, on unimproved areas or on overstocked farms) molasses will readily increase a cow's energy intake.

In every milking herd there are cows that would be very responsive to changes in energy intake. As a rule, cows in early lactation or heavy milkers cannot satisfy their appetite from pasture alone. Feeding them a high energy supplement will help reach their production potential.

### **How much does molasses increase milk production?**

When molasses or grain are fed for all or most of a lactation, you can expect to get about 1 kg of milk from each kg of dry matter fed.

As explained earlier because of the differences in moisture contents, 1 kg of grain as fed will give 1 kg milk and 1 kg of molasses as fed will give 0.7 kg of milk.

The same results are obtained whether cows are run on temperate or tropical pastures.

One important thing to note is that the exact response will vary with the length of the feeding period. Generally, the immediate response will be 0.4 to 0.6 kg milk per kg of molasses dry matter. As the feeding extends, this level of response will increase due to improved milking persistency.

Irrespective of the length of a feeding period, there is a difference between the immediate response and the carryover response for the lactation.

For example, a group of cows were fed 3 kg of molasses each day for 120 days after calving, then for contentment (0.5 kg per day) till drying off.

The immediate response during the feeding period was an extra 2 L of milk per cow per day. So a cow giving 9 L could give 11 L if she was fed 3 kg of molasses.

The response continued after feeding had stopped. The normal decline in milk production that comes in later lactation was not so rapid when molasses was fed in early lactation. The cows responded by giving a total of 535 L of milk from the 360 kg of molasses fed to each of them.

For the best response to early lactation feeding of molasses, it is critical that good pasture be available after feeding ceases.

Feeding molasses during the dry period can increase production in the following lactation. In feeding trials in the Gympie area, cows were fed 3-4 kg of molasses each day for the last 60 days of the dry period. Each cow produced an extra 135 L of milk during the next lactation.

Although molasses is a relatively cheap source of energy, it should not be the basis for milk production. The basis should come from good pastures with molasses to increase individual cow yield.

### **Does molasses affect milk composition?**

A summary of experiments with molasses feeding shows that the butterfat percentage usually stays the same or drops slightly if molasses is fed instead of grain. Some experiments have shown an increase in butterfat percentage, others a decrease with molasses feeding so it is still not a clear issue.

The same experiments indicate that S.N.F. percentage is slightly increased with molasses feeding. There is one instance where molasses is known to cause a drop in fat percentage. Problems have occurred when farmers have tried to feed large amount of molasses to cows grazing rye grass pastures. The combination of molasses and lush, low fibre pastures seems to lead to low fat test and scouring.

### Can molasses be used for growing stock

Molasses appears to be as good as grain for fattening or growing stock as long as it does not provide more than about 25% of the animals' dry matter intake. This applies to fattening steers or growing heifers.

### Molasses for cattle survival and maintenance

Molasses may be successfully used for survival feeding of cattle when roughage supplies are limited.

Daily amounts of molasses needed for survival:

Weaners and yearlings .. .. .	2.0 kg
Cows in good condition, early pregnancy .. .. .	3.6 kg
Cows in good condition, late pregnancy or early lactation .. .. .	5.2 kg
Poor cows, late pregnancy or early lactation .. .. .	6.4 kg

It is advisable to add 30 gms urea to each kg of molasses.

Drumlickers (the axle type, not the floating type) or blocks are effective for drought feeding if they are started early enough for the cattle to get used to them and before too much condition is lost.

### Molasses for contentment in the bails

Some herds always require some feed to keep cows quiet in the shed. If this is the main reason for feeding molasses in the shed it would be wiser to use molasses blocks. This would be cheaper and cleaner.

### Health problems with molasses

There are several health problems that can occur when molasses is fed. As mentioned, scouring has occurred when cows are grazing lush feed and eating a large amount of molasses.

Bloat can also occur when a large amount is fed. Molasses toxicity is commonly referred to as a disadvantage for molasses. However, it occurs in only 5% of animals fed and only when animals are suddenly forced to eat a large amount of undiluted molasses. It is most common in animals that consume the greatest quantity of molasses when group fed.

The onset of symptoms is rapid, characteristic of a central nervous upset. Breathing becomes rapid, body temperature drops, there is pronounced muscular weakness and the animal may become comatose and die within 24 hours.

Mild cases recover if molasses is removed and they are drenched with a solution rich in phosphorus and sodium.

Symptoms have been produced experimentally by feeding steers 9 kg of molasses per head per day.

### Molasses as a carrier for other supplements

Molasses does not improve the digestibility of roughages as well as urea, M.A.P. and protein feeds. It can improve the intake of poor quality feeds by encouraging stock to eat otherwise unappetising feeds (for example, molasses poured over cereal straw).

### Urea

Molasses is a good carrier for other supplements like urea and M.A.P. It makes them more palatable and provides extra energy and minerals including sulphur and trace elements. It also fulfils the need for a readily available carbohydrate source for urea to be fully utilized in the rumen.

Pasture quality is reduced in winter on most Queensland dairy farms. Unless a high protein winter crop is planted for grazing, the only feed available to cattle is dry pasture, low in protein (as low as 6%) and high in fibre with poor edibility and digestibility. In these circumstances, urea/molasses supplements have appeal. As a nitrogen supplement, the mixture should contain a high ratio (say 30% weight for weight) of urea to molasses. At these high levels of urea there has to be some way of restricting the animals' intake.

The most common ways of controlling urea intake in highly concentrated mixes are using roller drums or feeding hard licks or blocks.

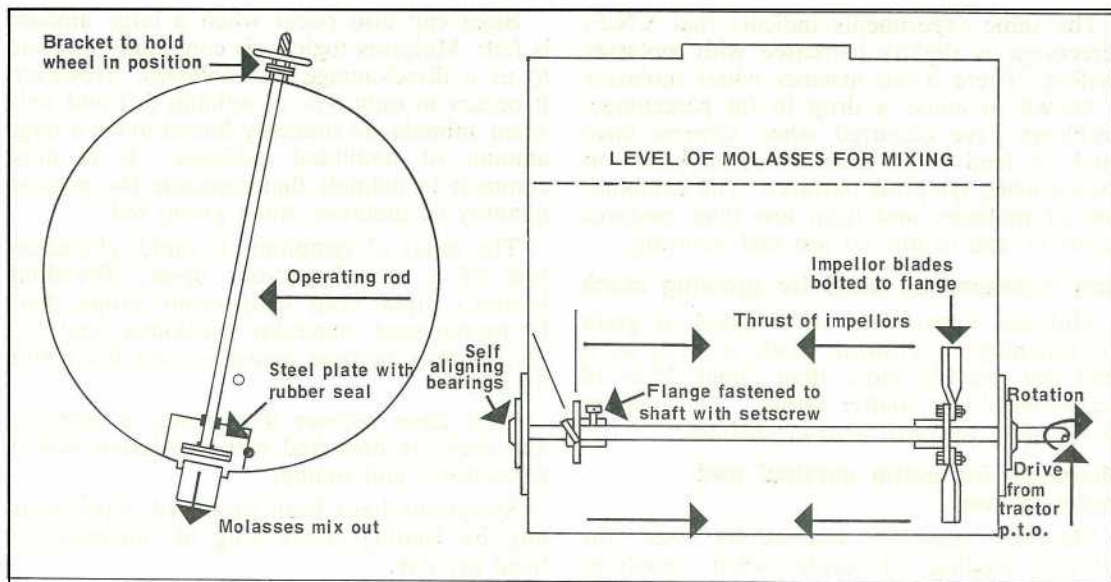


Figure 1.

An important safety factor is to make sure that the urea is evenly distributed through the molasses. It is easy to determine the evenness of the mixture if mixing is done by hand.

As cows can only take in a certain quantity of molasses each day (about 3.6 kg per day) you can limit urea intake according to concentration.

With a mix of 80% molasses, 17% water and 3% urea, a cow eating 3.5 kg of molasses will take in 130 gms of urea—the required daily amount. Adding water makes the molasses easier to handle. The urea can be dissolved in the water before mixing it with the molasses. Care must be taken to avoid fermentation. Cattle should be introduced slowly to this type of mixture. In the first week allow 1 to 2 kg molasses per head, with urea strength by the third week.

If you find that it is difficult to mix supplements into molasses, a simple mixer could be used. One such mixer is illustrated in figure 1.

### Molasses in licks

Molasses is a suitable foundation for lick blocks. Commercial feed companies now produce dehydrated molasses blocks, either pure

or with additives. These are particularly useful for bail feeding—for contentment or for supplementing minerals and protein.

Blocks can be made on the farm. One useful old recipe for an all purpose block is:

Crushed grain	..	40%
Molasses	.. ..	20%
Coarse salt	.. ..	20%
Urea	.. ..	10%
Bone flour	.. ..	7%
Bone meal	.. ..	7%
Chrisphos	.. ..	7%
Meat meal	.. ..	5%

Dissolve the urea in 4.5 L of hot water. Add the molasses then the other ingredients. Drop into a half 200 L drum. Tamp the mixture down. Allow a few hours for the block to harden before feeding it out.

Molasses in this case is acting as a binder and flavour enhancer for the lick and at the same time providing some energy.

The Department of Primary Industries' Beef Cattle Husbandry Branch is at present testing home-made molasses blocks containing molasses, urea and salt plus a hardener.

## Economics of buying and feeding molasses

### Bulk buying

Bulk buying is recommended because:

- It is cheaper to buy molasses in bulk and cheaper to transport.
- Storage on the farm is easier in bulk. It eliminates handling of 200 L molasses drums and a 9 000 L tank occupies less space than its equivalent storage in 45 x 200 L drums.
- The cane crushing season is usually from July to November and many mills do not have storage for out of season supply. It is sound economy to buy during the crushing season and store enough for 3 to 6 months use out of season. Otherwise it may be necessary to haul from a distant mill at a higher price. The price of molasses can vary from \$25 to \$60 per tonne landed on the farm. This depends on the source, distance of cartage, the amount bought and the time of the year. Freight costs are most significant. Freight, out of season, can account for more than 40% of the landed cost of molasses.

• During the crushing season, the production of molasses exceeds demand. It is necessary therefore, for some mills to sell to the Australian Molasses Pool when they are overloaded. This molasses is then lost to local farmers.

In the 1977/78 season 19 000 tonnes went to the Pool. With better farm bulk storage, local demand could reduce this export loss and allow more molasses to remain in the region. The cost of bulk storage pays for itself very quickly.

Buy molasses by the tonne not by volume—when you buy by volume you are paying for air.

### Does it pay to feed molasses?

The economics of feeding molasses are favourable, especially if fed to cows in early lactation (up to 120 days after calving).

Previously, we stated that 1 kg molasses (as fed) should return 0.7 kg milk.

The expected monetary return from molasses can then be calculated for varying milk prices.

Table 3 gives the expected return (in cents per kg of molasses fed) at varying milk prices and molasses prices.

TABLE 3

MOLASSES PRICE \$ PER TONNE	MILK RETURN (CENTS PER LITRE)																	
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
20	0.8	1.5	2.2	2.9	3.5	4.3	5.0	5.7	6.4	7.1	7.8	8.5	9.2	9.9	16.6	11.3	12.0	12.7
23	0.5	1.2	1.9	2.6	3.3	4.0	4.7	5.4	6.1	6.0	7.5	8.2	8.9	9.6	10.3	11.0	11.7	12.4
25	0.3	1.0	1.7	2.5	3.1	3.8	4.5	5.2	5.9	6.6	7.3	8.0	8.7	9.4	10.1	10.8	11.5	12.2
28	0	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	8.9	10.5	11.2	11.9
30	-0.2	0.5	1.2	1.9	2.6	3.3	4.0	4.7	5.4	6.1	6.8	7.5	8.2	8.9	9.6	10.3	11.0	11.7
35	-0.7	0	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2
40	-1.2	-0.5	0.2	0.9	1.6	2.3	3.0	3.7	4.4	5.1	5.8	6.5	7.2	7.9	8.6	9.3	10.0	10.7
45	-1.7	-1.0	-0.3	0.4	1.1	1.8	2.5	3.2	3.9	4.6	5.3	6.0	6.7	7.4	8.1	8.8	9.5	10.2
50	-2.2	-1.5	-0.8	-0.1	0.6	1.3	2.0	2.7	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.3	9.0	9.7
55	-2.7	-2.0	-1.3	-0.6	0.1	0.8	1.5	2.2	2.9	3.6	4.3	5.0	5.7	6.4	7.1	7.8	8.5	9.2
60	-3.2	-2.5	-1.8	-1.1	-0.4	0.3	1.0	1.7	2.4	3.1	3.8	4.5	5.2	5.9	6.6	7.3	8.0	8.7

## Storage

### How much storage?

The best response to molasses feeding is up to 3.6 kg molasses per cow per day. A practical level of molasses feeding is as follows:

During the summer months when paddock feed is adequate, a contentment ration of molasses is fed—approximately 1.5 kg per cow per day (that is if feeding is in the bails).

