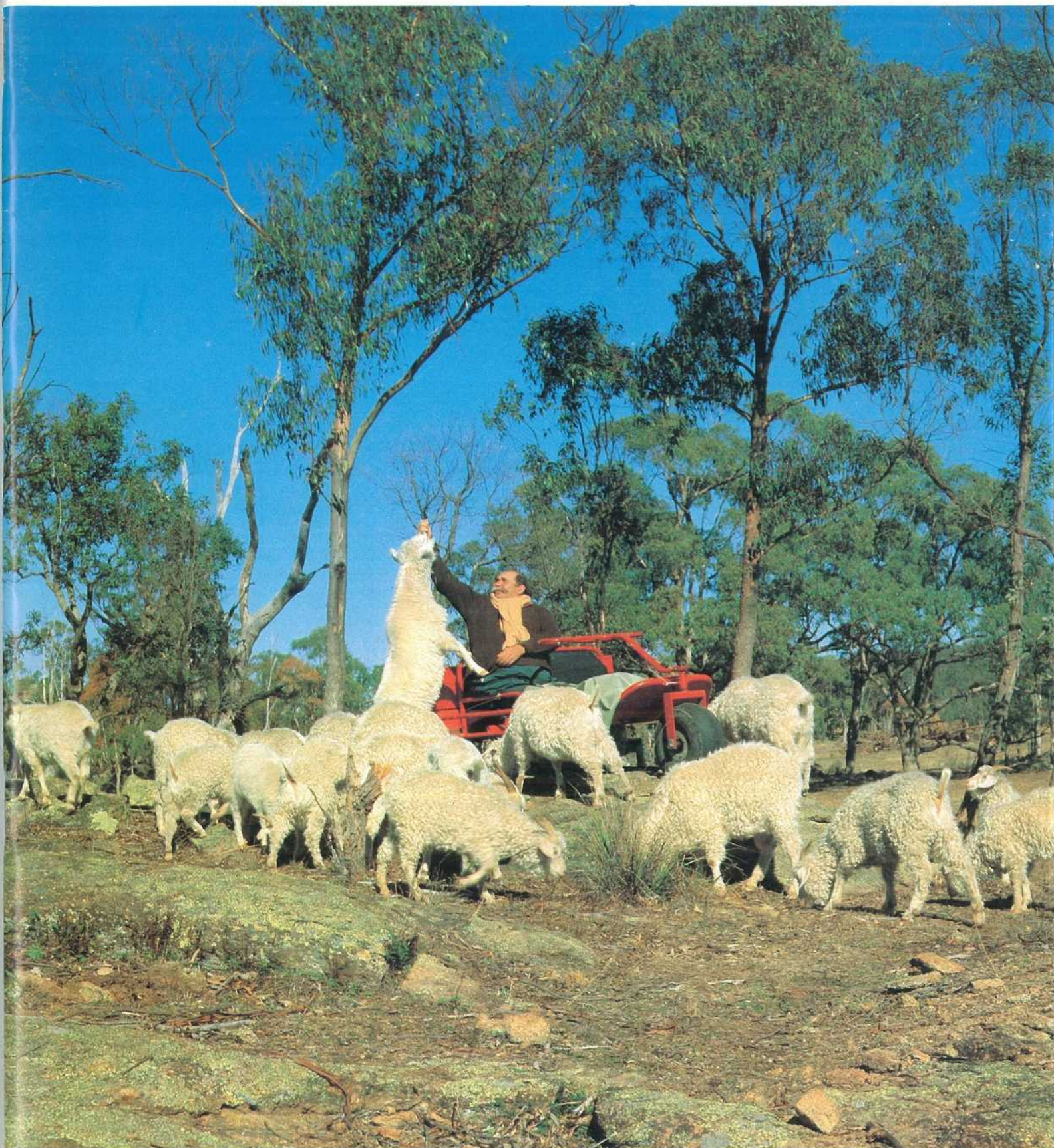


QUEENSLAND AGRICULTURAL JOURNAL

September–October 1981 Vol. 107, No. 5





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Cover: 1981, the year of the disabled, has shown that these members of society can and do make very worthwhile contributions in many diverse occupations. However, it takes a special kind of courage for the disabled to make a success of farming. See 'Farming is not always easy' in this issue. Photograph by R. B. Porter.

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Farming is not always easy

by R. B. Porter, Information and Extension Training Branch and I. F. Swann, Agriculture Branch

It is not all that unusual for a grazier to convert a property to near maximum productivity in little more than 12 months and with minimal outside help. But, when that grazier is severely disabled, this development becomes a considerable achievement.

Last year, 'Spring Plains' was an underdeveloped 348 ha sheep property near Stanthorpe on southern Queensland's Granite Belt. Sam Cristina has converted it to a highly productive fat lamb enterprise. As a result of a car accident, Sam has physical disabilities. The most obvious and severe is that he cannot walk.

While he was in hospital recovering from the accident, Sam, after reviewing the practical work options available to him, chose fat

lamb raising. Apart from being financially rewarding, the management of a fat lamb enterprise looked to be physically possible for him.

In January 1980, Sam and Grace Cristina moved to 'Spring Plains'. The property comprised about 35% wet flats which supported some white clover (*Trifolium repens*), paspalum (*Paspalum dilatatum*) and also weeds such as swamp rushes (*Juncus* spp.) and reed grass (*Arundinella nepalensis*).

The remaining 65% is mainly coarse sands which dry out quickly. About half of this area carried green timber, both virgin and thick regrowth, when Sam took up the property. These coarse sands can be used for annual pasture species and, to a limited extent, for lucerne pasture.

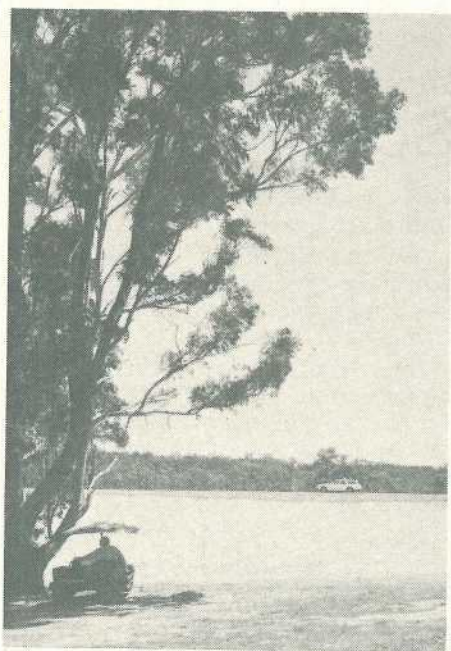


Upper photograph. Sam Cristina has had to develop original techniques to open and close the gates at 'Spring Plains'. 'Each one is different,' he says. For this gate, he uses ropes and pulleys.

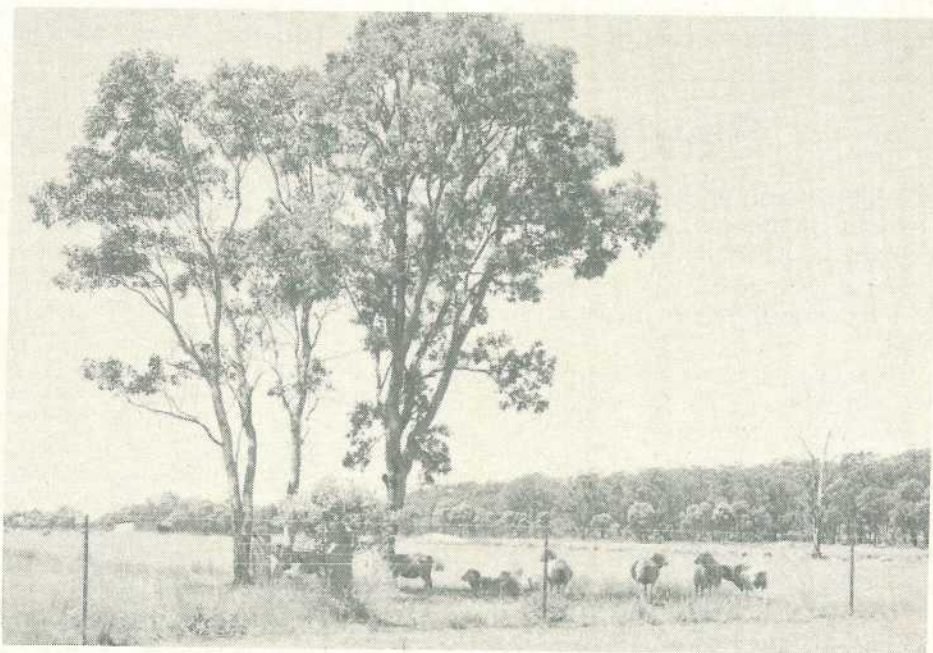
Lower photograph. Sam Cristina demonstrates the versatility of 'The Tarantula' a New Zealand made, go-almost-anywhere tractor. Here, he drives it down a dam wall.



Sam Cristina talking to D.P.I. extension officer for the Stanthorpe Shire, Ian Swann.



The wall of a 50 megalitre dam built at 'Spring Plains' by a Stanthorpe district dam builder, Trevor Johannsen.



Stock on some of the improved pastures at 'Spring Plains'.

'Spring Plains' has granitic soil and is in a 740 mm average rainfall zone. This rainfall is too low to support perennial temperate pastures such as white clover and fescue (*Festuca arundinacea*), except on the wetter soils.

It was estimated that if 'Spring Plains' was developed conventionally, it would carry about 1 060 cross-bred ewes to produce fat lambs. That estimate has already been reached.

Mobility was one of the most obvious difficulties that Sam had to overcome at the outset. He also needed a platform from which he could work. The answer is called a gnat—a New Zealand-built go-almost-anywhere tractor.

It is a 3-wheel flat-top vehicle, with a Honda motor, an electric start, three forward gears and a reverse gear. Sam steers it with a tiller which is fitted with hand controls. He calls it 'The Tarantula'.

The property is criss-crossed with pathways built for 'the Tarantula', although the machine can traverse almost anything except large rocks and creeks.

The tyres are sometimes casualties in rough going. Sam carries food and water on 'The Tarantula' and has installed a two-way radio in case he is stranded through a mishap.

The property has been subdivided with permanent fencing into 17 paddocks. Sheep are given a fresh paddock every day. This takes 'no time' because they are inspected twice daily and they wait at the gate to be moved each morning. Sam also follows a fairly rigid programme of drenching for worm control.

Pasture development has been very rapid. The two most positive methods of pasture improvement in this area are the use of superphosphate on pastures that contain some winter legumes, and timber treatment. These are the aspects that Sam concentrated on initially.

Last year, 252 ha were 'supered' with an average application of 760 kg per ha. This is a heavier than normal rate but it is not wasted because a super bank is built up in the soil, so maintenance applications in future can be lower. There was a good response by clover to the super early last winter but it dried off later in the year. However, the treated paddocks maintained the sheep in good condition even when feed became short. Extra legume seed was oversown with the super, but there was not a good strike in the dry winter.

About 48 ha of green timber have been treated with 'tordon' and there is already a big improvement in the native grass. Another 48 ha of thick regrowth have been pulled. This area will require careful attention to subdue further regrowth. One method that Sam is considering is to introduce goats for 1 or 2 years.

Future developments include 24 ha of irrigated pasture and 53 ha of dryland pasture.

A 50 megalitre irrigation dam has just been completed for pasture irrigation. The irrigated pasture should make the feed programme safe for fat lamb production as well as allowing potential for increased flock size.

A further 53 ha of dryland pasture has been sown under a cover crop of turnips. Turnips were chosen

because they do not cost much to sow and are an excellent grazing crop for ewes and lambs in the Stanthorpe district.

Annual pasture species Wimmera rye (*Lolium rigidum*), clustered clover (*Trifolium glomeratum*) and woolly pod vetch (*Vicia villosa* subsp. *varia*) were sown with the turnips. As well as being relatively cheap to sow, these annuals are the most suitable species for these coarse, sandy soils. As with all pasture on these soils, establishment can be slow, and resowing in future years may be necessary.