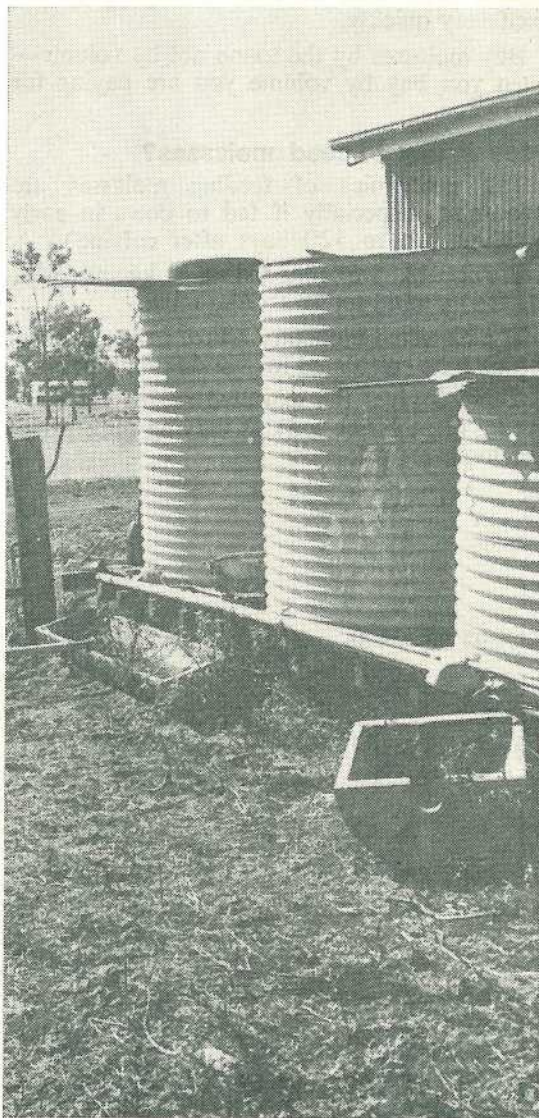


Plate 1. Galvanized water tanks being used to store molasses.

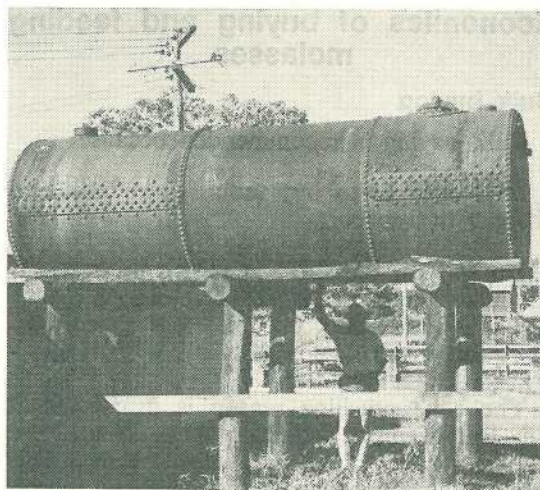


Plate 2. A 13 000 L converted steam boiler elevated to gravity feed into the bails.

During the winter months up to 3.6 kg per cow per day would be fed.

Normally, molasses is available from mills up to the end of January. This means that the planned storage must be adequate from February until after crushing starts—say August.

	F	M	A	M	J	J	Total
kg/cow/day	1.5	1.5	3.6	3.6	3.6	3.6	
kg/cow/month	45	45	108	108	108	108	522 kg/cow

Therefore the amount of molasses for 100 cows is 52 200 kg (that is, 35 000 L).

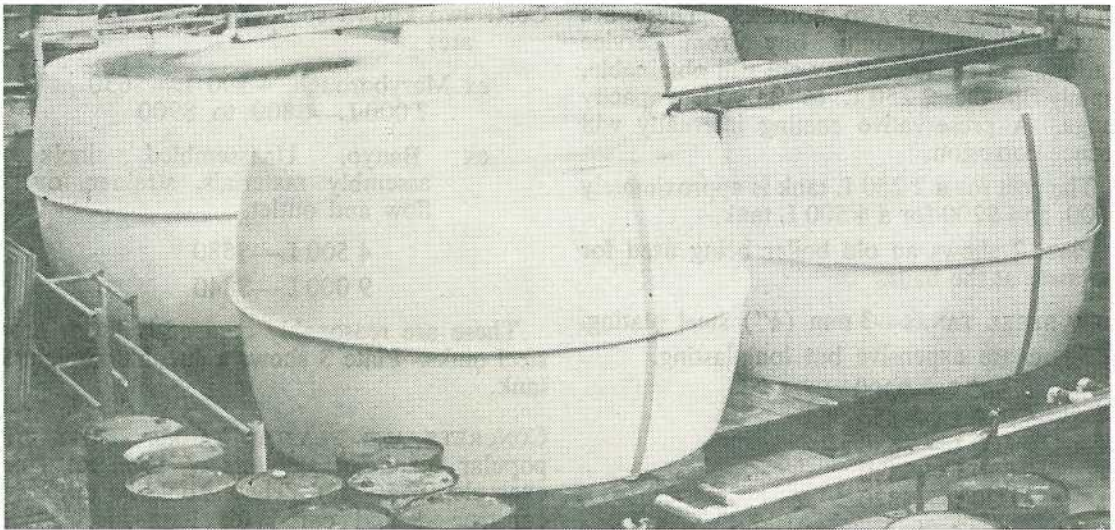
Therefore, approximately 35 000 litres storage is required for a 100 cow herd.

At the end of the crushing system make sure all storage tanks are full. The savings made from bulk molasses storage quickly pay for the installations.

### Types of storage

Loans are available through the Lands Administration Commission at 9.325% interest over a short term (2 to 3 years) for molasses storage and feeding facilities.

Suitable types of bulk storage are as follows:  
**GALVANIZED WATER TANKS.** Cemented and reinforced, old tanks will last for many years especially if coated with a preservative. A 4 500 L cemented water tank will hold approximately 3 500 L of molasses.



*Plate 3. Heavy-duty 9 000 L fibreglass tanks designed for molasses storage.*



*Plate 4. Concrete tanks up to 22 500 L storage capacity are ideal for molasses.*

New water tanks need only be reinforced (bands fixed around the outside and coated with a preservative on the inside).

The cost for old tanks is nothing—new tanks cost approximately \$100 for 4 500 L.

Plate 1 shows galvanized water tanks being used to store molasses.

**OLD FUEL TANKS AND BOILERS.** These are usually an opportunity buy from service stations and the like. They are still obtainable, mainly in the 2 250 L to 9 000 L capacity range. A preservative coating internally will reduce corrosion.

The cost for a 2 250 L tank is approximately \$100, and \$200 for a 4 500 L tank.

Plate 2 shows an old boiler being used for molasses at the bails.

**NEW STEEL TANKS**—3 mm ( $\frac{1}{8}$ " ) steel plating.

These are expensive but long-lasting.

Cost: 2 500 L—\$300  
5 000 L—\$550  
7 200 L—\$680  
10 000 L—\$820  
14 000 L—\$870

This price includes outlet and manhole.

**FIBREGLASS TANKS.** Again, these are expensive but are long-lasting and will not corrode.

Cost: two known sources of fibre glass tanks are:

ex Maryborough, 4 500 L—\$650  
7 000 L—\$800 to \$900

ex Banyo. Unassembled, includes assembly materials, strainer, overflow and outlet,

4 500 L—\$580  
9 000 L—\$840

These are reasonably competitive with new steel tanks. Plate 3 shows a suitable fibreglass tank.

**CONCRETE AND PLASTER TANKS.** These are popular for large amounts of molasses (for example, 22 500 L). They should be properly constructed and cured for long life. Most companies that manufacture concrete tanks for molasses treat them with an extra coat of plastic and three coats of bondcrete.

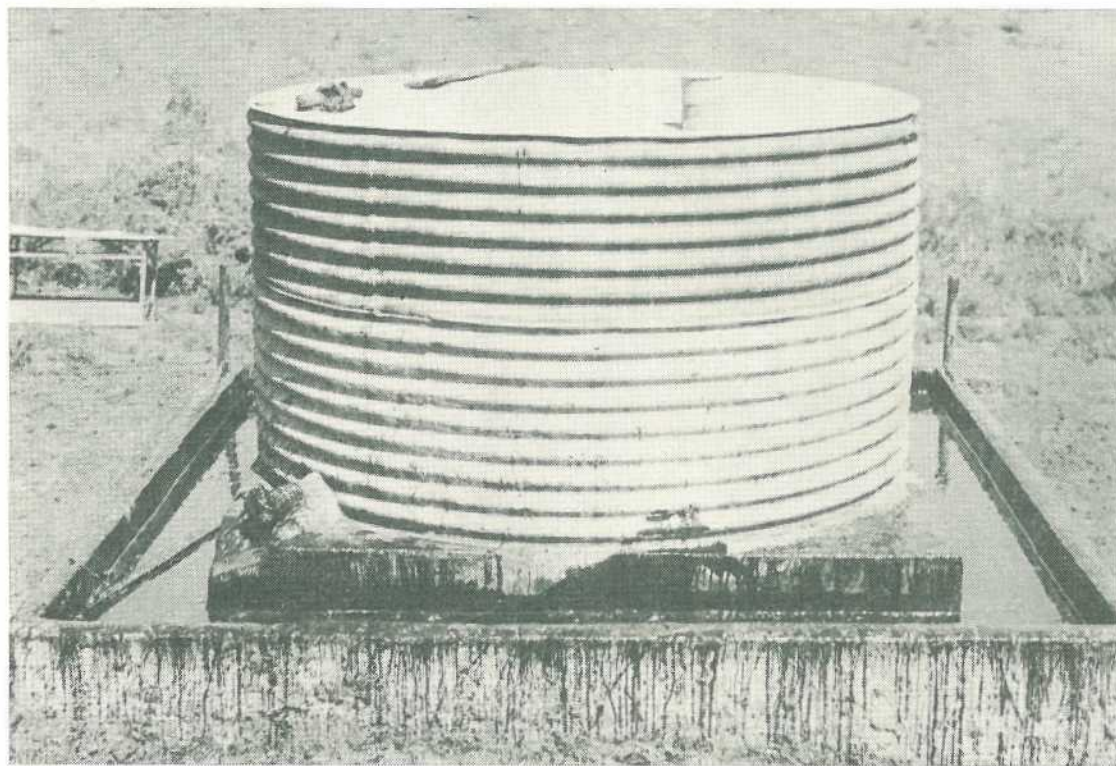


Plate 5. Feeding molasses outside the bails. This particular system incorporates a galvanized tank for storage with taps either side for easy flow into the concrete troughing surrounding the tank.



These companies do not recommend tanks larger than 22 500 L for molasses storage. If you want 45 000 L storage, use 2 tanks.

The cost for a 22 500 L tank is \$800 to \$1 000 plus freight.

A concrete molasses storage tank is shown in plate 4.

PLASTIC BAGS are available for storage—2 250 L capacity.

### Protective coatings

Two protective coating materials are available—Bitumastic and epoxy-resin based products.

**BITUMASTIC PAINTS.** The best is Perma Roof, a paint-on product for most surfaces, both metal and concrete. For concrete surfaces coat with Perma Primer first to give a good seal-on bond. Both are available from Bushell and Co., Moorooka.

Concrete surfaces—allow 1 week for cement to dry before application. The Perma Primer costs \$23 for 25 kg. It will penetrate approximately 3 mm into concrete to give a good bond. Then coat with Perma Roof. Costs are \$25 for 25 kg and 5 kg covers 10 m<sup>2</sup>.

**PAINT-ON EPOXY RESINS** are suitable for coating inside concrete or galvanized iron tanks. They are available from:

ICI/Dulux (West End, Brisbane)  
Concrete Aids (Hendra)

Ciba Geigy (West End, Brisbane)—a two component epoxy resin. 5 kg costs \$23 and will do 11 square metres (120 sq. ft.).

H.B. Sales (Margaret Street, Brisbane) H.B. Sales have two products. HBQ2611 is extremely non-corrosive to acids, alkalis, solvents and other common reagents. It is a two part epoxy resin. 5 kg costs \$30.68 and 1 kg will cover 1 m<sup>2</sup>.

It may be applied with fibreglass cloth to add reinforcement. When thinned with MEK solvent it can be satisfactorily sprayed using a low pressure paint sprayer.

HBQ7535 is a chemical-resistant coating formulated specifically for concrete surfaces. Application is by brush or roller. This product provides an impervious plastic finish to the concrete. 5 kg costs \$20.10 and 1 kg will cover 1 m<sup>2</sup>.