Once the new irrigated and dryland pastures are established, the property could run more than 1 200 ewes. However, Sam feels it is safer to restrict the breeding flock to that size and purchase additional store stock when there is surplus feed.

Sam is proud of his achievement—and why not? He has worked from daylight to dark for a year. He has helped with the fencing and does the tractor work. He manages the enterprise.

The rewards are now apparent. Despite a dry year, the property carried 600 cross-bred ewes throughout 1980, and the first two consignments of the 600 progeny each topped the Warwick fat lamb sale. Another 600 ewes were bought in mid 1980 and began lambing at the end of the year.

The high production can be ascribed to very intensive management of the sheep and a rapid rate of property development—and that can be attributed to Sam's determined pursuit of a goal.

Savings in Approved T.B. Schemes

GRAZIERS who undertake an approved tuberculosis eradication scheme will avoid testing fees and stand to obtain worthwhile tax savings as well.

This advice comes from Queensland Department of Primary Industries Veterinary Services Director Mr Ian Wells.

He said that cattle from tuberculosis-infected herds that did not have an approved eradication programme would in the future have to be tested before they were consigned for slaughter. The new ruling would take effect from 1 April 1982.

It would also apply to cattle moving to and from interstate for slaughter.

Mr Wells said the rule had been introduced to protect those graziers who had adopted a tuberculosis eradication programme. Only a small number of herds were out of this category.

He said that, overall, the tuberculosis eradication programme was proceeding well, with only about 200

of the 34 000 herds in Queensland still infected. However, many of those herds were large ones.

Recent changes to the Income Tax Act had encouraged the eradication programme because, from October, graziers with approved programmes would pay less tax on their incomes.

Mr Wells said this would allow graziers with approved destocking programmes to sell large herds in one year and average the income over a 5-year period. It would also allow graziers to offset the cost of replacement against the profit. This would reduce the amount of tax payable.

In addition, expenses for some improvements considered essential for an eradication programme had become tax deductible. This would enable graziers to erect cattle yards, crushes and internal fences.

Mr Wells reminded graziers that they needed prior Departmental approval of destocking and development programmes for their claims to be considered by the Taxation Department.

Growing carnations

by M. E. McKay, Horticulture Branch.

This article by Margaret McKay is the first in a series covering different aspects of floriculture. These articles which will be of greatest interest to commercial growers will appear in the Journal over the next 12 months.

The carnation has been cultivated by man for over 2000 years. Today, after centuries of selection and hybridization, it bears little resemblance to its wild parent. This is thought to have been a clove-scented pink variety native to the western Mediterranean.

The perpetual flowering carnation now grown commercially is distinguished from other garden forms by its erect habit of growth, long flower stem and continuous flower production. The bulk of the modern

commercial varieties has been developed from William Sim produced in 1938 and named after its breeder.

Although carnations are extremely popular they must be considered to be a marginal crop for field production in coastal Queensland. The varieties have been bred for temperate climates. In the hot, humid summers of Queensland, they perform badly. Quality is adversely affected and flowers are small, and stems short and weak. In addition, the climatic conditions aggravate the leaf and soil-borne disease problems, and most carnation growers in Queensland suffer severe losses through diseases.

Cultivars

Carnation cultivars being grown commercially in Queensland and available from the virus-free scheme in Victoria include:

Sim Carnations

Arthur	white/red stripe
Better Times.....	medium pink
Calypso	pink/white fleck
Caravelle Red.....	red
Clear Yellow	pale lemon
Cocomo	yellow/red fleck
Cream Dusty	magnolia
Cream Tangerine ..	cream/pale tangerine centre
Crowley	pale pink
Dark Purple	dark purple
Dusty.....	dark, dusty pink
Ember Rose	rose pink
Ember Rose II	dark rose pink
Esperence	dark pink/red fleck
Flamingo	dark pink
G.J. Sim	red/white fleck
Harvest Moon	golden yellow
Joker	maroon
Laddie.....	delicate pastel pink
Large Cream Dusty	magnolia
Lena.....	pink
New Arthur	white/more fleck than Arthur
New Arthur (D)....	white/more fleck than New Arthur
Orchid Beauty	mauve
Pink Dusty	dusty pink



Spray carnation production in Israel under a saw-tooth greenhouse.

Pink Mist.....	blushing pink
Pikes Peak Frosted..	strawberry/white markings
Portrait.....	dark pink
Red Diamond	white/heavy red edge and fleck
Scania.....	red
Shocking Pink.....	deep, bright pink
Sunset.....	dark tangerine
Sylvie.....	dusty pink/red markings
Tangerine.....	tangerine
Telstar.....	buff-yellow/broad red markings
White.....	white
William.....	red
William 50-1.....	red
William 50-2.....	red
William 50-3.....	red
Yellow Dusty.....	yellow

Spray Carnations

Cerise Royalette	cerise-pink/white fleck
Christine.....	lemon/pale pink fleck
Corona.....	lemon/red edge
Dark Pink Lisa.....	dark pink
Elegance.....	cerise/pale pink edge
Elli May.....	pale pink/magenta edge
Exquisite.....	purple/mauve edge
Heidi Tgr.....	white/pink edge
Lavender Royalette.....	lavender
Lillian.....	bright pink
Lisa Tgr.....	pale pink
Mini Queen.....	cerise/pale pink edge
Orange Elf Tgr.....	orange/red edge
Peachy.....	apricot
Purplette.....	magenta
Purple Haze.....	off white/magenta strip
Red Baron.....	red
Sams Pride Tgr.....	deep cerise
Scarlett Elegance.....	pale pink/red centre
Scarlett Miniqueen.....	pale pink/red centre
Sunshine.....	orange/dark orange fleck
Toni.....	pale yellow/purple markings
White Elegance.....	white
White Lillian.....	white/serrated edge
White Royalette.....	white

Field Carnations

Clarinda.....	cream/red fleck
Cyclamen Madam Bouche.....	cyclamen/dark cyclamen stripes
Dale Featherstone	pale yellow/red fleck
Dark Apricot.....	apricot/red markings
Dark Poulsters Supreme.....	dark pink
Italian.....	white/mauve stripe
Madam Bouche.....	cream/pink stripe
Poulsters Supreme Light.....	pale pink
Red Strip Madam Bouche.....	cream/red stripe
Ron Oakley.....	white/dark purple stripe
Salmon Queen.....	bright mid pink
Scarlet Sallie.....	red
Speckled Featherstone.....	pale yellow/red fleck
Waltams White.....	white
White Sallie.....	white
Yellow Field.....	yellow/red markings

Location and soils

Well-drained soils are essential for the successful production of carnations. They will not tolerate water-logged conditions as this aggravates the serious soil-borne disease problems.



Glasshouse production of Sim carnation in Queensland.

Irrigation is essential to produce flowers of a marketable quality. Flowers can also be damaged by frost. When temperatures fall below -2°C frost damage can be expected. Flowers are also damaged by high temperatures or severe wind. In addition, the size of flowers and the stem length and strength will be reduced when night temperatures exceed 19°C .

As the crop may be air-freighted interstate or to north Queensland, new producers must take account of the closeness of their property to air transport facilities.

Preparation

The land preparation for carnations is similar to that of other small crops. If a cover crop has been grown, it should be turned under about 2 months before carnations are to be planted so that it will have rotted down. The first ploughing is usually 200 to 250 mm deep. The land is then left in a rough state until 2 or 3 weeks before planting. It is then ploughed again and worked to a fine tilth with discs, cultivators or harrows.

If a soil fumigant is to be applied for disease or weed control, no organic matter should be applied at least 1 month prior to the treatment. Undecomposed organic matter absorbs the fumigant and reduces its effectiveness. Bromine, absorbed to organic matter, can be phytotoxic to carnations.

The most suitable soil reaction for carnations is within the pH range of 6.0 to 7.0, that is, medium acid to

approximately neutral. If required, lime or dolomite may be broadcast before the second ploughing at the rate required to adjust the pH reaction to within the desired range. Advice about soil testing can be obtained from the Department of Primary Industries' horticultural advisory officers.

Establishment

Planting material

Virus-free carnation cuttings are available from specialist propagators in Victoria. These can be obtained either as unrooted or rooted cuttings. A list of cultivars has been presented in an earlier section. The importance of obtaining clean planting material cannot be over emphasized. Carnations are susceptible to a number of systemic diseases which are readily carried in planting material taken from diseased stock.

A flower grower having financial difficulty often resorts to propagating from flowering plants to save the cost of purchased cuttings. However, reducing costs of cuttings may not be the best way to reduce general production costs. Also, a flower grower who wishes to propagate his own cuttings must consider the costs of propagation facilities, space for stock plants, labour, storage facilities and his ability to meet planting schedules.

Few growers would want to contend with the lengthy procedures for maintaining 'disease-free' carnations. This involves establishment of a stock plant area with plants grown on raised benches in pasteurized

media. Entry to the stock plant area should be restricted. Persons entering should wear clean clothing, sterilized footwear and wash their hands. Stock plant areas should be replaced with certified cuttings each season.

Propagation

Although there are many ways of propagating a carnation, usually only terminal cuttings are used by commercial flower producers. These are obtained from the specialist propagators in Victoria.

The average length of the cuttings would be between 100 to 150 mm. The cutting is usually broken from a mother plant at or below a node and the bottom leaf pair removed. It is not necessary to trim leaves and in fact this has been shown to be a detrimental practice as it slows the rate of rooting.

The use of root-promoting hormones such as Indolebutyric acid (IBA) at concentrations of 0.25 to 1% is beneficial in hastening rooting of carnations and increasing the amount of roots formed. Higher concentrations of root-promoting hormones should not be used as they can cause uneven or delayed rooting and sometimes a basal burn on the cuttings.

Unrooted and rooted cuttings can be stored dry at 0°C plus or minus 0.5°C for 3 months. The cuttings should be placed in polyethylene bags and stored in the cold room with adequate air circulation around the bags. The reason for indicating a variation of no more than plus or minus 0.5°C is to reduce the water loss from the cuttings. If the temperature falls below -1.5°C there is a danger of the plants freezing.

Only healthy cuttings should be stored. It is a wise precaution to dip cuttings in Zineb prior to storage.

Carnations have been rooted successfully in many types of media. Any media should hold moisture and have good drainage characteristics and must not become compacted. A popular media is a 50-50 mixture of peat and perlite or sand. The rooting media and all trays etc. should be sterilized before the cuttings are struck. Sanitation at this stage is particularly important as one diseased cutting may infect the entire crop.

Bottom heat of 21° to 26°C can be used to improve the speed of rooting. This can be achieved by placing low voltage cables or hot water pipes in or below the bench. Bottom heat is particularly useful when using mist.

Mist propagation systems are useful to aid rooting of carnations. The principle of misting is to keep a film of water on the leaf surfaces which reduces the water loss and keeps the leaves cooler. Misting systems can be operated on a time clock or an electronic leaf. Mist is only applied during the day. If the cuttings are not propagated under mist, it may be necessary to shade the cuttings to reduce water loss.

Some commercial propagators in the United States use nutrient mist during propagation to prevent the mist leaching nutrients from the leaves of the carnation cuttings. When the cuttings are removed from the mist, the application of a liquid nutrient solution would probably be useful.

During rooting, cuttings are usually spaced 25 mm apart in rows 50 mm apart. They are planted approximately 13 to 25 mm deep.

Cuttings should be removed from the mist when the roots are about 6 to 13 mm long. This will take about 3 to 4 weeks depending on the cultivar and the time of the year. If the roots are allowed to get any longer there is excessive breakage of the roots during the planting operation.

Rooted cuttings should be hardened off for a few days before planting out into the field. This can be done by turning off the mist and gradually reducing the water supply.