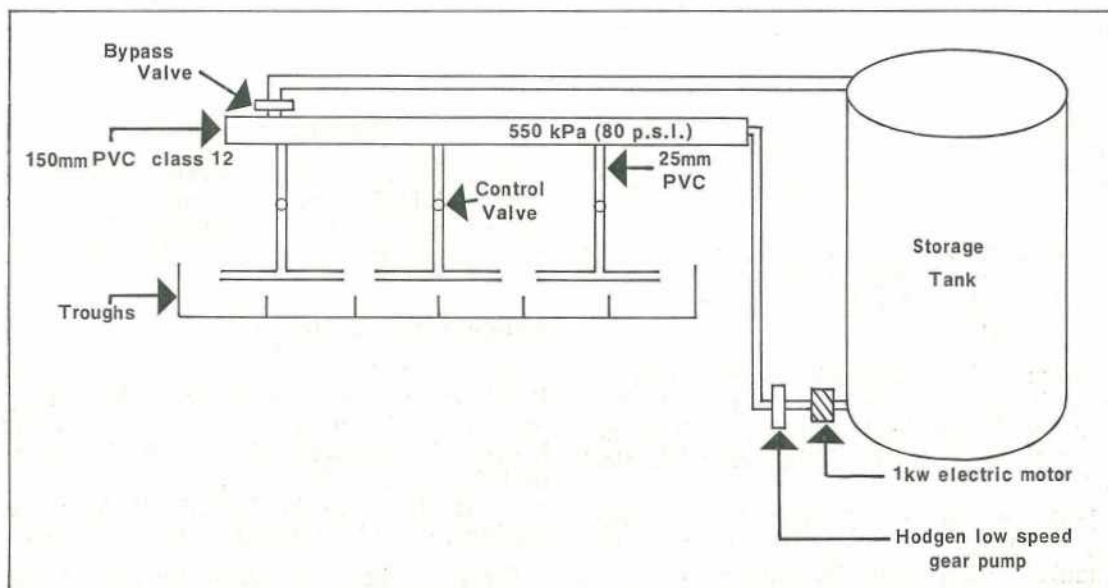
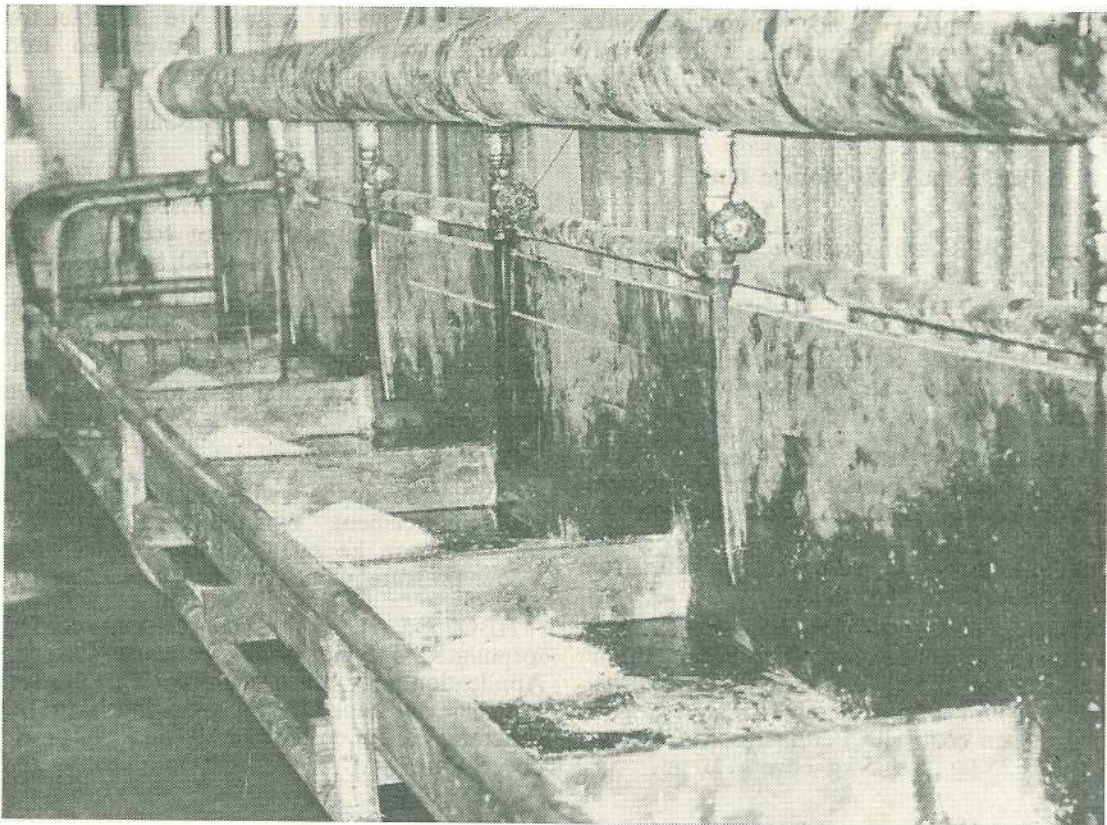


Figure 2.



*Plate 6. Feeding inside the bails. This photograph shows a class 12 PVC 150 mm diameter pipe overhead and 25 mm PVC downpipes with taps for individual feeding.*

Some tanks may need to be etched before painting. Acid etching can be done with a solution of one part of hydrochloric acid to four parts water.

**WARNING.** Do not use epoxy-resins in an enclosed space if there is inadequate ventilation. They give off toxic gases which can have severe health effects.

**NOTE:** It is an expensive operation to use protective coatings for bulk tanks. Make sure their use is absolutely necessary. It is not necessary to coat the inside of thick steel tanks.

Molasses does not ferment during storage and is relatively inert unless water is added. If tanks are left empty for some period, wash them thoroughly and drain to remove residues.

## Feeding systems

Many farmers, even knowing the profitability of feeding molasses, are reluctant to use it because of its messy nature. There are many simple, clean ways of handling molasses.

### Feeding outside the bails

Free access is the easiest way of feeding. It allows for a greater intake, is less messy and the shed routine is not upset if feeding is stopped. Free access does not imply uncontrolled access. It is preferable that the molasses feeding area be locked off from the grazing area and controlled access be allowed.

Cows can be given access for one or two periods during the day, or night access.

The simplest system is for an open, round trough (approximately 3 m in diameter and 1 m high) to be filled directly from the bulk truck with the cows having direct access. Rain water will remain on top of the molasses and can be bailed-off or drained-off before fermentation occurs.

Other systems include the molasses being piped or tapped directly from bulk storage into troughs.

The system used in plate 5 is ideal. The molasses is stored in the galvanized tank and a tap on either side of the tank allows the molasses into the troughing which surrounds the tank.

### Feeding inside the bails

To feed molasses in the shed a good feeding system is essential.

**GRAVITY FED.** The simplest method and the best is an elevated storage tank, close to the shed, where the molasses is gravity fed into individual feed boxes or troughs in the bails. Either the troughs can be filled before milking commences and have the capacity to last until the end, or molasses flows to individual cows at a set rate—for production or contentment—throughout milking.

It is necessary that the overhead pipe in the bails be of sufficient diameter to act as a small reservoir and allow easy flow. A Class 12 PVC 150 mm diameter pipe is very popular.

**GEARED PUMP.** Where the storage tank cannot be elevated, a geared pump system is an alternative. Easy way, Strathpine manufacture and install such a system.

A 1 kw electric motor drives a Hodgen's geared pump which pumps the molasses through the system at a constant pressure of 550 kPa. The main pipe is a 100 mm PVC class and the droppers are 25 mm PVC. The control valve allows the molasses to run into each trough at a set rate. The by-pass valve allows the molasses to return to the storage tank. For a five aside Herringbone shed or 3 to 4 unit walk through bails, the cost is approximately \$1 000. This includes all materials except the storage tank, plus installation.

The advantage of this system is that a constant flow of molasses can be maintained and

there is no problem with the flow rate during cold weather when the molasses is thick and slow moving.

The material used for troughing, when feeding in the bails, must be considered carefully. Like the storage facilities, the corrosive nature of molasses is a problem.

Fibreglass is expensive but lasts well.

Steel troughs must be coated with an epoxy resin approximately once every 2 years.

Timber or hardiplank have been used successfully and last a long time.

The disadvantages of feeding in the bails are:

- The mess that often occurs.
- The corrosive nature of molasses on the floor of the bails.

Despite these handicaps, many farmers are prepared to rectify the problems periodically and are happy with bail feeding.

Figure 2 shows a simple bail feeding set-up using a geared pump.

'THE SALMO' SYSTEM, of mixing molasses and water has been devised by two New South Wales dairy officers, J. N. Salkeld and R. V. Moss of Lismore.

Molasses, water and additives are mixed using the vacuum from the milking machines. The vacuum draws a controlled volume of the ingredients through the primary and secondary mixers. Air is admitted with water before it is mixed with the molasses and again at a point immediately before the mixture is elevated. Air must be admitted to prevent surging within the mixture limit and to help push the molasses and water along. It also helps by causing turbulence.

The molasses and water can be mixed while the milking machines are being cleaned after milking or while giving the pre-milking rinse. The mixture is ready for use once the vacuum is released from the unit. It flows by gravity into the troughs.

A detailed diagram and explanation of the 'Salmo' system is in the October 1976 edition of 'Dairy Topics' published by the New South Wales Department of Agriculture.

The recommended mixture was 50:50, molasses:water.

## Molasses supplies

The supply of molasses is assured but not continuous (it is seasonal). Storage facilities are a problem at most mills. Farmers should buy as much molasses as possible during crushing so mill storage facilities are not over-taxed and molasses is not lost to the pool. The following mills have molasses available for dairy farmers.

### Bundaberg

Fairymead organise and manage the molasses pool. Molasses is usually available all-year-round at pool prices (\$30 to \$32 per tonne). The pool price is governed by overseas prices.

There is storage for 40 to 50 000 tonnes of molasses at Bundaberg.

### Childers (Isis)

Molasses is usually available from July to March, sometimes to mid April. Two-thirds is sold to the pool, the rest locally at about \$23 per tonne from the mill. The mill only has storage for 2 000 tonnes.

### Maryborough

In most years, molasses is available from July to the middle or end of February. Possibly less than 50% is sold locally, the rest going to the pool. Price at the mill is \$23 per tonne. The mill has 2 500 tonnes storage space.

### Nambour

Molasses is only available during crushing (mid July to late November). Over 90% of

the molasses is sold within Queensland—very little goes to the molasses pool. Price at the mill is \$22 per tonne. The mill has no storage for molasses.

### Rocky Point

Molasses is available to all customers from July to December. During the period December to June, molasses is only available to regular buyers. Price at the mill is \$25 per tonne and the mill will deliver. The mill has 2 150 tonnes of molasses storage space.

### Condong, Harwood, Broadwater

These northern New South Wales mills have ample molasses supplies and large storage capacities. They could be used more by dairy farmers to reduce the pressure on South-east Queensland mills. Deliveries to South-east Queensland cost \$38.50 per tonne landed.

### Far North Queensland

The Mossman, Hamilton, Mulgrave and South Johnston mills all hold enough molasses for the dairy industry until the next crushing period. Price at the mills averaged \$24.50 per tonne. The average landed on the Atherton Tableland price is \$32.20 per tonne.

### Central Queensland

The Pleystowe, Cattle Creek, Farleigh, Marian and Racecourse mills usually have sufficient stocks for the dairy industry at an average price of \$25.30 per tonne. Mill suppliers can purchase molasses at about half that rate.

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## CHANGING YOUR ADDRESS?

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This means that, in some cases, subscribers will receive the next issue at their old address.

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# The Leptospermums of South-eastern Queensland

LEPTOS is a Greek word meaning slender or thin, and the Greek word for seed is *sperma*. The name *Leptospermum* describes the minute seeds of these plants.

Leptospermums are woody shrubs or small trees. They have alternate leaves with entire margins. Either no venation is visible or one to three veins are prominent. Glandular dots are present in the leaf tissue and can be seen with magnification or as transparent dots when held to the light. In the majority of species, the flowers are solitary, axillary and sessile, but in some the flowers are on very short pedicels, while in others there is a cluster of two or three flowers at the ends of short twigs in the axils of the leaves.

Individual flowers have a calyx-tube which is either cup-shaped or bell-shaped and this is joined to the ovary at the base. In each flower there are five sepals and five petals. These have a short claw at the base and end in a spreading portion which is usually orbicular. Numerous stamens are arranged in a single whorl. They are usually shorter than the petals and have thread-like filaments. A globular gland like a tiny, round bead can be seen between the two anther lobes on the outer side. In freshly-opened flowers, this gland is green and translucent. It changes as the flower ages to reddish-brown. The ovary usually contains five cells but some leptospermums have three or four.

The fruit is a capsule which opens in slits on the top to release fine linear seeds. Leptospermums flower freely and are a source of both pollen and nectar for bees. The honey produced is dark and strong-flavoured and is of little value for table purposes but is a good food for bees.

In other parts of Australia, leptospermums with pink flowers can be found but in South-eastern Queensland the flowers are usually pure

white. In some species the buds are sometimes flushed with red and occasionally the flowers themselves are pink.

There is no marked difference in appearance between the flowers of different species. The main difference is in the number of cells in the ovary and consequently in the fruit, and in the presence or absence of hairs on the top of the ovary or on the outside of the calyx tube and sepals.