Field management

Planting, spacing and arrangement

Carnations are usually grown in beds 1 m wide. The total yield of flowers from a bed depends on the number of lateral shoots produced within the bed.

Several different spacing patterns can be used for planting carnations (figure 1 a, b, c, d and e). Patterns a, b and c were developed to allow better air flow patterns between the plants which is thought to reduce the incidence of foliar diseases. However, trial work carried out at the Redlands Horticultural Research Station showed that the plant density had little influence on leaf disease control and chemicals were effective at low and high plant densities.

A higher early yield is obtained at higher plant densities. If growers only wish to grow carnations as a winter crop, they are advised to use high density plantings as this will give a higher early yield.

A cutting should not be planted deeper than it was during propagation. A deep planting may help to support the cutting but it will not grow as rapidly and will have a greater chance of becoming diseased. The cutting should be planted by pressing soil around it and then watered.

To reduce wilting, particularly during the summer months, the plants should be watered lightly and frequently for the first few days.

Trellising

Many different methods of trellising can be used for carnations. Most commonly, they are trellised with two or three layers of Cyclone high tensile ring lock 90/30 cattle fencing wire mesh supported by metal star picket fence posts spaced 3 to 5 m up to the bed.

Pinching and disbudding

Removal of the terminal growth (pinching) of a young carnation plant encourages the buds in the axils of the remaining leaves to break and develop more uniformly and thus produce a bushy plant. Laterals break readily after pinching, particularly under high light intensities.

Pinching delays flowering and reduces the productive time in the cropping cycle. Although it is necessary to pinch once, it is suggested that carnations should not be pinched a second time. Instead, producers should increase the plant density to that recommended earlier.

When pinching, the growing point must be removed. Malformed growth will occur if the crop is not pinched correctly.

The purpose of disbudding is to improve the size of the flower. Lateral buds developing on the lower part of the stem are easy to remove by bending the bud and its short stem at right angles to the main stem and twisting it slightly. Buds forming at the base of the terminal bud are more difficult to remove and there is a risk of physical damage to the terminal bud if the lateral buds are very small. However, unsightly scars can result if the lateral buds are allowed to become too large.

Established beds of carnations produce flowers continuously, with marked flushes of flowers during the spring and summer months. Disbudding must be carried out as a routine weekly operation. As the buds are removed, they should be collected in a container for disposal and not left on the ground.

Spray and field carnation cultivators may also require some disbudding to ensure a more uniform flowering. In this case, the terminal bud is removed.

Influence of environmental factors

Temperature. The recommended temperatures for greenhouse carnation production are 12.5°C at night and 19°C during the day. A maximum day temperature of 21°C is recommended. Hence, it is evident why carnations are not well adapted to production in Queensland. Under higher temperatures, the number of petals are reduced. This results in smaller flower size. Usually, stem length and strength are also reduced by high temperatures. In addition to these adverse influences on flower quality, the severity of many carnation diseases increases under high temperatures.

Temperature fluctuations of greater than 6°C in 1 hour are thought to be the major cause of calyx splitting. A disorder called 'hollow flowers' is also caused by high temperatures and high light intensities. The number of petals is so reduced under these conditions as to make the calyx feel soft. This disorder often occurs in summer in Queensland.

Light. In Europe, light intensities in winter are very low and limit carnation production during this period. However, in Queensland it is unlikely that light intensity would be sufficiently low to limit growth except during periods of overcast weather.

Daylength. Flowering in carnations is promoted by long daylengths. It is delayed but not prevented by short daylengths. A carnation shoot changes from a vegetative to a reproductive condition when it has about six pairs of leaves. The photoperiod influences the rate of flowering and characteristics of the stems. Carnations grown under short daylengths of 8 hours have longer stems, slightly larger flowers and produce more lateral shoots. Those grown under 16-hour photoperiods have shorter stems and fewer lateral shoots.

Artificial lighting of carnations is a useful practice to advance the flowering time of crops for the late winter market. The long daylength treatment is applied for a 2 to 3 week interval followed by a 2 to 3 week period of short daylengths. Sometimes, a second 2 to 3 week interval of long daylengths is applied. Lighting is not effective unless a minimum night temperature of 10° to 12°C can be maintained.

In Queensland, growers should consider the possibility of growing carnations as a winter crop with supplementary lighting to avoid the environmental problems associated with summer production.

Greenhouses can be used to protect carnations from weather damage. Some greenhouses are relatively cheap and easy to construct. Further information will be presented in later articles in this series.

Irrigation

Irrigation is essential for successful commercial carnation production as stem length and the size of the flower will be reduced by a shortage of water. During the early stages of growth, the plants will not remove a great amount of water from the soil as they are small in size. As vegetative growth continues, the demand for water increases.

It is difficult to determine exactly when to water the crop. This depends upon many factors such as the type of soil, the season and the crop response. However, knowledge on when to water can be gained through observation of the crop over a few seasons.

Tensiometers can also be used to help a grower to determine when to water the crop. Tensiometers measure how strongly the water is held by the soil and thus give a measurement of how much energy the plant must exert to obtain this water. If growers wish to use a tensiometer they must determine at what tension their soil should be watered.

This can be done through observation of the state of the crop and the readings on the tensiometer.

If a probe-type tensiometer is used, then the probe should be marked so that it is inserted to the same depth each time. It should also be inserted in the same relative position of the bed. Do not measure moisture tension at one time in the middle of the bed and the next time on the outside rows.

The soil readings may be the same but irrigation will then be made on the basis of different water contents since the centre of the bed is usually wetter than the outside.

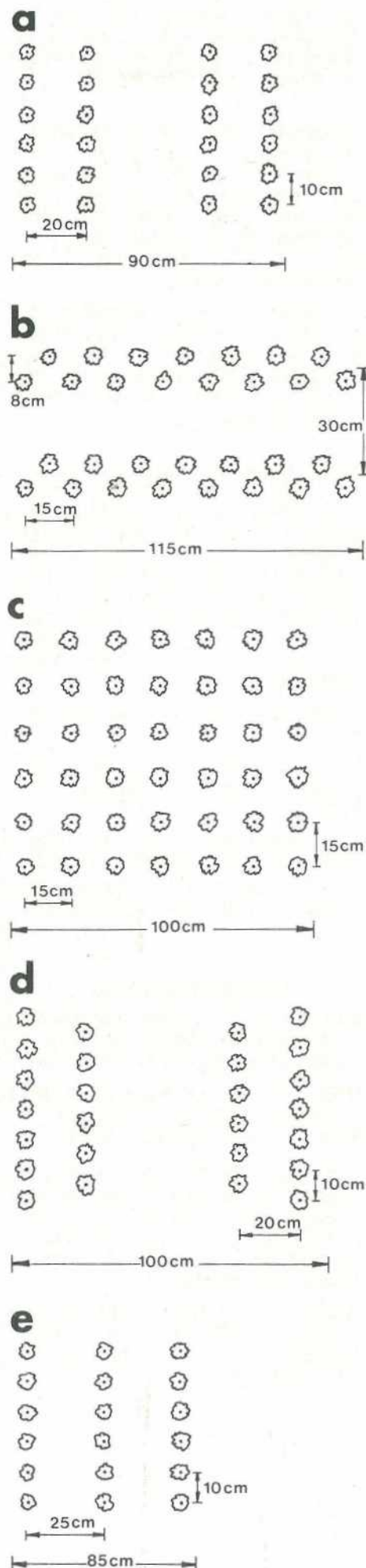
In Queensland, most carnation growers water with an overhead sprinkler system. This system aggravates leaf diseases.

Where overhead sprinkler systems are used, watering should be done early in the day so that foliage dries before nightfall. Some growers also use trickle or drip irrigation systems and these have the advantage of keeping the foliage dry.

Another alternative system is the microjet system where a spray line is placed around all sides of the bed at a height of about 100 mm and water is applied from nozzles in a semi circular spray. In this system, most of the foliage stays dry.



New carnation planting with drip irrigation.



Fertilizer

Carnations are produced under widely varying fertilizer programmes and it is difficult to give recommendations on fertilizer requirements as no trials have been conducted on carnations in Queensland.

Growers either use solid inorganic fertilizer materials or a liquid feeding programme.

When solid fertilizer materials are to be used, a fertilizer with an N:P:K (nitrogen : phosphorus : potassium) analysis of 5:7:4 is suitable for preplant applications. An application, broadcast on the bed of 5 kg per 20 m is suggested.

Most growers sidedress carnations every 4 to 6 weeks with an N:P:K analysis of 5:7:4 at 2 kg per 20 m of bed, or with a Nitrophoska Red or Blue at 1 kg per 20 m of bed.

High analysis fertilizers with a similar ratio of nutrients can be used at equivalent rates of application. In areas where deficiencies of some trace elements occur, foliar application of these is advisable.

Liquid feeding programmes are widely used for carnation production in the United States and Europe. Growers in these countries rely on the services of a consultant who tests the soil prior to planting and monitors the nutrient programme and crop response during the cropping cycle. Further information on liquid feeding is presented in later articles in this series.

Harvesting and grading

Flowers must be cut at the correct stage of development to optimize vase life. If a flower is cut beyond its peak of maturity it does not last as long as a flower cut at an earlier stage. Carnations should be cut when the flower is open and the first petals are at an angle of 90° to the calyx. They should be harvested every day in summer and every second day in winter.

They are normally picked by snapping the stem at a leaf node. In Europe and the United States, a stem length of 900 mm is required for first quality flowers. However, in Queensland a stem length of 600 mm is acceptable.

On the flower stem, there are a number of vegetative lateral shoots, which if left on the plant would develop into flowers. In Queensland, cutting long stems results in removal

of some of these lateral shoots and hence reduces the total yield of flowers from the crop.

Flowers should be placed in water in a cold room at 0° to 2°C after harvesting to remove field heat. All water containers should be kept clean by scrubbing, and treated with a disinfectant or bleach. This removes bacterial growth which can adversely influence flower quality. Water in the containers should be changed daily. There are many chemical preservative solutions which will significantly increase the vase life of cut flowers.

Flowers are graded on stem length bunched in tens. Quality grades and bunch sizes have not been standardized and vary from grower to grower.

Packing

Carnation bunches are wrapped individually or sleeved in cellophane or paper before packing. This avoids breakage of the flower heads while packing and unpacking. They are usually packed in shallow hampers with only two layers of bunches. The stems are anchored in the middle of the carton by a partial partition. This prevents bruising of the petal and movement of the bunches in the carton, if it is mishandled.

Storage of flowers

Carnations can be stored dry for 2 to 4 weeks at a temperature of 0° to 0.5°C without deterioration. The boxes of flowers should be cooled to at least 5°C and then wrapped in polyethylene film to maintain a humid atmosphere around the flowers before being cooled down to the desired storage temperature of 0° to 0.5°C.

It is advisable to store only high quality flowers which are free from pests and diseases otherwise problems may result. Carnations are adversely affected by ethylene and hence should never be stored with fruit and vegetables or with decaying or diseased plant material.

After flowers come out of low temperature storage or, if the flowers have wilted or been out of water for any period of time, the stems should be recut and the flowers placed in warm water at a temperature of 32° to 43°C for a short period and then stored at 5° to 10°C for 12 hours before packing. During this period, they should be kept out of draughts or bright light. It is also advisable to use a chemical in the water to prolong vase life.

Left. Figure 1. Plant spacing patterns for carnations.

Pest and disease control

Pest control

Moth larvae, chiefly *Heliothis armigera* are the most economically important insect pests of the carnation. This species likes to feed initially on the petal bases of the developing bud and later on the ovarian tissues.

The damage to the developing flower renders it unsaleable. Even slight damage to the petal bases of a carnation prevents a florist breaking blooms for rebinding as part of her floral technique.

The *Heliothis* caterpillar can be controlled by spraying with methamidophos (Nitofol (R)).

Red spider mites can attack carnations. The damage can occur on any part of the plant. Symptoms of red spider infestation are a white stippling which coalesces into a general silvery and subsequent russetting. This results in leaf shrivel and death of the plant if the pest remains unchecked.

Spraying with either dicofol (Kelthane (R)), propargite (Omite (R)), demeton-S-methyl (Metasystox (R)), aldicarb (Temik (R)) or dimethoate (Rogor (R)) will control this pest.

Other pests which may be encountered are aphids and thrips. If control measures are warranted, use dimethoate (Rogor (R)), or aldicarb (Temik(R)).

Disease control

Foliage and flower diseases. Rust, *Alternaria* leaf spot and grey mould are the most important diseases affecting foliage and flowers.

Rust, caused by the fungus *Uromyces dianthi*, produces small blisters on the stems and leaves which may turn yellow and die. The blisters rupture to release masses of rusty-brown spores. Rust reduces the yield and quality of flowers.

Alternaria leaf spot or blight, caused by the fungus *Alternaria dianthi*, is common in commercial plantations and home gardens. It produces small purple spots which enlarge to form spots with purple margins and grey-brown centres. Severe leaf blight reduces flower quality.

Botrytis cinerea is a problem in wet weather. There is a tan to light brown decay of the flowers which become covered with a fluffy grey mould.

To control these leaf and flower diseases, spray with mancozeb every 10 to 14 days. If rust control is inadequate, spray with oxycarboxin (Plantvax (R)). In wet weather, it may be necessary to add benomyl (Benlate (R)) if botrytis flower blight causes concern.

Soil-borne diseases. The most serious soil-borne diseases of carnations are Fusarium wilt, Rhizoctonia stem rot and Sclerotium collar rot.

Plants affected with Fusarium wilt become bleached and dried out. Often, only part of a plant shows these symptoms. When the stem is cut, the browning of the vascular system is evident. In the advanced stage, the roots rot and the plant turns pale green or tan and is completely wilted.

Rhizoctonia and Sclerotium stem or collar rots are most serious in hot, wet weather. Carnations suddenly wilt, turn brown and die. The roots are often rotted and the stems have a shredded appearance. Sclerotium collar rot can be recognised by the presence of black to brown sclerotes about the size of cabbage seed at the base of the stem. These resting bodies of the fungus enable it to survive in the soil for many years.

Soil infested with *Fusarium*, *Rhizoctonia* or *Sclerotium* should be treated with a broad-spectrum fumigant a month or more before planting. The most suitable of these fumigants are Di-Trapex, Di-Trapex CP and Basamid. Chloropicrin-methyl bromide mixtures are also used but methyl-bromide can affect carnations particularly when the soil contains a high content of organic matter.

Aerated steam is used to control weeds, fungi and nematodes in glass-house beds. Treatment at 60°C for 30 minutes controls pathogens without destroying all beneficial micro-organisms and is preferable to steaming at 100°C.

After fumigation or aerated steam treatment, the soil can be reinfested by using diseased planting material,

by roots growing out of the fumigated zone or by a rise in the water table. In Europe, carnations are often grown in raised beds.

Nematodes. Root knot nematodes (*Meloidogyne* species) are responsible for the formation of large swellings on the roots. The galls are often invaded by other organisms which hasten the breakdown of the root system and collapse of the plant.

Nematodes are controlled by preplant soil treatment with a broad-spectrum fumigant or with the nematicide DD injected at the rate of 250 L per ha 3 or more weeks before planting.

Virus Diseases. There are several virus diseases of carnations which may reduce flower production and quality. However, the Victorian Department of Agriculture has released virus-free carnation cuttings which are being propagated by specialist propagators who then supply material to flower growers. So it is now possible to avoid losses caused by viruses.

This material can be obtained from:

Mr F. Baguley, Heatherton Road, Clayton South, Melbourne, Vic. 3169

Mr I. Montgomery, R.S.D. 5 Ways, South Gippsland Highway, Victoria.

Mr R. Healey, Cnr. Royena and Barbara Streets, Morrabbin, Vic. 3189

Further reading

Besemer, S. T. (1980) *Introduction to Floriculture*, Edited by Roy A. Larson (Academic Press, New York).

Holley, W. D. and Baker, R. (1963) *Carnation Production*, (W. M. C. Brown Co. Inc. Dubeque, Iowa).

Langhans, R. W. (Ed) (1961) *A manual of the culture, insects and diseases and economics of Carnations*, (New York State College of Agriculture, Cornell University, Ithaca, New York).

Anon (1967) *A Manual of Carnation Production*, Ministry of Agriculture, Fisheries and Food, Bulletin 151 (H.M.S.O. London).

Grader grass—a nuisance weed

by H. G. Bishop, Agriculture Branch

Since its accidental introduction into Queensland over 40 years ago, grader grass (*Themeda quadrivalvis*) has caused concern among landholders as a potential threat to crop, pasture and animal production.

Its initial spread along the east coast of Queensland has been spectacular, but the spread into drier areas is more gradual.

Grader grass is an annual and research findings suggest the use of management practices which prevent its germination as the best means of control. Avoid grass fires, heavy stocking, short mowing and soil disturbance of any areas where grader grass is growing or likely to invade. These practices are discussed in more depth later in this article.

Grader grass is basically a nuisance weed of certain specific situations. Although special management practices are necessary to keep it under control, it is not regarded as a serious economic threat to any of our grazing or agricultural industries in coastal or near coastal areas. However, its threat to extensive grazing operations in the drier 'monsoonal' tropics remains to be judged and is being closely studied by Departmental officers.

Origin

Grader grass is native to India where it occurs as a component of perennial native pastures receiving an annual rainfall of 375 to 2 000 mm. In that country, best development occurs with 500 to 875 mm rainfall.

Description

Grader grass is a robust annual with one to five or more erect, caney stems and long, narrow, well-spaced leaves. The seed-head is long, branched, and interspersed with short leaves. As the plant matures, the seed-head droops and the whole plant changes to a brown colour. Plant height depends on conditions but ranges from around 50 cm to over 2 m on roadsides and newly established pasture areas.

Grader grass can be distinguished from kangaroo grass (*T. australis*) by the presence of tubercle-based hairs

on the spikelet clusters (see figure 1). Kangaroo grass does not have these hairs and is a perennial grass.



Seed-heads of thatch grass (left) and grader grass (right).



Roadside growth of grader grass near Mackay.



Roadside growth of thatchgrass near Mackay.

History of Spread

Grader grass was first recorded in Queensland in 1935 at Habana near Mackay. One theory claims the seed arrived in the straw packing around electrical insulators, while another theory suggests that seed came from the stuffing used in imported horse collars.

Local residents claim that grader grass first appeared in a small triangle at Grech's tram siding at Habana. Draught horses were used to pull sugar cane wagons to this siding. The residents say that grader grass was confined to this triangle for 5 to 6 years. It then seemed to 'burst' out and in one season appeared along roadsides and tramlines throughout the Habana district, and soon spread throughout the Mackay region.

The drooping seed-heads on mature plants resemble the seed-heads of oats. During the 1946 drought, local farmers harvested the seed-heads, chaffed them and fed the chaff with pollard and molasses to their draught horses. Locally, the grass is still referred to as Habana or wild oats grass.

Because the grass rapidly colonized roadsides following soil disturbance by grading, it became known throughout Queensland as grader grass. Doubtless road graders and road vehicles in general contributed greatly to its rapid spread by distributing seed over long distances.

The earliest record of grader grass outside the Mackay district was in the Mareeba district in 1938. Whether this was another 'original source' or a result of seed transported from the Mackay (Habana) site is unknown. The 'original source' idea would seem the most feasible as a local resident of Tolga, near Atherton remembers seeing a clump of grader grass at Carbeen siding in 1937. He says it remained in this single spot for many years without apparently spreading.

Other early records (pre 1960) were from Cawarral (1952) and 'Fitzroyvale' (1956), both near Rockhampton, Ayr (1954), Cannonvale (1957), Proserpine (1959) and Atherton (1959). Records of herbarium collections are shown in table 1.

By 1964, it was occurring in high rainfall situations from Cairns to Brisbane with a few patches reported in the 650 mm rainfall zone in the Clermont-Capella area.

Grader grass has continued to spread north and south along roadsides and railway lines throughout Queensland up to the present time. It has also moved inland into rainfall

TABLE 1
Collections of Grader Grass in Queensland up to 1968*

Location	Year
Habana	1935
Mareeba	1938
Habana roadside.....	1947
Mackay	1947
Cawarral	1952
Ayr	1954
'Fitzroyvale', Rockhampton	1956
Cannonvale	1957
Atherton	1959
Proserpine	1959
Nebo-Sarina Road.....	1960
Saltbush Park	1961
Bundaberg	1962
South of Nebo	1962
Clermont-Capella	1963
Brisbane	1963
South Rockhampton.....	1963
Farnborough	1964
Cairns	1964
Gin Gin	1964
Eungella	1967

* from BLAKE, S.T. (1969)—Taxonomic and nomenclatural studies in the Gramineae No. 1. Proceedings of the Royal Society of Queensland, Vol. 80.

zones of 800 to 1 000 mm per year. On the other hand, an inspection in July 1981 failed to locate any occurrence in the Clermont-Capella area.

Grader grass does not yet appear to have reached its geographical limits, and continued but less spectacular spread is likely to occur.

In 1977, Government authorities in New South Wales and the Northern Territory reported isolated, currently insignificant occurrences of grader grass.

Another Nuisance Grass

A similar-looking grass has colonized many roadsides in coastal Queensland over the past 15 to 30 years and is sometimes mistaken for grader grass. It is thatchgrass (*Hyparrhenia rufa*), a native of tropical Africa. In Africa and in Brazil, where it has been introduced, it is used for grazing cattle. In the latter country, it is known as jaragua grass.

Thatchgrass was introduced to Queensland as a potential pasture species before 1940 but has not been accepted as suitable for grazing cattle. It is now widespread along road edges and road reserves throughout the North and South Kennedy, Port Curtis, Wide Bay and Moreton pastoral districts. A related species, *H. hirta*, also occurs in the Wide Bay and Moreton, as well as in the Maranoa and Darling Downs regions.

Thatchgrass can be distinguished from grader grass by having finer stems, more tillers per plant, and a more open and more erect seed-head.

The racemes (branches) of the seed-head project beyond the subtending leaves and occur as a single pair. In grader grass, the racemes are much more congested, mixed with the subtending leaves, and there are several pairs together, as in oats. Seed-heads of both grasses are shown in figure 1.

Although similar to grader grass in its habit of colonizing roadsides, thatchgrass is currently regarded as a lesser nuisance. It seldom occurs in grazed pastures and appears unable to persist under grazing. In parts of the Mackay Wet Coast it is gradually replacing grader grass on roadsides. This is probably because it is a perennial—its growth commences earlier in the wet season.

Research

By the early 1960s, the vigorous growth and rapid spread of grader

grass along roadsides was causing concern among graziers.

Representations by the Central Coastal Graziers' Association of Queensland to the Department of Primary Industries, the Superintendent of Stock Routes and the Government Botanist led to experiments being conducted at Mackay between 1965 and 1967 to evaluate its weed status and methods of control.

Following a request from the United Graziers' Association of Queensland in 1973, investigations were carried out by officers of the Department of Primary Industries in Mackay into the fodder value of grader grass. The results are presented later in this article.