The capsules also differ in size and shape. Some have a high-domed top, while others are flat on the top with the valves projecting above the surface after the seed has been shed. The high-domed capsules are hard and woody and persist for at least a year before dehiscence occurs. The others have a very thin wall and usually shed their seed very soon after flowering.

Leptospermums are found only in Australia, New Zealand, Lord Howe Island, Borneo and the Indian Archipelago.

Twelve leptospermums are native to South-eastern Queensland: *Leptospermum luehmannii*, *L. brachyandrum*, *L. whitei*, *L. speciosum*, *L. liversidgei*, *L. petersonii*, *L. Aavescens*, *L. juniperinum*, *L. phyllicoides*, *L. semibaccatum*, *L. microcarpum*, and *L. attenuatum*.

## *Leptospermum luehmannii*

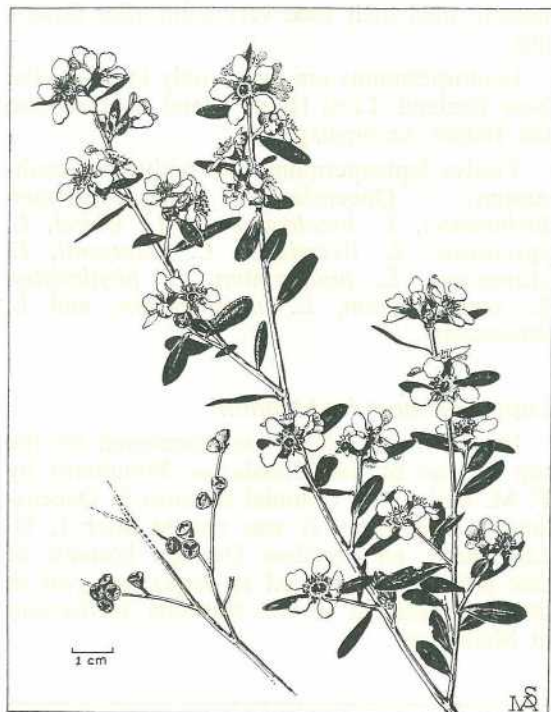
In 1884, this plant was discovered on the top of one of the Glasshouse Mountains by F. M. Bailey, the Colonial Botanist in Queensland at that time. It was named after J. G. Luehmann, an excellent German botanist of that period, who played an important part in the establishment of the National Herbarium in Melbourne.

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by Beryl A. Lebler, Botany Branch.

**DESCRIPTION:** This is a tree about 3 m tall with a smooth, reddish-brown bark which is shed in long, thin strips. The leaves are oblong-lanceolate, up to 3.5 cm long, 0.8 cm wide and have a blunt tip and a tapered base. Both surfaces of the leaves are dark green and glossy and although the midrib is the most prominent vein, one or sometimes two indistinct veins are seen on either side of the midrib. The leaves spread widely from the stem. Copious large oil glands are scattered throughout the leaf and these are easily seen with magnification.

The flowers are in clusters of three or four in the leaf axils at the end of short branches. These are at the ends of the twigs in the leaf axils. Usually only one or two flowers are open at a time. The calyx tube is glabrous, but silky, white hairs cover the outer surface of the spreading sepals as well as the margins and the tips of the inner surfaces.



*Leptospermum luehmannii*.

The white petals are 0.5 cm long, not as wide and are slightly cupped. About 30 stamens form a ring around the edge of the calyx rim.

In freshly-opened buds, the filaments all curve in towards the centre of the flower and the yellow anthers and prominent green, globular glands can be seen with magnification. As the flower ages, the filaments become erect and by this time the pollen has been shed and the gland has changed colour and shrivelled. The thick, green style in the centre of the flower is short and the stigma is at the same level as the base of the filaments.

The fruits are brown and dry, 0.3 cm in diameter and not as deep. They contain three cells and the valves protrude slightly after the seed has been shed. This occurs as soon as the fruits mature, usually within a few months.

**FLOWERING TIME:** This plant flowers during the summer months.

**HABITAT:** It grows on cliff faces or on the rocky tops of mountains.

**DISTRIBUTION:** It has been found only in Queensland, in the Glasshouse Mountains and in one area in the Numinbah Valley.

#### *Leptospermum brachyandrum*

Two Greek words, *brachyos* meaning short and *andros* meaning male are combined to form the specific epithet. It refers to the short stamens in the flowers.

**DESCRIPTION:** This is a dense shrub or small tree to 4 m in height, with rough, flaky bark on the lower part of the trunk and smooth bark above. This is shed in thin strips. The branches are slender and the tips droop like those of willow trees. The leaves are linear—lanceolate to elliptical, up to 4 cm long, and 0.4 cm wide and end in a pointed tip. Their texture is soft. The midrib is the only prominent vein but magnification shows a fainter vein on either side, parallel to it. White, silky hairs are present on the young leaves, stems and inflorescences. These disappear with age.

The flowers are white, 0.8 cm in diameter, and are in little clusters of up to eight flowers at the ends of the twigs, appearing to be in the axils of the leaves at the branch tips.

In mature flowers the calyx tube, the outside of the sepals, and the top of the ovary are green and glabrous. The petals have short, broad claws and are 0.2 cm wide in the rounded portion. About 20 stamens with slender filaments are arranged in a ring inside the petals. They are almost as long as the calyx lobes and half the length of the petals.

The fruit is campanulate, 0.3 cm deep and as wide and opens in three valves. Usually within a few months all the seed has been shed and the fruit itself has fallen.

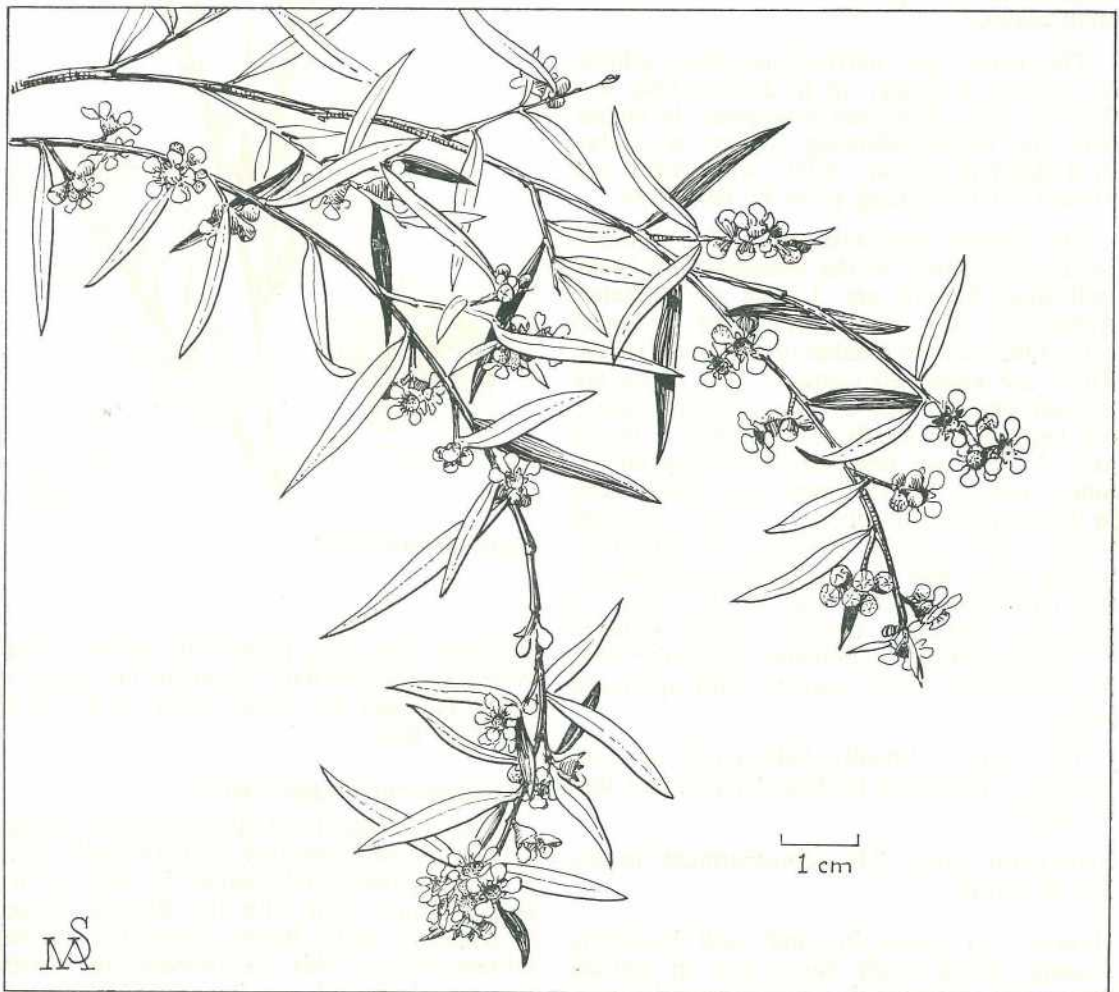
**FLOWERING TIME:** This leptospermum flowers between late spring and the end of summer.

**HABITAT:** It is common along creek banks and is also found in damp areas in mixed open forest.

**DISTRIBUTION:** It is found only in Queensland and New South Wales from as far south as the Hastings River to as far north as Ravenshoe.

### *Leptospermum whitei*

In 1919, W. D. Francis, a botanist on the staff of the Queensland Herbarium, discovered flowering plants of this species at Beerwah and also on Bribie Island. They



*Leptospermum brachyandrum*.

were described as a species of *Agonis*. Subsequent examination proved they belonged to the genus *Leptospermum* and in 1931 this leptospermum was named in honour of C. T. White, the Government Botanist at that time 'who had done so much towards the investigation of the flora of Queensland'.

**DESCRIPTION:** In the young stages this is an attractive, rounded bush forming a dense clump to ground level. As the plant grows, it develops into an erect shrub or tree to 5 m high with a thick, spongy and flaky, fissured bark which can be torn off in thick strips like that of a paper-bark tea tree. The tree has a rounded crown and the flowers are confined to the tips of the branches in these adult plants.

The leaves are narrow-lanceolate, elliptic to obovate in shape, up to 2.5 cm long and 0.4 cm wide. They are blue-green in colour with the midrib showing clearly as a line of a different colour. Silky, white hairs are present on the young parts of the plant.

The flowers are clustered in few-flowered heads at the ends of the branches and twigs. Individual flowers are 1.5 cm in diameter. Appressed, silky, white hairs cover the green calyx tube and the outside of the green sepals. There are about 30 stamens. The petals are 0.5 cm long but only 0.3 cm wide and spread out between the sepals. Each flower is in the axil of a concave bract which is hairy on the outer surface. These bracts are clearly seen in the young inflorescences where the imbricate bracts with a dense covering of spreading, woolly hairs give a cone-like appearance to the inflorescence. The top of the ovary is glabrous and three divergent ridges indicate the number of cells it contains. The calyx tube is bell-shaped and is covered with appressed hairs.

The fruit is broadly bell-shaped or cup-shaped. It is 0.4 cm in diameter and half that in depth.

**FLOWERING TIME:** This leptospermum flowers late in spring.

**HABITAT:** It grows in sandy soil bordering swamps, along creek banks and in wallum flats and is common in peat swamps in open forest.



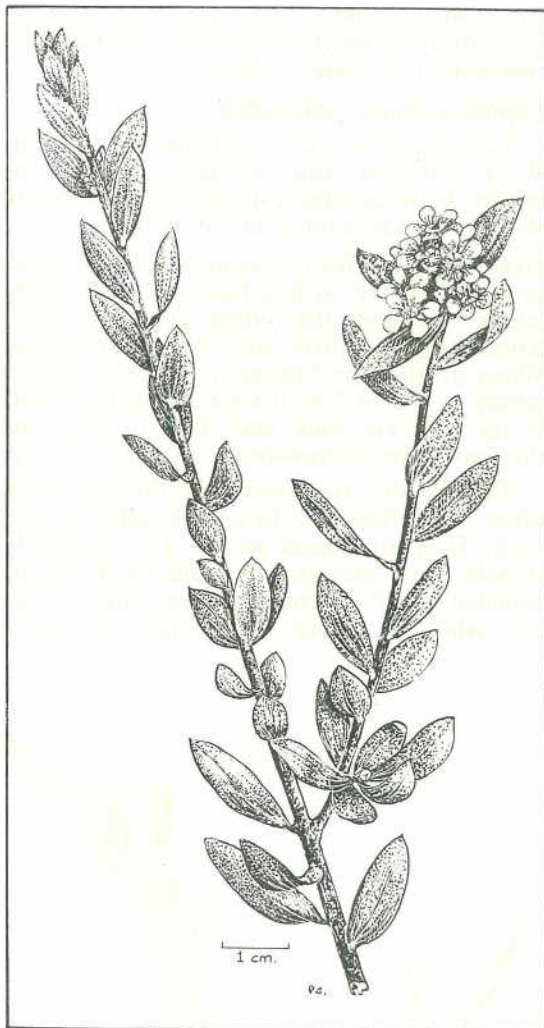
*Leptospermum whitel.*

**DISTRIBUTION:** It is found only in New South Wales and Queensland from as far south as Coff's Harbour to as far north as Noosa to Tin Can Bay.

#### *Leptospermum speciosum*

This plant was first found by Alan Cunningham in the Moreton Bay area. In 1843, when it was described and named, it was the first leptospermum seen with the flowers massed in heads of many flowers instead of having solitary flowers. This was probably the reason for the choice of *speciosum* (which means showy) as the specific epithet.





*Leptospermum speciosum.*

**DESCRIPTION:** This is a dense, usually rounded and clump shrub which can grow to a height of 4 m but is more often seen as a shrub 1 to 2 m high. The bark is flaky and the twigs are rounded and brown. A dense fuzz of both short and long, spreading hairs covers the twigs. Silky, white, appressed hairs cover the young shoots and inflorescences.

The leaves are stiff in texture, dark bluish-green in colour, up to 2 cm long and 1 cm broad. They are almost sessile and are nar-

rowed abruptly to both ends and curve upwards from the stem. Copious oil dots are scattered throughout the leaves and can be seen when held against the light. Five veins can be seen as paler green lines running from base to tip. When crushed, the leaves yield a scent like eucalytus oil.

The flowers are crowded in globular terminal heads at the ends of the twigs, and on short lateral branches in the axils of the terminal leaves. The flowers are sessile. In the bud stage they are covered by stiff, brown, concave bracts which are covered with appressed, silky hairs. Very short silky hairs cover the calyx tube and the sepals. The spreading petals are orbicular, 0.3 cm long and as wide. There are about 20 stamens on filaments less than 0.2 cm long. Individual flowers are 1 cm in diameter.

The ovary contains three cells and the campanulate fruits are 0.5 cm wide and almost as long.

**FLOWERING TIME:** It flowers late in winter and in the early months of spring.

**HABITAT:** It is common in swampy areas of sandy heath lands, near creeks and standing water in wallum flats, and can form pure stands as an under-storey in tea-tree forests.

**DISTRIBUTION:** It grows only in New South Wales and Queensland from as far south as Iluka to as far north as Fraser Island.

Wallum lemon-scented wild may (*Leptospermum liversidgei*)

This plant was named in honour of Professor A. Liversidge of the Sydney University 'as a slight recognition of his efforts in the furtherance of industrial science in Australia' and 'the establishment of the Technological Museum in Sydney'. A great deal of experimental work was done at that establishment on essential oils. Since this plant yields the essential oil citral it is appropriate that a name commemorating him should be given to it.

**DESCRIPTION:** This is an erect, glabrous shrub 2 to 3 m high, often with a single stem with many lateral branches in the upper part. The leaves are on a short, wide petiole and are lanceolate-ovate, just over 0.5 cm long, less than 0.2 cm wide, and end in a blunt tip.

They are slightly concave and spread from the stems. Often there are rudimentary lateral branches in their axils. Although copious oil glands are not evident without magnification, even brushing against the foliage releases the pronounced citron odour from this plant.

The solitary flowers are on very short, leafy stalks which end in a pale green glabrous calyx tube. This is broadly bell-shaped, less than 0.5 cm long and as wide. The white petal-like calyx lobes are less than 0.2 cm long and have rounded tips. They are about one-third the length of the petals. These have broad claws and spread out flat between the sepals. Each petal is slightly cupped. In most plants, the petals are white flushed with pink. Plants with pink flowers have been found in several areas. A mature flower can be 1.5 cm in diameter with petals just over 0.7 cm long and 0.5 cm wide.

A ring of about 30 stamens arranged in an irregular fashion stands up from the calyx rim. The filaments are slender and white and are about 0.2 cm long. The bright green flattened top of the ovary glistens from the nectar secreted. The flower has a faint, sweet perfume. In the bud stage most of the outer surface of the calyx tubes is flushed with red giving a pink colour to the bud. In the mature flower this colour is restricted to a narrow band at the base of the sepals. Occasionally, plants are found in which the centre of the petal is pale rose pink surrounded by a narrow white margin. In these flowers the sepals are red with a very narrow white margin.

The brown, woody capsules are almost 1 cm wide, half as deep and they are domed. The persistent woody calyx lobes can be seen at the base of the dome. In the second year, the capsules split open along five slits in the dome to release many small, thread-like, pale red-brown seeds.

**FLOWERING TIME:** This shrub flowers in summer.

**HABITAT:** It is common on sandy or peaty soil and in swampy situations on wallum flats.

**DISTRIBUTION:** It is found from as far south as Port Macquarie in New South Wales to as far north on the mainland as Bundaberg and Fraser Island offshore.

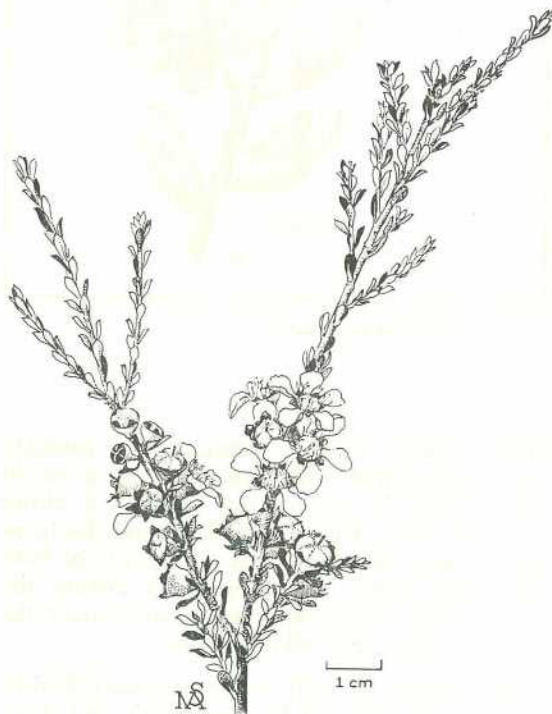
**GENERAL REMARKS:** This plant has recently been brought into cultivation by some nurseries specialising in native plants.

### *Leptospermum petersonii*

This plant was first collected in 1905 by W. J. Peterson from Wilson's Peak on the border between Queensland and New South Wales. It was named in his honour.

**DESCRIPTION:** This is a compact, bushy shrub or small tree up to 6 m high with light green leaves. At first, the young growth is silky-haired but the leaves soon become glabrous. When crushed or bruised the leaves yield a strong citron or lemon scent. The leaf blade is up to 3 cm long and 0.5 cm wide and the leaves are narrow-ovate with a blunt tip.

The flowers are solitary in the leaf axils, often with a flower at the end of each flowering stem. They are almost sessile. The calyx tube is pale green and glabrous and the lobes are rounded and 0.25 cm long. They are petaloid and white in colour. The petals are up to



*Leptospermum liversidgei*.

0.7 cm long and almost as broad and have a very narrow claw at the base. They are cupped and slightly crinkled. The flowers can be just under 2 cm in diameter.

The woody fruits are grey-brown, up to 0.7 cm in diameter and have a bell-shaped calyx tube with a high, curved dome which eventually opens in five valves. The capsules do not release the seeds before the flowers appear in the following year.

**FLOWERING TIME:** The plant flowers during summer.

**HABITAT:** It grows in rock crevices or on the top of cliffs and is common on rocky gorges.

**DISTRIBUTION:** It is found only in the southern part of South-eastern Queensland on the mountain peaks of the border ranges, on the Darling Downs near Ballandean and in the northern parts of New South Wales near the border.

**GENERAL REMARKS:** This is widely cultivated as a specimen tree and when planted close together and pruned regularly makes an excellent hedge.

#### Wild may (*Leptospermum flavescens*)

In 1798 when the British botanist Sir James Edward Smith described this plant he gave it the new name *flavescens* which means becoming yellow. He wrote 'the flowers appear to be a fine yellow in the dried specimens'.

**DESCRIPTION:** This is usually a shrub which varies from a small, stunted shrub to a plant 3 m in height but it can occasionally become a tree to 8 m high. The habit of growth varies from erect shrubs with ascending branches to shrubs with drooping, willow-like branches and there is also great variation in leaf size and shape.

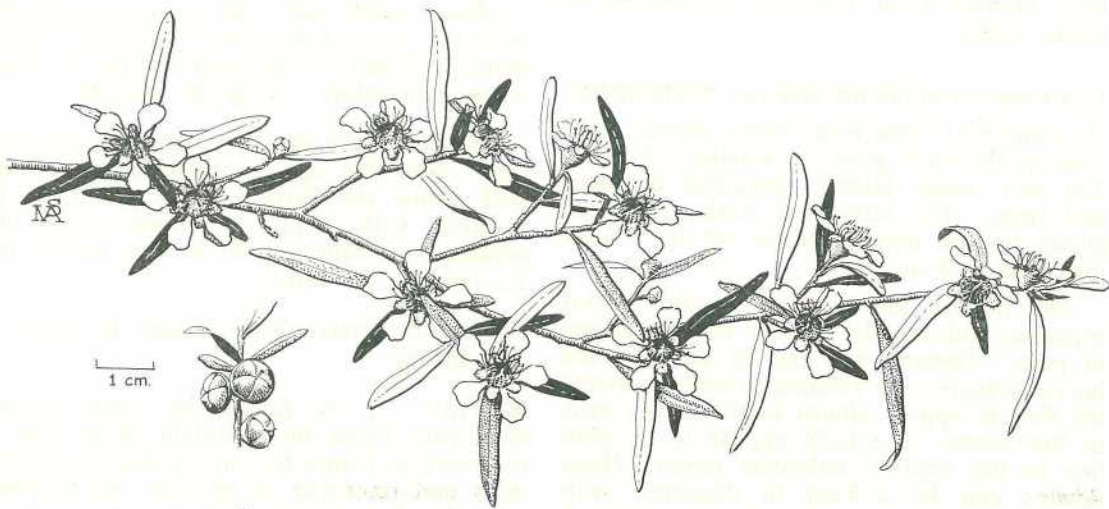
The leaves are dark green and spreading, usually about 1 cm long and 0.2 cm wide and are linear-lanceolate to narrow-oblong.

The flowers are solitary and terminal on short lateral branches sometimes so short that at first glance they appear to be axillary.

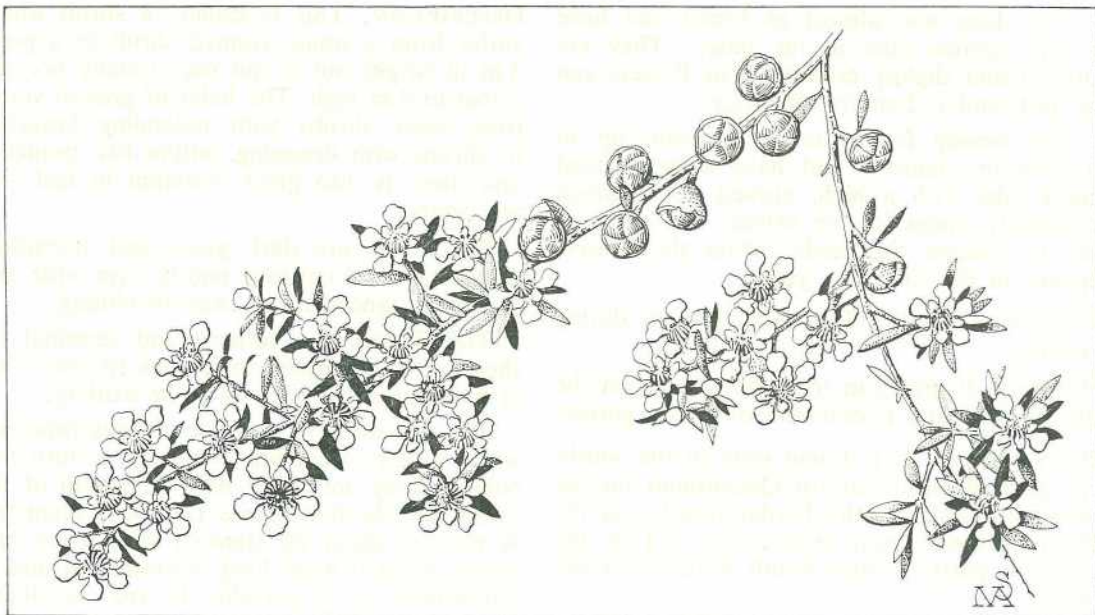
The flowers have a glabrous calyx tube and white sepals resembling petals in texture and colour. They are about half the length of the petals and the flowers are 1.2 cm in diameter. A ring of about 20 stamens with white filaments about 0.4 cm long is prominent and in old flowers it is possible to see the thick, green style and the glabrous top of the ovary.