Concern was also being expressed by cane farmers at its invasion of plant and ratoon cane and of cane

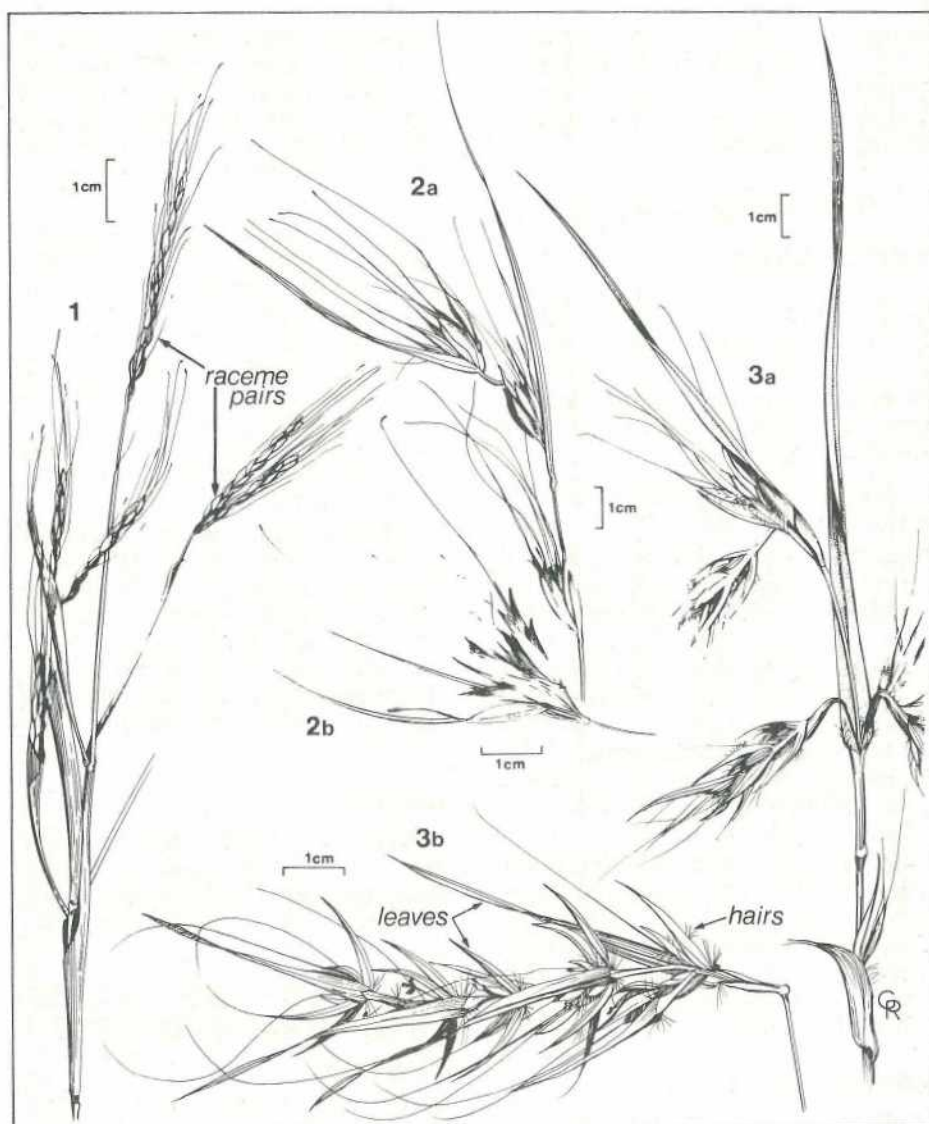


Figure 1. Portions of seed-heads of three grasses.

1. Thatchgrass (*Hyparrhenia rufa*)
2. (a & b) Kangaroo grass (*Themeda australis*)
3. (a & b) Grader grass (*Themeda quadrivalvis*)



The author mowing grader grass in a citrus orchard near Mackay.

headlands. By the late 1960s, officers of the Bureau of Sugar Experiment Stations in Mackay were experimenting with chemical and cultural methods of control.

The Nuisance Value

Pastoral industry

Grader grass is seen by graziers as a threat to the productivity of native and improved pastures. It is a quick-maturing annual with the ability to colonize disturbed and overgrazed areas. It is seldom eaten after the flowering stage.

Situations where grader grass is of greatest nuisance value are:

- In the establishment year of sown pastures, by competing for nutrients, moisture and light.
- In pasture seed crops, by increasing the difficulty and costs of both the seed harvesting and cleaning operations. Isolated occurrences of grader grass in the Northern Territory are put down as introduced in pasture seed from Queensland.
- In Verano stylo (*Stylosanthes hamata*) and old Townsville stylo (*S. humilis*) pastures, where the recommended management is for moderate to heavy grazing and where no improved grass species has been sown.

Cultivation situations

Grader grass is an extra weed to be controlled in the following situations:

- Sugar cane growing—Grader grass can be controlled by the normal weed control cultivations.

However, when cane is too tall to cultivate, grader grass requires constant slashing along headlands and fire-breaks and often requires chemical spraying where it occurs at the beginning of each cane row.

- Specialist legume seed growers—It is a problem in the establishment year or when plant cover is reduced by disease of the crop or by the harvesting operation. Rolling of twining legumes such as Siratro (*Macroptilium atropurpureum*) late in the wet season allows the crop to climb over and smother dense areas of grader grass.
- Orchards and gardens—Grader grass can be a nuisance in orchards using a bare fallow or short mowing between trees. It can also be a nuisance in private or large park lawns where it can keep regrowing after mowing, and rapidly makes the lawns look untidy.

Roadsides

Grader grass makes roadsides look untidy and unless regularly mown reduces visibility. It also causes a fire hazard once it has matured and died.

WHAT DO WE KNOW ABOUT GRADER GRASS?

Germination

Being an annual, grader grass regenerates from seed each year. Each seed has a long awn (bristle) which helps to bury the seed by twisting it into the soil when the awn becomes moist. Seedlings grow vigorously.

Experiments indicate that the seed will not germinate under dense shade and that the viability of seed in the soil decreases with time.

If grader grass is prevented from seeding, establishment in the following season is greatly reduced.

Experimental results have also shown that the removal of pasture cover by burning, short mowing or heavy grazing gives grader grass an ecological advantage and stimulates its germination and establishment.

These findings suggest the use of management practices which prevent its germination as the best means of controlling grader grass. Once the seed has germinated, however, shading has little effect on subsequent growth of the seedlings.

Under favourable conditions, growth is rapid and the plant can reach 2 m in 6 to 8 weeks. Flowering occurs within 5 to 6 weeks of germination, with ripe seed being present at 10 weeks.

Growth habit is variable. In pure stands under fertilized and moist conditions, plants of one to six tillers grow erect to over 2 m and contain very little leaf. In regularly mown lawns or headlands, the plants keep sending up new tillers and can set seed at a height of less than 10 cm.

In a grass species evaluation experiment at Mackay in 1978, grader grass yields (as a weed) of over 3000 kg per ha were recorded after 3 months' growth. Leaf to stem ratios were around 1:4. Although visually the ratio appears to be wider, grader grass stems are hollow (pithy) and light weight.

Spread

Grader grass has poorly developed mechanisms for the natural movement of seed over long distances. However once it is established, its prolific habit ensures rapid development into dense stands.

New infestations over long distances usually result from the transport of seed by introduced carriers such as vehicles, machinery or human activities.

Usefulness

Grader grass is readily eaten by stock between the stages of germination and flowering. After flowering, stock avoid grader grass although some people claim that horses will graze the mature ripe seed-heads over winter. The leaf percentage of grader grass is low and the plant matures rapidly and then dies. It is therefore edible for only a short period of the season.

Chemical analyses were carried out on samples of grader grass and some improved pasture grasses collected from a property near Mackay in 1973. At the pre-flowering stage (March) grader grass had similar protein value (leaf and stem) to *Kazungula setaria* (*Setaria sphacelata* var. *sericea*) and angleton grass (*Dichanthium aristatum*) although Hamil grass and grazed *Kazungula* had higher values. In mature plants (May) grader grass leaf had similar protein levels to *Kazungula setaria* leaves but its stems had lower values than those of *setaria*.

Control

Control through management

Avoid grass fires, heavy stocking, short mowing and soil disturbance of any areas where grader grass is present or likely to invade. These practices allow light to penetrate to the soil surface and provide an ideal seedbed for germination.

Sown pastures should be maintained in a vigorous state by moderate stocking and adequate fertilizer applications. Experience has shown that most perennial sown pasture species, if adequately fertilized, will prevent grader grass establishment in the second year. Where grader grass is very dense, autumn sowing of pastures is recommended for frost-free areas. Being a summer-growing annual, its competition to the establishing pasture is greatly reduced.

Where grader grass has established, slashing in the flowering to soft seed stage will reduce the amount of seed available in the following year.

Spot spraying with 'Gramoxone' will kill grader grass (pre-seeding) and allow perennial species to recover.

If grader grass invades native pastures in lower rainfall areas, control may be more difficult. This problem is now highlighted in the lower Peninsula areas where grader grass has spread into native pastures on heavy soils with 700 to 1 000 mm rainfall.

Early indications suggest that control methods successful on the wet coast may be less effective in this drier environment. In these areas, native pastures have a more open canopy and are much less competitive than sown pastures on the coast. Fewer improved pasture species are available for sowing in these inland areas and those which are successful also have an open canopy. Bush fires are often a problem too.

However, the basic principles still apply and over-stocking will have to be avoided at all costs. The use of fire as a management practice in extensive pasture systems may have to be modified, with burning only every 3 to 4 years where excess growth accumulates. The rate of infestation of native pasture would be expected to be slower than for wet coastal areas.

Cultivation areas have to rely on cultural and chemical means of control.

Orchards and gardens have to rely on cultivation or the growing of heavy cover crops, and heavy mulching around trees.

Seeds Legislation

The Agricultural Standards (Seeds) Regulations of 1969 were amended in January 1981 to make grader grass a restricted seed with 500 the maximum allowable number of seeds per kilogram of crop seed.

Crop or pasture seeds containing less than 501 grader grass seeds per kilogram may be sold provided the seed is labelled with a warning 'RESTRICTED SEEDS PRESENT'. The label must also state the common name of each restricted seed and the number present per kilogram of crop or pasture seed.

Examination of seed testing laboratory records showed that grader grass had been identified in commercial seed samples of most tropical legume and grass species. While it is well known that machinery, vehicles and livestock are significant carriers of grader grass seed, it was considered that restricting it would assist landholders with clean properties to avoid introducing grader grass when buying pasture seeds.

Seed recognition

The seed of grader grass is 6 to 7 mm long with the pointed base rather blunt or rounded. The awn is sometimes attached. The elongated caryopsis (kernel) is usually found enclosed in smooth brown bracts (see figure 2).

The seed of kangaroo grass is similar but larger (8 to 14 mm long) and has a sharp-pointed callus at the base.

Chemical control

Knock-down sprays

'Gramoxone' at 400 mL to 200 L (30 mL to 15 L) of water plus a non ionic wetting agent such as

'Agral-60' will give a good kill of plants from seedlings up to knee height. If plants are past this growth stage, a repeat application when seed is at the soft dough stage will prevent the development of fertile seed.

Gramoxone is most suitable for non-crop areas but may be used with care in certain crop situations. However, specific recommendations should be obtained for these from your local D.P.I. extension officer.

Pre-emergence spray

'Treflan' incorporated into the soil at planting time will give control of grader grass for approximately 3 months in legume seed crops.

Treflan can also be used to control grader grass in plant or ratoon sugar cane as long as care is taken to incorporate it into the top 10 cm of soil. Specific recommendations should be obtained for the use of Treflan in crops.

Conclusions

Although grader grass can be controlled by the use of chemical sprays, experience indicates that sensible management practices will greatly reduce any problems caused by its presence.

In the drier monsoonal tropics, graziers and departmental officers will have to work together to devise management practices which will reduce its impact on these extensive pasture areas.