The persistent fruits can be seen on the bare stems below the leaves and flowers. Often they do not shed their seed until 2 or 3 years after they are formed. They are grey and woody, about 0.7 cm in diameter, and almost as deep. They have a high, rounded dome and the five carpels are shown by five radiating lines before the capsule opens.

**FLOWERING TIME:** This plant blooms early in spring.



*Leptospermum petersonii*.



*Leptospermum flavescens*.

**HABITAT:** It grows in sandy wallum heath, on the margins of rain-forests where it often forms dense thickets and in open eucalyptus forests.

**DISTRIBUTION:** It is found in South Australia, Tasmania and all the eastern mainland States to as far north in Queensland as Cape Flattery.

**GENERAL REMARKS:** Many forms of this plant are available from nurseries specialising in native plants.

*Leptospermum flavescens* var *grandiflorum*

**DESCRIPTION:** This is an erect, dense, glabrous shrub which grows to a height of about 2 m with many lateral, spreading branches and twigs. The leaves are dark green and glossy on the upper surface, up to 1.5 cm long and 0.4 cm wide.

The flowers are terminal on the lateral branches and usually solitary but sometimes in pairs. Towards the end of the twig the lateral branches are reduced to such an extent the flowers appear almost sessile in the axils of the leaves. The buds appear to be pink due to the reddish, imbricate sepals. Open flowers can be 2.5 cm in diameter, with petals almost 1 cm long and as wide on a

very short claw. About 30 stamens with white filaments 0.5 cm long stand erect in a ring. The pink colouration persists in the central portion of the sepals which is crowded with conspicuous glandular dots. A narrow, white band forms a border around the central portion. The thick, green style ends in a flattened green stigma and is slightly shorter than the stamens.

Minute white hairs are sparsely scattered over the calyx tube, while appressed white hairs are found on the lower surface of young leaves particularly along the midrib.

Brown, woody capsules from the previous year's flowering can be found on old wood well below the leaves. They are 1 cm in diameter with a high, rounded dome and contain five cells which do not dehisce for 12 months or more.

**FLOWERING TIME:** This flowers in early to mid spring.

**HABITAT:** It is found in open, grassy eucalyptus forest on mountain slopes and is common on ledges and in crevices on mountains and on rocks at or near the summits of isolated mountain peaks.



*Leptospermum flavescens* var. *grandiflorum*.

**DISTRIBUTION:** It grows in Tasmania, the Blue Mountains area in New South Wales and in Queensland to as far north as Mt. Beerwah.

**GENERAL REMARKS:** Plants from the isolated mountain peaks on the Macpherson Range usually have dark rosy-red buds with the colour covering all of the sepals. The deep colour persists in the open flower and can be seen between the bases of the spreading petals. The flowers are usually only 2 cm in diameter and the capsules 0.8 cm in diameter.

### *Leptospermum juniperinum*

Juniperus is the name for a group of conifers extensively used in European formal gardens. They are evergreen trees or shrubs with spreading needle-like leaves.

**DESCRIPTION:** This is an erect shrub to a height of 3 m with one main stem and thin, twiggy, spreading branches. The leaves are up to 1 cm long, linear, flat or concave-acuminate and end in a slightly pungent point. Silky, appressed hairs are usually found on the lower surfaces of the young leaves.

The flowers are 1 cm in diameter and are solitary at the ends of extremely short twigs in the axils of the upper leaves, often forming a leafy inflorescence more than 15 cm long. At first glance the outer wall of the ovary appears to be glabrous but microscopic examination reveals a scattering of very short, appressed, crinkly hairs particularly at the base and on the pedicel.

The sepals are about 0.1 cm long, round and white. They are the same texture as the petals. The petals are orbicular and individual flowers are 1 cm in diameter.

The capsule has a high, rounded dome and always has five cells. The fruits persist on the plants for more than 12 months before releasing their seeds.

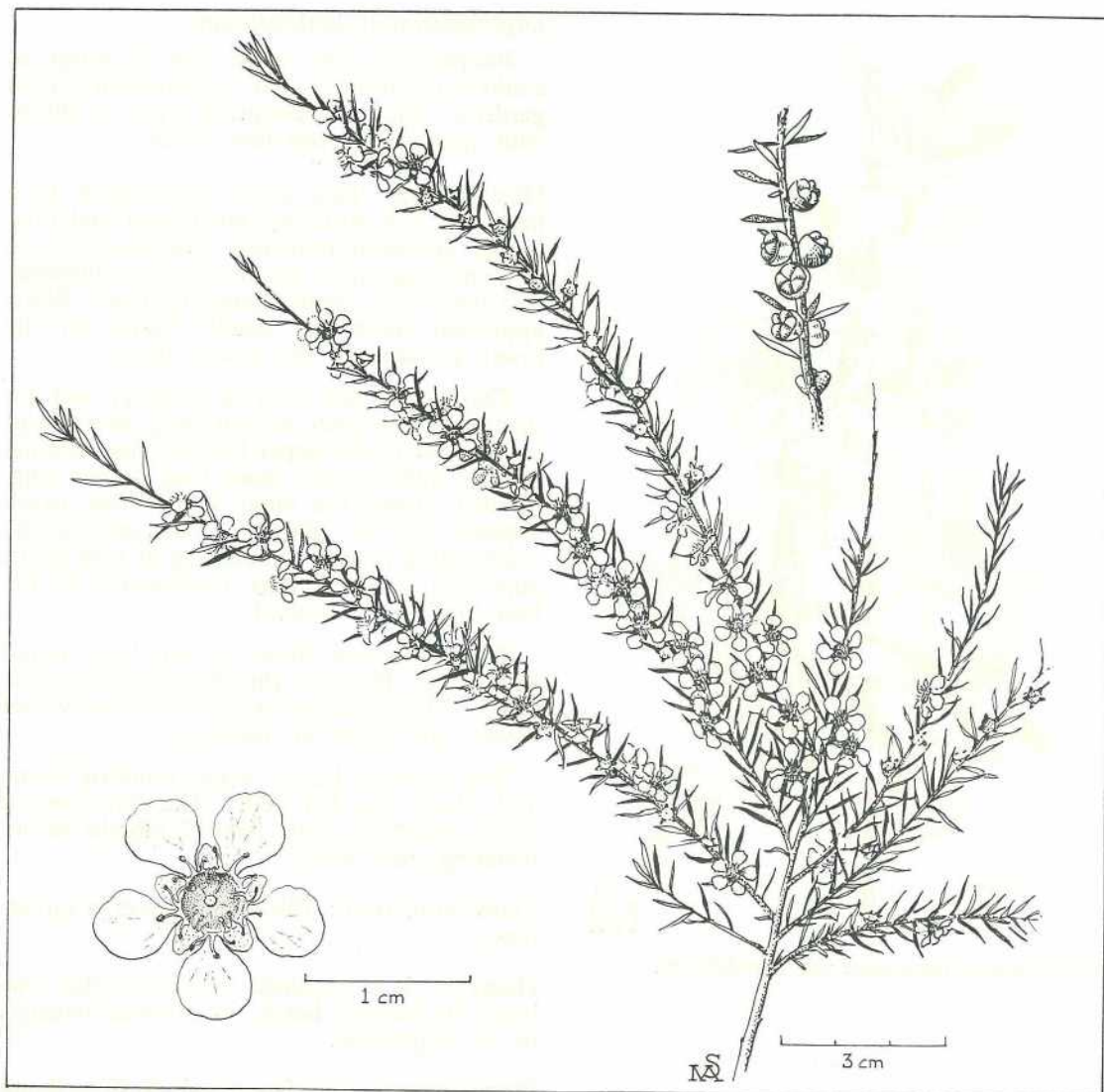
**FLOWERING TIME:** This plant flowers in spring-time.

**HABITAT:** It is common on the coastal lowlands in wallum heath, in tea-tree swamps, or in sedgeland.

**DISTRIBUTION:** It is found only in New South Wales and Queensland to as far north as Cooloola on the mainland and Fraser Island offshore.

### *Leptospermum phyllicoides*

*Phyllicia* is the name of an evergreen shrub which was commonly grown in European gardens. It has alternate, crowded leaves and small, white flowers. The Greek suffix *oides* indicates resemblance. When this leptospermum was described in 1843 the choice of the specific epithet suggests that it reminded the botanist of the familiar garden plant.



*Leptospermum juniperinum.*

**DESCRIPTION:** This is a tall shrub or sometimes a showy dense symmetrical tree to 6 m high. It has many twiggy branches and linear-lanceolate leaves up to 2.5 cm long which end in an acute point. Although the oil in the leaf tissues is thought by some people to be citron or lemon-scented, others find it more reminiscent of eucalyptus oil.

The flowers are white and on pedicels at least 0.5 cm long, which are solitary in the axils of the leaves. In lateral branches, which are often short, leafy racemes of two to four

flowers can make a showy, compacted inflorescence. Individual flowers are up to 0.8 cm in diameter and consist of a pale green calyx tube which is attenuate at the base and ends in five rounded sepals. These curve up between the spreading petals. The slender, white staminal filaments are of different lengths. They do not all stand erect above the petals but spread above the flower, the longer stamens often spreading out along the petals. The stamens are up to twice as long as the petals. The fruit is dry and bell-

shaped, 0.2 cm long and as wide, and the three cells in it are deeply sunken. Seed has been shed long before the flowering in the next year.

**FLOWERING TIME:** This flowers in summer.

**HABITAT:** It is found in rocky places on bouldery hillsides, often near creeks.

**DISTRIBUTION:** This plant grows in all the eastern mainland States. In Queensland, it is confined to the border ranges and Girraween National Park.

**GENERAL REMARKS:** This attractive addition to gardens has recently been brought into cultivation.

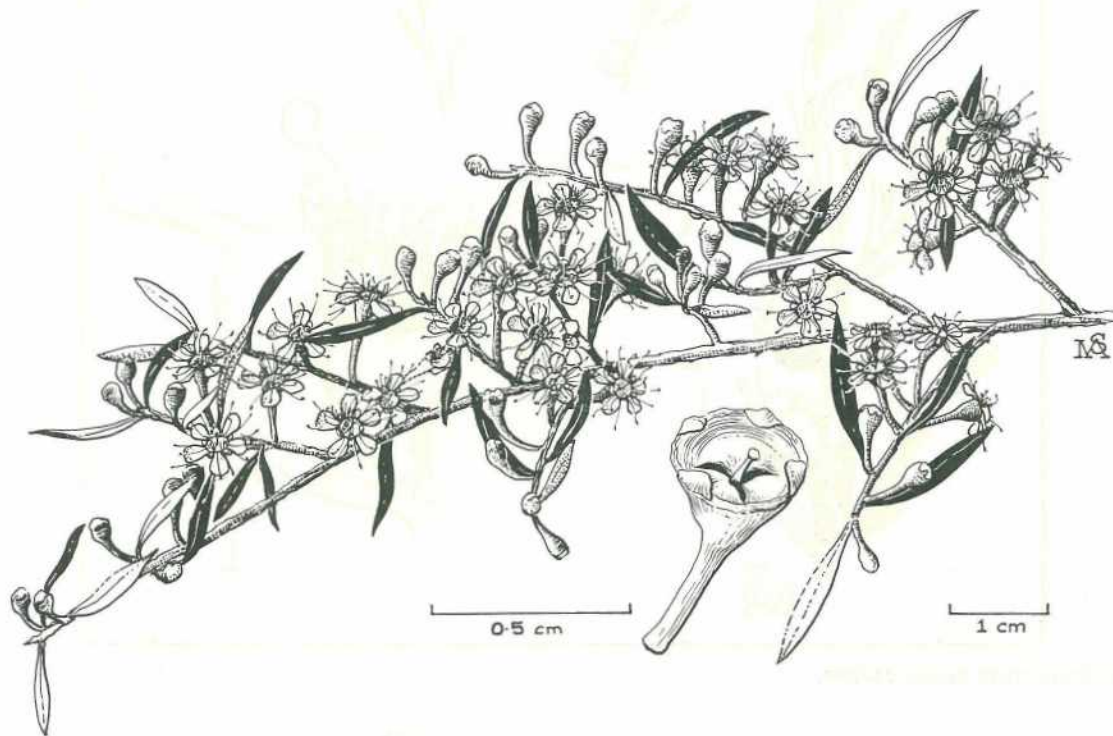
### *Leptospermum semibaccatum*

The fruit of this plant differs from that of most other leptospermums. In the early stages of development, the fruit is softly succulent and berry-like. It is this character which gives rise to the specific epithet. The Latin word *baccatus* means berry-like or pulpy.

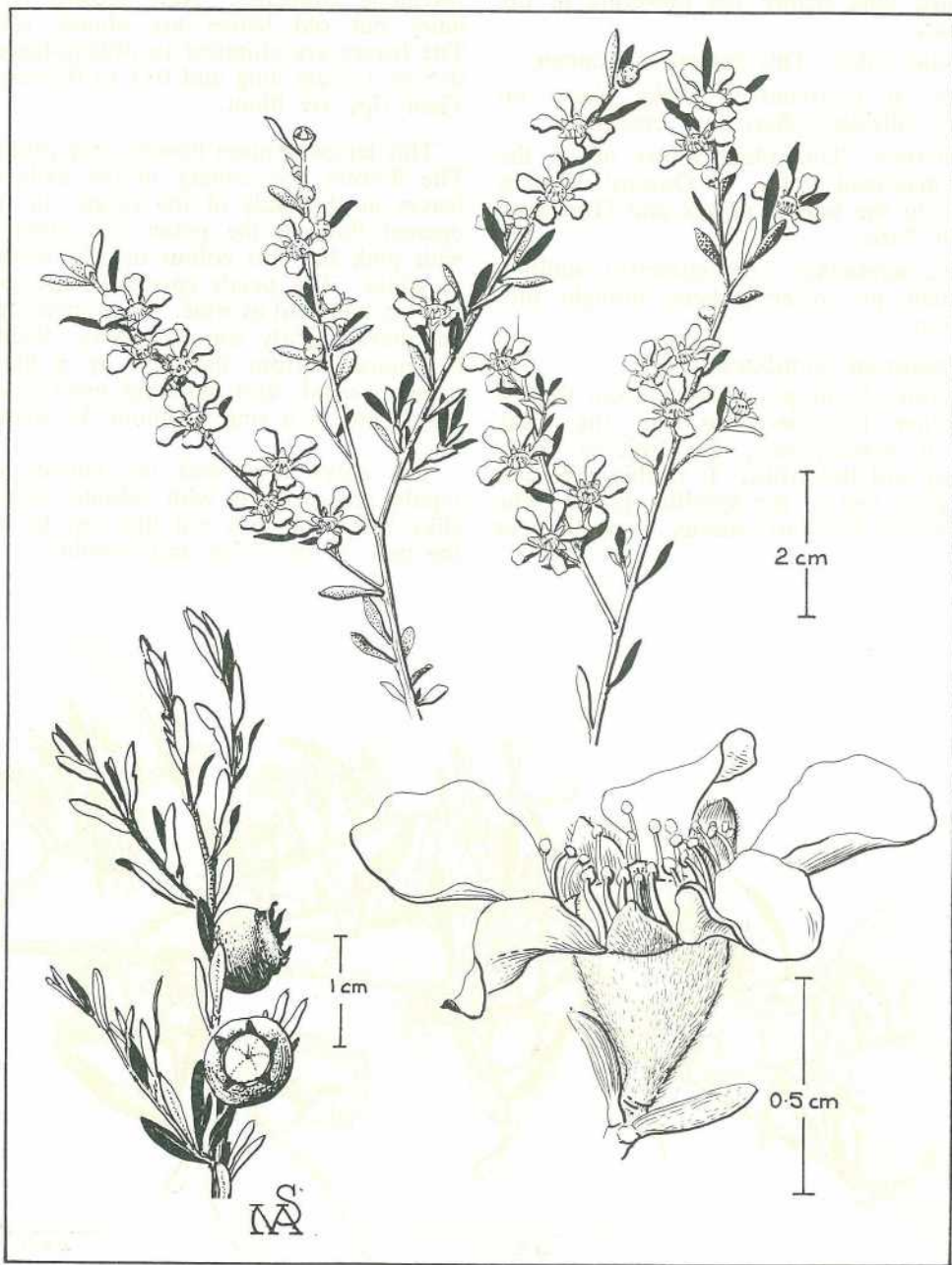
**DESCRIPTION:** This is a shrub 1 to 2 metres high, with several twiggy stems usually with spreading branches. New growth is silky-hairy but old leaves are almost glabrous. The leaves are elliptical to oblong-lanceolate; 0.5 to 1.5 cm long and 0.1 to 0.3 cm wide. Their tips are blunt.

This leptospermum flowers very prolifically. The flowers are solitary in the axils of the leaves at the ends of the twigs. In freshly-opened flowers, the petals are often tinged with pink but this colour usually soon fades to white. The petals spread widely and are 0.3 cm long and as wide. They curve upwards and have slightly wavy margins. Each petal is separated from the next by a blunt triangular sepal, and standing erect from the calyx tube is a ring of about 30 stamens.

The calyx tube and the outside of the sepals are covered with minute, appressed, silky hairs. A dark red line can be seen at the base of the calyx and corolla.



*Leptospermum phyllicoides*.



*Leptospermum semibaccatum*.



The fruit is almost globular and about 0.7 cm in diameter and 0.5 cm long. When young and fresh it is light green, smooth and fleshy. Dried fruits are wrinkled on the outer surface. The capsule is slightly domed and splits into five cells releasing the seed before the next flowers appear.

**FLOWERING TIME:** The main flowering time is spring.

**HABITAT:** It is one of the commonest plants in the wallum flats of South-eastern Queensland and grows in poorly-drained areas.

**DISTRIBUTION:** It is found from as far south as Ballina in New South Wales to as far north in Queensland as Burrum Heads on the mainland and Fraser Island offshore.

**GENERAL REMARKS:** Although most plants have white flowers, in several areas plants have been found with very pale to deep pink flowers.

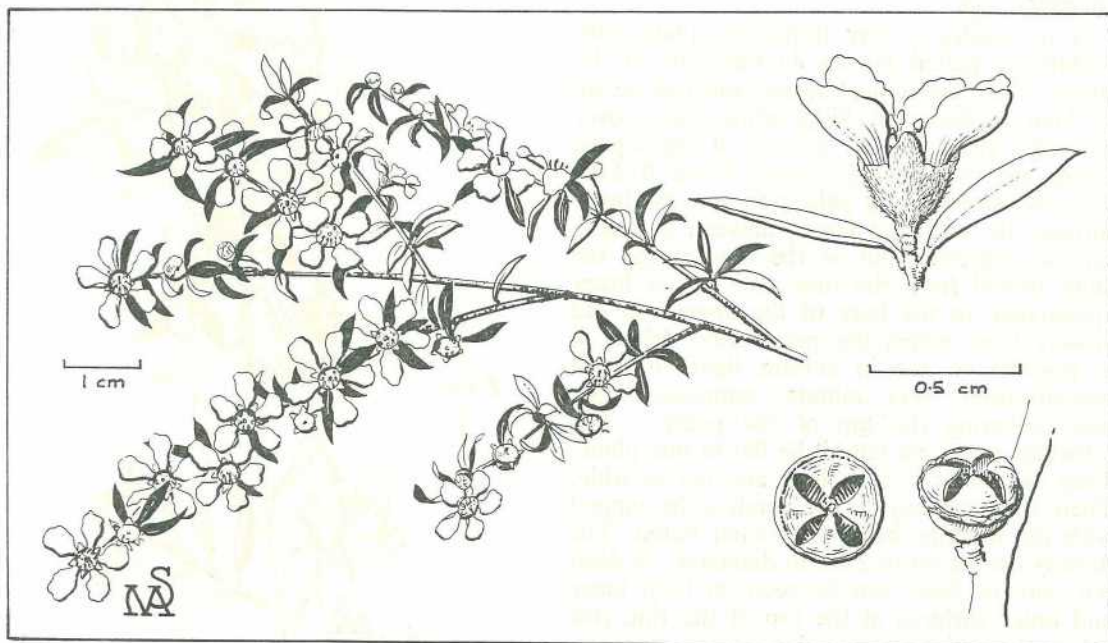
#### *Leptospermum microcarpum*

This plant was first found by C. T. White in 1892 on Mount Cooroora, south-west of Pomona. The specific epithet describes the very small fruit.

**DESCRIPTION:** This is a shrub which can grow to a height of 4 m. It can have several stems and on old plants the bark peels off in long, thin flakes about 3 cm wide. The branches in young plants are thin and whippy and appressed hairs are scattered over the young twigs. Magnification shows oil-glands thickly studding the leaves. These are more or less clustered on the stems. They are leathery in texture, ovate to ovate-lanceolate and more or less incurved, up to 1.2 cm long and hairs are often scattered on the lower surface of the leaves.

The flowers are solitary and axillary and are on pedicels about 0.1 cm long. The buds have a pink appearance as the outer surfaces of the sepals are flushed with red. Spreading white hairs cover the outside of the calyx tube and the sepals.

About 20 stamens are arranged around the rim of the calyx tube. In freshly-opened flowers they are bent in towards the centre of the flower and the translucent globular green gland is easily seen. The white petals can vary in shape from acute to almost rectangular and are up to 0.5 cm long and almost as wide. The top of the green ovary is glabrous.



*Leptospermum microcarpum*.

The fruits are black, 0.3 cm in diameter, about 0.2 cm deep and usually have four cells, occasionally five or three.

**FLOWERING TIME:** This plant usually blooms early in spring.

**HABITAT:** It is common on rocky hillsides in eucalyptus forests and it can be found in rocky crevices on isolated peaks. It often forms almost pure stands on mountain slopes.

**DISTRIBUTION:** It is found from just over the border in New South Wales to as far North as Kilkivan and as far west as Amiens on the Darling Downs.

### *Leptospermum attenuatum*

The Latin adjective *attenuatum* means narrowing to a point. It describes the shape of the calyx tube which tapers to the base.

**DESCRIPTION:** This is a twiggy often multi-stemmed shrub with spreading branches and can reach a height of 4.5 m. Long, straight, white hairs are present on new growth, showing as a fuzz against the light. The leaves are almost sessile, narrow oblong to linear and up to 2 cm long and 0.4 cm wide. A central vein which is lighter in colour shows clearly on the leaf with a less distinct vein on either side.

It is usually a very floriferous plant with solitary or paired flowers in the axils of the leaves. They are almost sessile and can be up to 2 cm in diameter. Silky white hairs cover the calyx tube and the outside of the sepals. These are triangular in shape about 0.2 cm long and smooth and pale green on the inner surface. In buds and young flowers, the hairs can be appressed but as the flowers age the hairs spread from the tube and give a fuzzy appearance to the base of the flower. In old flowers from which the petals have fallen, it is possible to see in certain lights or with magnification, very minute, appressed silky hairs covering the top of the ovary. The orbicular petals do not all lie flat in one plane. They are about 0.5 cm long and not as wide. There is a tendency for the petals to be cupped with the margins being somewhat fluted. The flowers can be up to 2 cm in diameter. A deep red, narrow band can be seen on both inner and outer surfaces at the top of the rim, just below the point of insertion of the stamens. About 30 stamens with greenish-white fila-

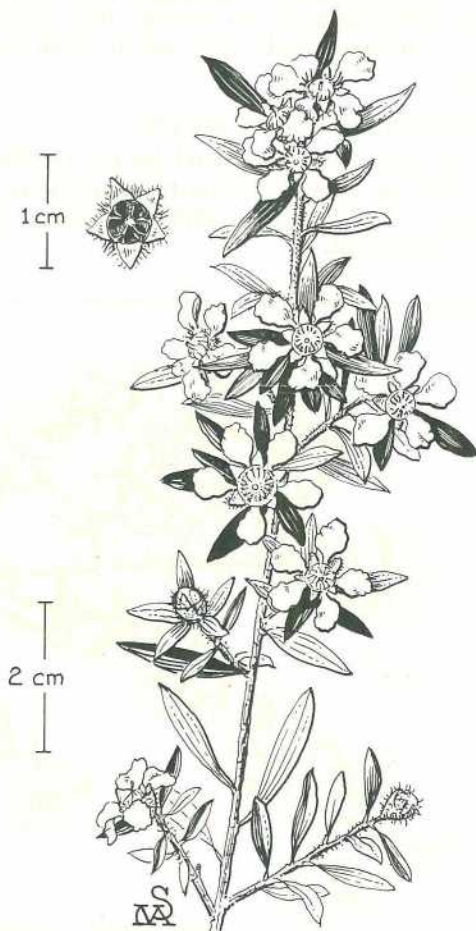
ments about 0.2 cm long are in the ring. The bright green top of the ovary glistens from the nectar secreted.

The fruit contains either four or five cells and the dead calyx tubes are persistent. The seed is shed very soon after flowering is finished.

**FLOWERING TIME:** This plant flowers late in spring.

**HABITAT:** It grows in wallum heath, on poorly-drained sandy flats, on the rocky slopes of mountains, on open eucalyptus forest on hillsides, and on sand dunes in banksia heath scrub on the offshore islands.