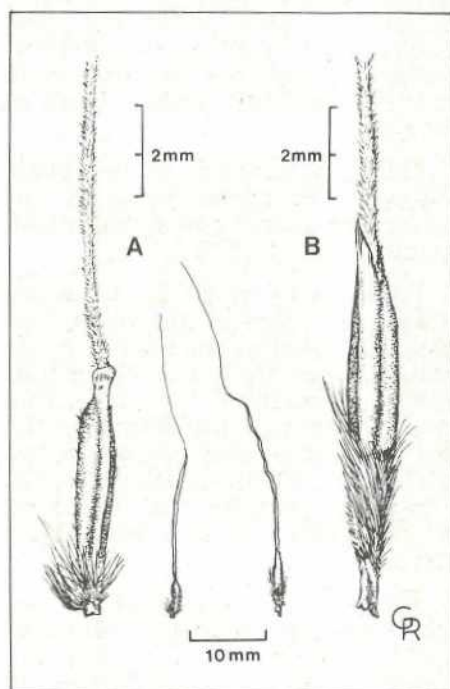


Figure 2. Seeds (including associated attachments) of grader grass (A) and kangaroo grass (B).

Central boar performance testing

by Dr C. P. McPhee, Husbandry Research Branch

Performance testing of boars began at the Rocklea Testing Station in 1969. Since then, the number of boars tested per year has grown from 100 to 440.

The capacity of the station is small in relation to the total Queensland pig population. Entry is therefore restricted to boars likely to have a high genetic impact on the whole population. To date, this has meant concentrating on boars bred by Queensland Large White and Landrace studs.

Testing is now being extended to non-stud herds who conduct their own performance testing programmes and sell breeding stock. The advantages of station over other forms of performance testing include greater accuracy and the ability to compare boars from different herds.

Conduct of the test

The present form of the test was introduced in 1978. Boars are received in littermate pairs at the station at approximately 20 kg live-weight. At first, boars from different herds are mixed in outside pens before being moved into the Station at 40 kg. This pre-testing phase serves to even-out differences between groups due to variation in the environments of their herds of origin.

Shortly after arrival at the station, boars are Halothane tested for the malignant hyperthermia gene which causes P.S.S. and P.S.E.

From 50 kg to 90 kg, boars are subject to rigidly controlled performance testing conditions in the station. They are kept in single pens under conditions of controlled temperature and humidity and are fed as much as they can eat in two 20 minute periods each day. The feed is a practical diet based on wheat, barley and soya bean and is fed moist.

Each boar is weighed weekly and his food consumption measured daily to estimate food conversion efficiency. When his weekly weight is nearest to 90 kg, fat depths are measured at the shoulder, mid-back, side (P₂ and K) and loin positions

using an ultrasonic instrument. Boars which fail the performance test are slaughtered and carcass measurements taken as a check on the echo-soundings.

Health and physical soundness

Boars are accepted for testing only from herds which are free from brucellosis and which have a generally good health record. On entry to the station all boars are dewormed, treated for possible leptospirosis, sprayed for external parasites and examined for physical soundness. Boars are under veterinary supervision throughout the test and on completion are given a thorough physical examination, particularly for leg soundness.

A post-mortem examination is carried out on all boars slaughtered. Before sending boars which have passed the test back to their owners they are transferred from the station to a shed specially designed to allow exercise and acclimatisation to outside weather conditions.

Assessing the results

The performance test is an expensive way of rearing a boar but it is carried out because it gives more information about the genetic merit of a boar than is usually available when he is reared on the farm. Genetic merit can, of course, never be known exactly. If it could, breeding would be a relatively easy operation.

No performance test is completely accurate. All it does is improve the chances of picking a valuable boar. There will undoubtedly be high-performing boars whose offspring perform disappointingly, but there will be more whose offspring are an improvement on previous generations.

Pig breeders are in a more fortunate position than most other livestock breeders. A great deal of information has now been collected on the inter-relationships and heritabilities of those measurements taken on boars in the performance test. This information is used to combine all the measurements into

an overall score using the mathematical procedure of linear programming developed and used in animal breeding for over 40 years.

The decision on which tested boar to use is based on a score and not on individual measurements. This score reflects the ability of the boar to sire profitable offspring—the profit being the difference between the value of the carcass to the consumer and the cost of producing it. Even if a breeder knows the measurements, it is extremely difficult for him to choose which tested boar to use. No amount of experience could lead to as accurate a combination of all the different measurements taken as the score whose calculation is based on years of experimentation and observation.

Interpreting the points score

The score is adjusted so that the average boar receives 100 points. Boars which receive more than 100 points are approved as sires, and those that receive fewer than 100 points are slaughtered. There is no upper limit to the point score, although most pigs will receive fewer than 200 total points. Using this system in scoring, we expect one boar in two will score 100 or more and one boar in 50 will score 140 or more.

The score is divided into two halves. The first half is a score for economy of production and reflects the genetic potential of the boar for rate and efficiency of growth. The second half of the score gives information on carcass quality and reflects the boar's genetic potential for producing a lean carcass.

The value of points

The value of points can best be seen by examining the improvement in the pig population by using tested boars.

If the average score of the pig population were raised by 10 points in this way, then the monetary return from each pig would be 76c greater than before. An improvement of 20 points would be worth twice as much (that is \$1.52).

TABLE 1

Character	Average performance		% heritability
	Large White	Landrace	
Gain on test (kg/day)	0.87	0.89	64
Age at 90 kg liveweight (days)	170	169	31
Food conversion ratio (food/gain)	2.65	2.75	64
Fat depth: (mm)—shoulder	38.7	36.3	17
Fat depth: (mm)—mid back	19.2	18.3	42
Fat depth: (mm)—P ₂	19.4	19.4	42
Fat depth: (mm)—K	27.3	27.2	33
Fat depth: (mm)—loin	18.8	18.8	39
Score—economy of production	50	50	50
Score—carcass quality	50	50	46
Score—total	100	100	51

TABLE 2

Trait	Percentage of variation between boars caused by—		
	Genes	Farm environment	Maternal environment
Daily gain	64	0	6
Age at 90 kg	31	21	23
F.C.R.	64	0	3
Av. fat	35	7	14
Economy score	50	0	2
Carcass score	46	3	7
Total score	51	0	6

TABLE 3

Breeder	Boars tested	Boars approved
	Landrace	
Fowler	53	30
Goodwin	6	2
Kimber	2	1
Kajewski	17	10
Learmont	14	5
Lorenz	35	13
Patch	7	3
Peters	8	5
Robin	62	28
Trout	51	29
	Large White	
Cotter	66	38
Franke	7	2
Freeman	10	3
Kajewski	10	3
Lucas	5	3
Mathiesen	30	17
Patch	2	2
Robin	6	2
Trout	25	16

Results

There has been a steady improvement of about 6 points per year in the performance of boars sent to Rocklea for testing. This means that over the past 5 years, the average value of each pig produced by a testing herd has increased by \$2.28.

Multiplying this figure by all the pigs sold for slaughter from testing herds and from commercial herds which buy breeding stock from them, gives a very worthwhile contribution by the station to the profitability of the Queensland pig population.

The 6 point annual improvement also means that a boar tested now is automatically 6 points better than a boar receiving the same score 1 year ago.

Another benefit from station testing not expressed in the score is the reduction in the number of stress-susceptible pigs reacting to the Halothane test. In the past 4 years, the incidence of reactor boars in Landrace has dropped from 6% to 4%.

Analysis of results

The performances of 1001 Large White and Landrace boars tested at Rocklea since 1978 were analysed. Table 1 gives averages and estimates of heritability of the various characters measured during testing.

The following conclusions were drawn from the analysis (table 1):

- Growth rates, both on test (50 to 90 kg) and from birth to 90 kg were similar for both breeds.
- Large Whites were more efficient food converters than Landrace. It is estimated that they eat 9 kg less food to bacon weight than do Landrace.
- Both breeds had similar levels of fat, with the exception of the shoulder position where Large White were fatter than Landrace.
- The most important characters had medium to high heritabilities (gain on test—64%, food conversion ratio—64% and P₂ fat—42%).
- Of all the measures of back-fat, the P₂ is the most satisfactory. It has a reasonably high heritability and is strongly related to fat measurement taken at other positions.
- The trait with most influence on a boar's test station score is the food conversion ratio.

Several causes of variation in the performance of station-tested boars were investigated. There were (i) genetic, (ii) the environment of the farm of origin, and (iii) the maternal environment of the dam. The percentage of variation in performance traits accounted for by these causes is given in table 2.

For accuracy in performance testing, the contribution to boar variation from genes should be a maximum and from farm and maternal environment a minimum. Daily gain and F.C.R. are very satisfactory from this point of view. Average fat is less satisfactory, having 14% of its variation derived from maternal environment.

As expected, age at 90 kg has very large contributions from both farm and maternal environment. For this reason, this trait is not used in evaluating boar performance. Total score which is used to select or reject boars after testing has a satisfactorily large contribution from genes (51%) and low contributions from farm and maternal environment (0 to 6%).

Herd summary

Table 3 shows the number of boars for each breeder which completed testing in 1980-81 in a physically sound condition, and the number which were approved for use as sires.

Superior sires

Sires with more than eight sons tested at Rocklea during the period 1979-1981 were investigated. The best 10 of each breed on the basis of the average scores of all of their tested sons are listed in Table 4.

Of the 20 sires listed, four were imported, 11 were the sons of previously tested sires and five were the sons of untested Australian sires.

TABLE 4
LANDRACE

Sires			Sons		
Reg. No.	Name	QAR* No.	Tested	Approved	Score
37402	Moonlight Rainlover 1632...	930	15	12	123
	Freemont Seabird 2nd.....	Imp	8	5	119
39674	Northlea Valiant Lad 8714..	1085	31	24	117
33996	Turua Reality 760.....	..	11	7	115
39661	Blaxland Super Don 3214...	1125	13	7	113
39047	Lorenshell Superboy 730....	1098	12	8	111
39761	Caminda Rainlover 3653....	1041	12	7	110
33929	Lorenshell Supreme Lad 82..	..	12	7	107
	Freemont Dromus 31.....	Imp	18	12	106
38607	Caminda Royal Promise				
	3301.....	978	10	5	106
LARGE WHITE					
98080	Cefn Field Marshall 135.....	..	18	16	129
1864	Olaroy Major Morgan 492...	1138	24	15	120
	Millerlea Silver King (NZ)...	Imp	10	6	115
99197	Olaroy Blackhawk 107.....	987	21	13	110
99830	Delvue Kingston 6308.....	..	12	7	106
	Millerlea Blackhawk.....	Imp	18	9	102
529	Naiken Field Marshall 1978..	1036	36	18	100
100010	Olaroy Field Marshall 678...	1200	12	5	99
94503	Olaroy Blackhawk 760.....	845	10	4	99
94249	Delvue Ace 4411.....	..	10	4	87

*QAR—Queensland Advance Register.

Queensland in Royal Commission on Meat

THE Minister for Primary Industries, Mr Mike Ahern, M.L.A., announced that, in view of the very wide terms of reference for a Royal Commission and following a meeting with senior representatives of Queensland meat industry organisations, the Queensland Government would co-operate with the Commonwealth in an inquiry into the Australian meat export industry.

Mr Ahern said: 'The export meat trade is extremely complex and the Queensland Government will therefore be recommending to the Commonwealth that senior counsel should be appointed to assist the Commissioner. Queensland stands ready to nominate a suitable person.

'The State Government also considers that a senior representative from private enterprise with experience in all aspects of the meat trade should be appointed to the staff of the Royal Commission.'

Mr Ahern said: 'It is essential that the Royal Commission brings down its findings as soon as possible. The Queensland Government still considers that the inquiry should have been restricted to Victoria. Nevertheless, since the Commonwealth has seen fit to extend the inquiry, Queensland must co-operate. However, an extension into the domestic market can only delay the inquiry and at this stage, would serve no useful purpose. If the Royal Commission produces clear evidence

that an inquiry into the domestic meat inspection system in Queensland is justified, naturally we will re-consider our position.'

Mr Ahern added that the reported statement by the president of the Commonwealth Meat Inspectors' Association, Mr Vince Long, criticizing Queensland's inspection service was completely unwarranted.

'The Queensland meat inspection service is the most efficient in Australia, and serves as a model for others to follow. Ours is the only meat inspection service in the country which controls the production, processing and selling of meat for human consumption, throughout the marketing chain,' Mr Ahern said.