**DISTRIBUTION:** It is found only in the eastern mainland States to as far north in Queensland as Round Hill Head.



*Leptospermum attenuatum.*

### Field key to *Leptospermums* in South-eastern Queensland

1. Flowers in globular terminal heads in few-flowered clusters. Capsule with three cells ..... 2  
 Flowers solitary and axillary or terminal. Capsule with three, four or five cells ..... 5
2. Shrubs or trees to 3 m with smooth bark shedding in long strips. Flowers in clusters ..... 3  
 Shrubs or trees to 5 m with flaky or fissured bark. Flowers in globular heads ..... 4
3. Inflorescence with only three or four flowers. Calyx tube glabrous, with silky hairs on outer surfaces of sepals. Stamens 30 ..... *Leptospermum luehmanii*  
 Inflorescence with up to eight flowers or more. Calyx tube and the outside of the sepals glabrous ..... *Leptospermum brachyandrum*
4. Heads with few flowers. Calyx tube and outer surfaces of sepals with white hairs. Leaves less than 0.8 cm wide and shortly petiolate ..... *Leptospermum whitei*  
 Heads with many flowers. Calyx tube and outer surfaces of sepals with dense, white, silky hairs. Leaves 1 cm wide and almost sessile ..... *Leptospermum speciosum*
5. Sepals petaloid and usually white. Capsules woody, five-celled, with a high rounded dome, persisting for at least a year before dehiscent ..... 6  
 Sepals not petaloid or coloured, often hairy on the outside. Capsules with thin walls and a flat top, dehiscent long before the next flowering ..... 9
6. Leaves strongly lemon-scented ..... 7  
 Leaves not lemon-scented ..... 8
7. Shrub to 3 m high. Leaves less than 1 cm long, lanceolate-ovate. Petals white, flushed with pink, or completely pink ..... *Leptospermum liversidgei*  
 Shrub or tree to 6 m high. Leaves more than 1.5 cm long, narrow-ovate. Petals white ..... *Leptospermum petersonii*
8. Calyx tube quite glabrous. Leaves narrow-oblong, linear-lanceolate to obovate up to 2 cm long ..... *Leptospermum flavescens*  
 Calyx tube apparently glabrous, but with minute appressed hairs, densest at the base of the tube. Leaves linear or concave-acuminate, ending in a pungent point ..... *Leptospermum juniperinum*
9. Flowers on pedicels at least 0.5 cm long. Staminal filaments of different lengths, up to twice as long as the petals. Capsule with three cells ..... *Leptospermum phyllicoides*  
 Flowers sessile or in pedicels less than 0.5 cm long. Staminal filaments shorter than the petals and all the same length ..... 10
10. Developing fruit globular, succulent and berry-like. Calyx tube silky, with minute appressed hairs. Capsule with five cells ..... *Leptospermum semibaccatum*  
 Developing fruit campanulate, not fleshy. Silky hairs on calyx tube and outside of sepals ..... 11
11. Leaves clustered, leathery, up to 1.2 cm long, ovate to ovate lanceolate, more or less incurved, tip acute and slightly pungent. Capsule usually with four cells, sometimes three or five ..... *Leptospermum microcarpum*  
 Leaves not leathery, up to 2 cm long, narrow-oblong to linear, tip pointed but not pungent. Hairs on calyx tube appressed in buds spreading in mature flowers. Capsule usually with five cells but sometimes four ..... *Leptospermum attenuatum*

# What price your horse?

by B. W. TANZER, Veterinary Services Branch.

TETANUS in horses is a cruel and unnecessary disease.

Cruel because the affected horse suffers great agony. Unnecessary because tetanus is very easy to prevent and the prevention costs are low. Tetanus is very common in horses and the death rate is high.

## Clinical symptoms

Lockjaw, associated with rigidity of the muscles and dilation of the nostrils, raised temperature and sweating. Muscular spasms during which the third eyelid protrudes across the eye. Ears are erect and stiff. Affected horses are reluctant to move and eventually adopt a sawhorse attitude. Excitement, nervousness and anxiety are characteristic. If disturbed, the horse may have a spasm, fall to the ground and be unable to rise again. Death may occur from 2 to 10 days after symptoms first appear.

## Cause

The actual cause of tetanus is a toxin produced by bacteria called *Clostridium tetani*. The presence of the bacteria alone is insufficient to produce the disease as it requires an environment free of oxygen to multiply and produce toxin.

## Method of infection

Symptoms of tetanus may appear following entry of the bacteria to wounds caused by castration, wood splinters and nail pricks in the hooves. Broken bones may set up favourable conditions, while foals may be infected at birth through the navel.

## Source of infection

The sources of tetanus-causing bacteria are most commonly manure and earth, particularly earth rich in humus.

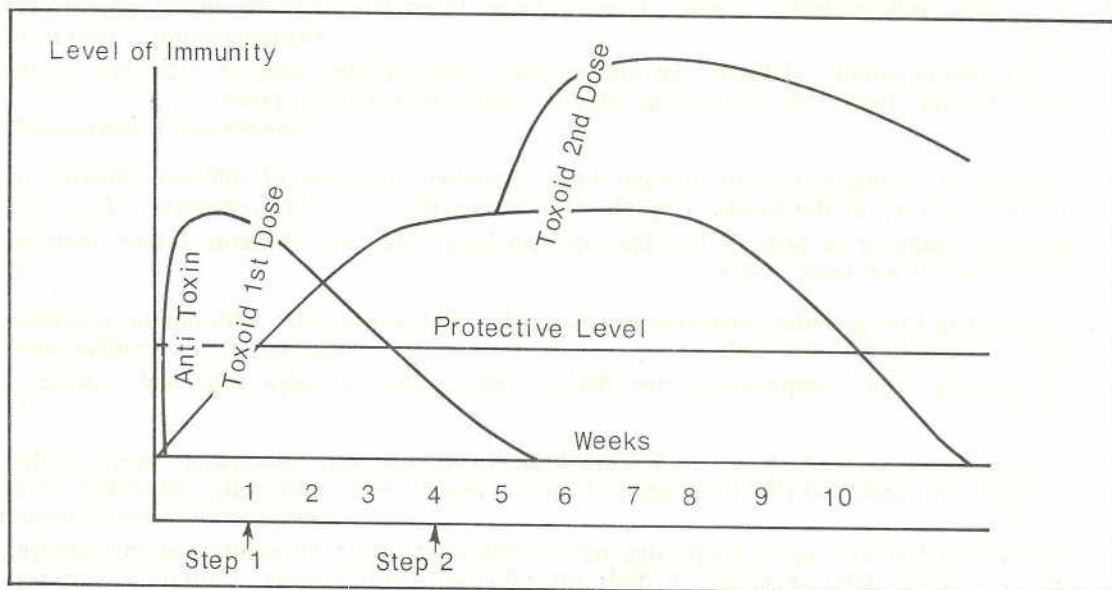


Figure 1.

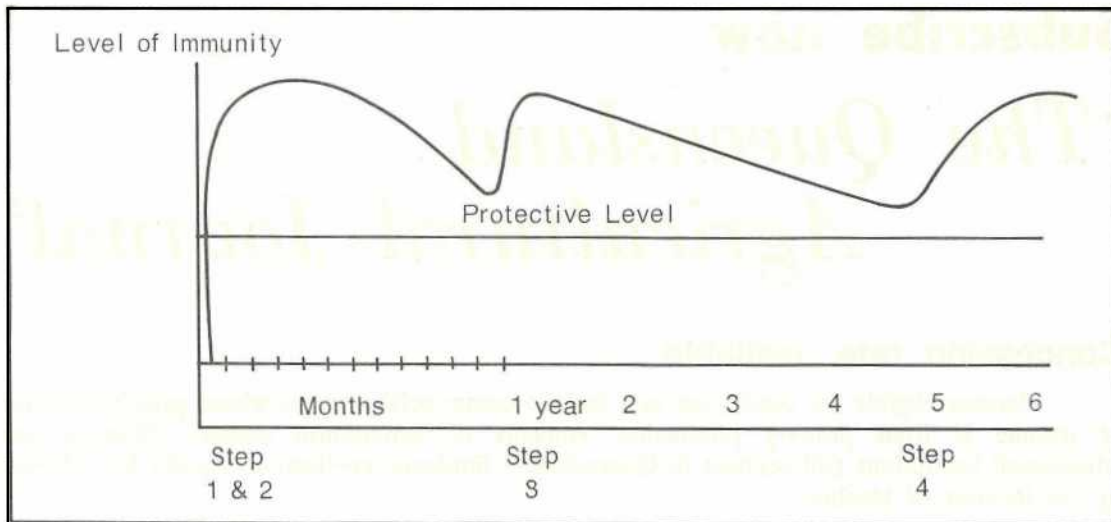


Figure 2.

### Treatment

Treatment is very involved and expensive and requires veterinary supervision.

- STEP. 3. Another injection of tetanus toxoid after 12 months. See figure 2.
- STEP 4. A further booster of tetanus toxoid after 5 years, and each 5 years thereafter. See figure 2.

### Prevention

A horse can be immunized at very low cost. It involves the following simple steps:

- STEP 1. An injection of tetanus anti toxin which affords protection against tetanus for approximately 3 weeks should be given under the skin on the upper third of the neck. The protective effect of tetanus toxoid is reached before the tetanus anti toxin protection wanes below the protective level. See figure 1.
- STEP 2. An injection of tetanus toxoid after 4 weeks. See figure 1.

### Protect the foal

Mares should be given a booster injection of tetanus toxoid 1 month before foaling, so that the foal will derive immune antibodies from the mare's colostrum. When the foal reaches 6 to 8 weeks of age it should be given an injection of tetanus toxoid followed by a second in 4 to 6 weeks' time. Then give a booster 12 months later, followed by a booster every 5 years. This should provide life-long immunity.

Remember, tetanus is a painful and usually fatal disease which can be prevented easily.



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# Foliar symptoms of manganese deficiency in wheat

by N. J. Grundon, Queensland Wheat Research Institute.

MOST soils in the Queensland wheat belt are neutral or alkaline in reaction, with pH above 6.5.

On such soils, manganese is not readily available to plants and may become deficient when environmental conditions or cultural practices depress the available supply.

Plants growing in manganese deficient soil show characteristic leaf symptoms which can be used to diagnose the disorder. This article describes the symptoms for wheat.

## The symptoms

Leaf symptoms increase in number and complexity as the deficiency becomes more severe. In mild forms of the disorder, the plants turn yellow and appear to wilt. In moderate to severe stages of the deficiency, leaves and plants may die.

**LEAF CHLOROSIS:** The younger, upper leaves turn yellow or chlorotic, beginning firstly as a mild interveinal chlorosis in the mid-section but rapidly spreading until the whole leaf turns a pale yellow-green. At this stage, the whole plant appears yellow-green in colour with only the very oldest, lowest leaves remaining a healthy bright green.

**WILTING:** The plants appear to wilt, and the stems and leaves droop downwards so that the leaves lie on top of the soil (plate 1).

**GREY FLECKS:** Small, elongated grey to white flecks or streaks appear in the interveinal tissue towards the base of the leaf blade soon after the leaves turn yellow and begin to wilt (plate 2). As the deficiency becomes more severe, these flecks of dead tissue appear in the mid-section of the leaf, but rarely proceed further towards the leaf tip.

In acute stages of the deficiency, the dead flecks join together to form a grey necrotic area at the base of the leaf, with the leaf tip remaining yellow-green (plate 3). This large area of dead tissue at the leaf base weakens the leaf which usually bends sharply or breaks at this point (plates 1 and 3).

**LEAF DEATH:** When manganese is severely deficient, the youngest leaves turn a straw-brown colour and form a thatch of dead leaves at the top of the plant (plates 1, 3 and 4). At this stage, the middle leaves usually have yellow-green leaf tips and dead, grey areas at the leaf base while the oldest leaves can remain bright green in colour. The stems and oldest leaves have a wilted appearance (plates 1 and 3).

## Correction of the deficiency

Manganese deficiency can be corrected by adding manganese sulphate (10 to 20 kg per ha) or manganous oxide (2.5 to 5 kg per ha) as a soil dressing at planting. If the crop is growing, a foliar spray of 0.5% manganese sulphate (0.5 kg manganese sulphate dissolved in 100 L of water) at the rate of 100 L per hectare usually corrects the disorder.

# Foliar symptoms of manganese deficiency in wheat



Plate 1. Wilted appearance of manganese deficient wheat. Note the dead younger leaves and the green, apparently healthy older leaves.

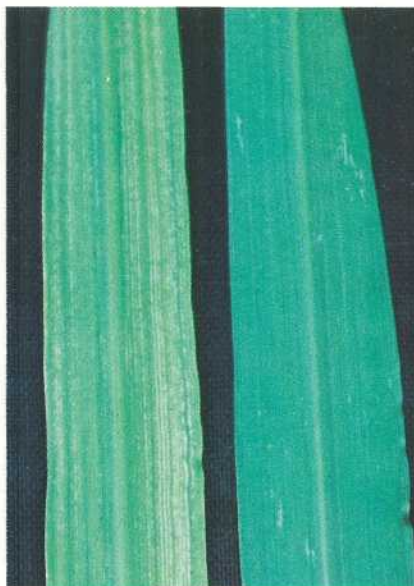


Plate 2. The grey or white flecking and streaking in manganese deficient leaf on the right is contrasted against the deep green, healthy leaf on the left.



Above. Plate 3. Wilted appearance of stems on severely manganese deficient wheat. The bases of the younger leaves have died while the bases of the older leaves are still green.



Right. Plate 4. The youngest leaves die and turn a straw-brown colour in severe manganese deficiency. Sometimes, the young leaves die before expanding from the leaf base of the older leaves.