Bracken fern—a threat to stock

By I. C. Douglas, Veterinary Services Branch

Poisoning of stock by bracken fern (*Pteridium esculentum*) is a common occurrence throughout much of Queensland's high rainfall areas. This article looks at the problem of poisoning and suggests some methods of control.

Common bracken (*Pteridium esculentum*) occurs in the high rainfall areas of all Australian states. In addition, northern bracken (*Pteridium garrabense*) and hairy bracken (*Pteridium revolutum*) are found in north Queensland. Bracken often becomes abundant in degraded pastures and in forest country.

Poisoning of horses

Bracken contains an enzyme which breaks down thiamine (vitamin B1) in the diet. Signs of thiamine deficiency result. Initially, an affected horse's movements will appear unco-ordinated. This will be followed by staggering and difficulty in standing. Collapse, convulsions and death may follow.

Poisoning of cattle

Cattle are poisoned by bracken in an entirely different way from horses. Affected cattle show no signs of thiamine deficiency. The factor responsible for toxicity in cattle has not been identified, but it appears to act by preventing the animal from making certain blood cells.

The cells responsible for blood clotting are reduced in number and internal bleeding occurs. Poisoned cattle will often die suddenly without showing any symptoms. Other cattle will have a high temperature and will be listless with a poor appetite. Blood may be found in the urine and dung.

Post mortem

Multiple haemorrhages are seen under the skin and throughout the viscera at post mortem examination of affected cattle. Inflammation and ulceration may be seen in the stomachs and intestines. Often blood will accumulate in the intestines.



The young frond on the left is more toxic than the older frond.



Note the erect stem and shallow root system.



Close-up of the frond.

Calves

Another form of poisoning occurs in calves. Blood may accumulate in the loose folds of the throat causing difficulty in breathing and swelling in the neck. Death is preceded by fever.

Treatment and control

Horses can be successfully treated by injections or supplements of thiamine. Treatment of cattle is difficult and is only likely to be successful in mild cases. Prevention of this disease is preferable to treatment.

Large amounts of bracken (in excess of 50 kg) must be eaten to

produce illness. Young fronds are more toxic than old fronds. Although dry fronds are less toxic than green fronds, these may be eaten in larger quantities.

Most cases of poisoning follow times when alternative feed is lacking or when overstocking occurs. Drying fronds following slashing and exposed roots following ploughing are particularly dangerous. Hay containing bracken is especially toxic.

Young calves are most susceptible. Calves may intentionally seek out bracken and selectively eat the young fronds.

Eradication of bracken fern can be difficult, especially if the paddock is

hilly or contains gullies. Mowing or slashing can be effective if undertaken when the new shoots have just developed. Chemical control is generally not successful.

Healthy pastures will compete strongly with bracken fern. Burning and overstocking will favour bracken rather than useful grasses and legumes.

Grazing of heavily infested pastures should be avoided, especially when feed is scarce. Supplementary feeding and the provision of phosphorus licks may be necessary. Calves should not be given access to infested areas.

Cabinet approves Soil Conservation Committee

STATE Cabinet has approved the formation of a planning committee to study Queensland's future soil conservation needs.

The Minister for Primary Industries, Mr Mike Ahern, M.L.A., said the committee would investigate all aspects of soil erosion control in Queensland and advise on the best way of using the State's resources to combat this serious problem.

Mr Ahern announced that Mr Don Eather, General President of the Queensland Graingrowers' Association would be chairman of the committee, together with the following members: Messrs Ivan Middleton (Chairman, Northern Downs Advisory Group Committee); Gordon Savage (Chairman, Cambooya Shire Council); Bill Allen (Chairman, Atherton Shire Council); Fred Soper (Vice-Chairman, Queensland Canegrowers' Executive); Jim Turnbull (Assistant Commissioner, Queensland Water Resources Commission); Wally Baker (Member, Land Administration Commission); and Keith

Trudgian (Division of Land Utilisation, Department of Primary Industries). Mr Trudgian will also act as Secretary of the Committee.

Mr Ahern added that the main terms of reference of the committee would include:

- development of possible roles for agricultural industries and local authorities in servicing the soil conservation needs of the community in association with soil conservation officers of the Department of Primary Industries;
- examination of trusts based on local authorities or other bodies, in accepting leadership by promoting and organizing soil conservation practices and raising funds for community works;
- investigation of ways and means of improving the present soil conservation service to farmers and the State, through legal, financial, administrative and technical matters; and
- examination of any other proposals which might improve

soil conservation practice in the State.

Mr Ahern said that the control and prevention of soil erosion throughout the State, particularly in the expanding cane growing areas of north Queensland and the grain growing areas of central and southern Queensland, where the soil erosion risks are high in newly developed country is of paramount importance.

He said: 'It is a big problem but it must be done. It must be tackled on a community basis. It is not just the farmer's problem. Fertile soil is part of our heritage and we cannot allow it to be continually eroded away. At present, new areas of farming land, particularly in central Queensland and on the western Downs, are being opened up at a faster rate than we can provide conservation services. Therefore, the need for conservation work is urgent.'

Mr Ahern added that the planning committee would report to Cabinet with their recommendations within 12 months.

Wheat in the southern brigalow

by G. B. Brooks, Commonwealth Department of Primary Industry

Over the past 25 years there has been a dramatic change in the major production emphasis in the southern brigalow region of Queensland.

Sheep enterprises had dominated primary production since initial settlement, but now the region contributes nearly one-half the area of Queensland's wheat crop (see figure 1).

The social, technical and economic changes which have occurred in the region, and in the wheat and sheep industries in general, have contributed to the increase in wheat production. Such development and changes in production emphasis have been paralleled in other regions of Australia such as the Mallee district of Victoria and in Western Australia.

Brigalow development

The southern brigalow region covers the brigalow lands of the Waggamba, Tara, Balonne, Murilla, Warroo, and Bendemere Shires. These lands are characterized by deep, gilgaied clay and clay-loam soils of good water-holding capacity with moderate phosphate and high nitrogen content.

These soils are readily identified by the brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) scrub which dominates the vegetation on such soils. The brigalow-belah soils are the most highly sought after agricultural soils in the region.

The ability to modify the brigalow-belah vegetation of the prime agricultural soils of the region—this is, to transform the virgin scrub to clean cultivation—has been a major problem. The brigalow-belah scrub forms very dense stands which regrow quickly after disturbance.

Ringbarking and burning was the only method of land clearing up until the 1950s. After 1960, when the first large crawler tractors were introduced, large areas of land were able to be cleared at a fraction of the time and cost previously possible. The control of regrowth after initial clearing has been, and continues to be, a problem. However, the establishment of crops and sown pastures, and improved chemical techniques have given more effective control of regrowth in recent years.

As well as assisting quicker land clearing, improvements in machinery technology in the 1950s and 1960s have also made large scale cultivation, sowing, and harvesting possible. Increases in tractor power, and the introduction of four-wheel-drive tractors, have contributed greatly to the expansion in cropping.

The clay and clay-loam soils most suited to cropping are heavy and difficult to work. Powerful machinery is necessary to cultivate large areas adequately and efficiently. Such large areas, characteristic of the southern brigalow, must be cropped to compensate for the relatively modest long term average yields obtained in the region.

Climate

It seems, from the available data, that the climate of the southern brigalow region has always had the potential for successful winter crop production. Table 1 shows the mean and median monthly rainfall for

Goondiwindi, Tara, and Dalby. Dalby has been an established wheat growing centre for over 100 years.

The figures for the two centres in the southern brigalow region are a little lower in total than that of Dalby, but are fairly similar over the growing period for winter cereals, especially those for Goondiwindi. Rainfall variability in the southern brigalow region is low compared with other similar regions (see table 2) such as the wheat growing district around Emerald.

A contributing factor to the recent development in the southern brigalow region has been the better rainfall years experienced since 1946. Figure 2 shows the annual rainfall figures for 100 years at Goondiwindi. During the 20-year dry period between 1925 and 1945, below average rainfall was received in 14 years, while in the 33 years since 1946, below average rainfall has fallen in only 14 years.

With only 100 years of data, it is impossible to say whether the 20-year dry period was a freak

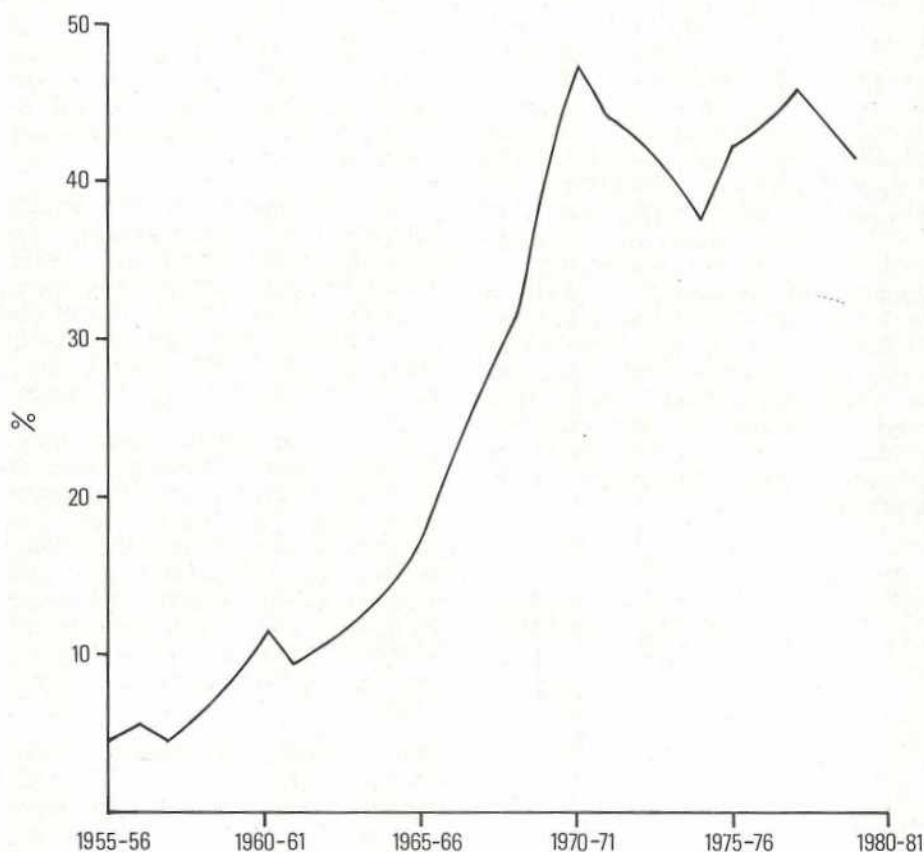


Figure 1. Percentage of Queensland's wheat area contributed by the southern brigalow region.

TABLE 1 Mean (a) and Median (b) Rainfall (mm) for Tara, Goondiwindi and Dalby

Centre	Years of records	Period		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Tara.....	61	1912-73	a	82	67	64	34	33	39	37	27	27	55	63	86	612
			b	64	43	49	27	24	32	32	17	18	48	53	67	616
Goondiwindi	94	1879-1973	a	79	69	59	34	40	42	41	34	38	48	59	71	613
			b	64	53	39	26	32	30	35	27	32	39	47	61	604
Dalby	101	1872-1973	a	86	77	68	35	32	42	41	30	40	57	70	93	669
			b	78	56	56	30	23	30	34	21	33	50	57	77	674

Source: Bureau of Meteorology.

occurrence or part of some climatic cycle. It is felt that the increase in annual average rainfall since 1946 has been a return to more normal rainfall patterns, rather than a succession of good seasons.

Such a succession of poor seasons between 1925 and 1945 would obviously have had an increasingly detrimental effect on the natural vegetation of the region. Farmers' views of the climate and its potential to support cropping must have been adversely affected by the 20-year dry period. Given these poor seasons, and the state of agricultural technology at that time, cash cropping would have been extremely hazardous. These conditions would have contributed to the postponement of large scale cropping activities until the early 1960s in the southern brigalow region.

History and development

Primary production in the southern brigalow region was largely confined to sheep, and to a lesser extent, cattle enterprises up until the 1950s. Large areas of brigalow country were first cleared by settlers in the Tara Shire around 1900. Major agricultural development did not occur until much later, but isolated interest was shown in crops such as wheat, oats, maize, lucerne, grapes, and tobacco. In 1910 at Goondiwindi, 50 t of grain and 100 t of hay were harvested from 40 ha, while another grower harvested 26 t of wheat from 19 ha. These yields tend to indicate that the soils and climate of the region had the potential for successful grain production.

TABLE 2 Percentage Variability of Annual Rainfall for Tara, Goondiwindi, Dalby and Emerald.

Centre	% variability
Tara.....	19
Goondiwindi	20
Dalby	20
Emerald	25

Source: Bureau of Meteorology.

All major towns in the southern brigalow region had railway connections by 1920. Most of these were short agricultural links developed for the encouragement of agricultural settlement rather than as purely commercial enterprises. The introduction of the railways solved many of the time and cost problems of transporting produce to coastal centres. It also promoted communication and stimulated town growth.

Efforts to establish closer settlement in the 1910s and 1920s failed, and contributed to a deep-seated mistrust of cropping. The main reason for the failure of close settlement programmes was a basic misunderstanding of the needs of agriculture in that environment. The size of holdings in these programmes were too small, and land with poor agricultural soils were chosen.

Prickly pear had a major impact on land use and development from the late 1800s until the early 1930s. Of the area affected, 80% was in Queensland. The most affected regions were the Tara and Waggamba Shires where one-half to two-thirds of the area suffered heavy infestation.

This infestation saw the virtual elimination of land suitable for cropping in the 1910s and 1920s because the pear seemed to seek out the prime brigalow-belah soils of the region. Prickly pear had practically disappeared by 1932, 6 years after the release of the *Cactoblastis* moth.

Also, in the 1920s, wheat prices fell significantly. Wheatgrowers at this time incurred a socially inferior status due to their debt to government and private institutions. Success, in both economic and social terms, for wheatgrowers in the 1920s and 1930s was seen to be influenced less by circumstances than by the mental outlook of the farmers.

The slump in wheat prices continued into the 1930s with government intervention in the form of a 'grow more wheat' campaign, and promises of price supports being necessary. These price supports did

not materialize, however, and this further worsened the position of wheatgrowers.

During the period from the mid 1920s to World War II, the southern brigalow region was in the grip of an extensive dry period. When this was combined with the factors mentioned above, it was not difficult to see why existing wheatgrowers were forced out of the industry, and any entry into wheatgrowing would have been effectively discouraged.

After World War II, the first stage of the Wheat Stabilization Scheme was implemented, which provided a guaranteed price equal to costs. This guaranteed price was well below world prices, however, and did not give the anticipated incentive to produce more wheat. By the end of the 1940s, the social status of wheatgrowers had changed as a result of their increased political power and the creation of wheatgrowers' associations. Subsequent stages of the Wheat Stabilization Scheme provided more attractive returns for growers.

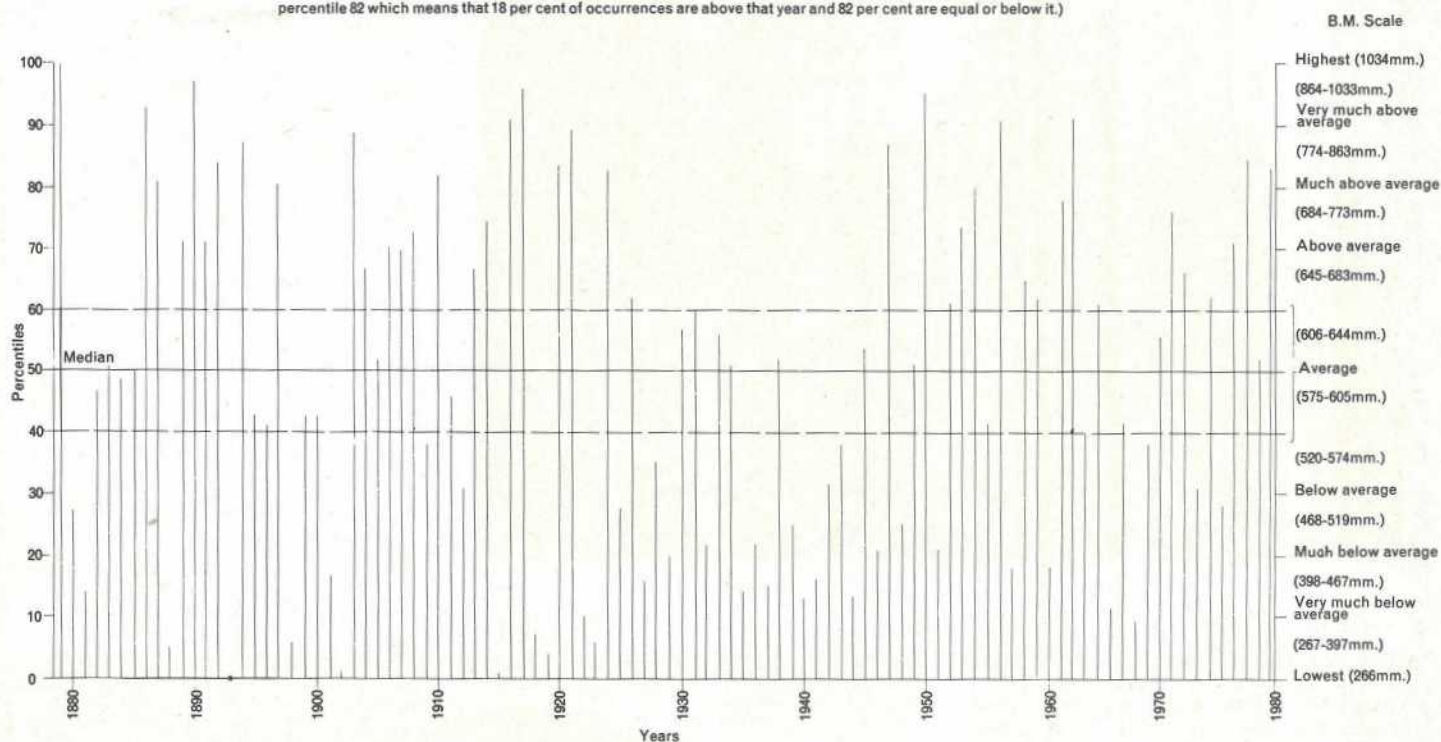
Some other factors contributing to the delay in the establishment of large scale cropping included insufficient knowledge of dryland farming techniques, a reluctance by established graziers to undertake new enterprises, damage to small and isolated areas of crop by kangaroos, pigs, and galahs, and uncertainty as to the form of primary production for which the region was best suited.

The 1950s and 1960s saw many significant changes, both within and outside the southern brigalow region which contributed to the transition to large scale cropping. There was a return to better climatic conditions after the dry period between 1925 and 1945.

The 1950s and 1960s saw dramatic increases in agricultural machinery technology which was a world-wide phenomenon. Graziers were also in a better financial position due to record high prices for wool during the Korean War.

GOONDIWINDI P.O. (Rainfall Percentiles 1879-1979)

(Percentiles show the ranking of each annual total within the period of record, e.g. for 1910 the total rainfall is at percentile 82 which means that 18 per cent of occurrences are above that year and 82 per cent are equal or below it.)



* Rainfall totals for 1893 not available

Note: B.M. Scale shows the official scale of deciles as used by the Bureau of Meteorology. Relevant rainfall levels for Goondiwindi are included as a guide

Figure 2. Source: Compiled from data supplied by the Bureau of Meteorology.

These conditions, combined with tax concessions and increased availability of manpower, created a situation where investments and property improvements were possible and practical.

Also, the average size of properties in the region decreased in the late 1950s and 1960s. This meant that land had to be used more intensively, which virtually forced farmers to undertake property improvement schemes. By this time, most farmers had the machinery and equipment to commence cropping, even if only on a small scale. The decision to undertake cash cropping seemed to depend largely on the quality of land on each individual farm, and the owner's confidence in that land to produce sufficient and consistent yields.

Another major influence on the transition to cropping was the effects of the 1965-66 drought. It appeared that few properties were affected by the drought so seriously that the owners were forced to leave the industry. However, poor liquidity and cash flow situations virtually forced many graziers into wheat production. This move into wheat production was reinforced by the wool price slump of the 1960s, and the relatively attractive wheat prices which gave wheat a better per ha return. Restocking costs were high after the drought, and wheat

production provided a good, quick method of generating income.

The services and facilities to support modern agriculture had to be gradually developed in the southern brigalow region, in keeping with the overall development of the region. Bulk handling facilities for wheat have consistently lagged behind production levels. Before 1962, all wheat in the region had to be bagged, transported to railway sidings and loaded manually. The main centres of the region are now well equipped to service the needs of modern agriculture, while adequate storage facilities are located close to producing areas throughout the region.

Wheat has become the dominant crop in the southern brigalow region, and has continually shown to be a reliable and highly profitable enterprise. The profitability of wheat production seems to have been capitalized into higher land values. Indications are that this trend will continue with more land being cleared for cultivation and more intensive use being made of current cultivated areas.

The development of any region involves a complex interaction of technical, economic and social factors which need time to evolve. The expansion of cropping into the southern brigalow region has been

essentially an experiment to test the limits of successful winter cereal production in Queensland's near south-west.

Along with this move, the technology of semi-arid agriculture has developed to handle increasingly harsh environments. Unlike the early experience in South Australia, this experiment has been successful, and wheat production will hold a permanent and dominant position in the future of the southern brigalow region.

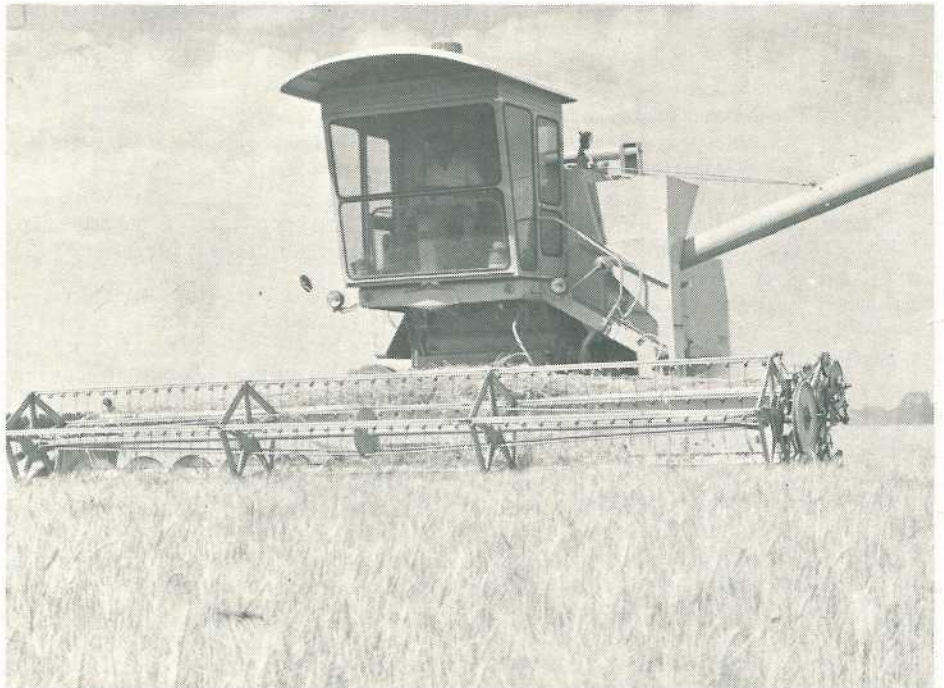
A parallel may be drawn between the development which is almost complete in the southern brigalow region, and recent development in the Mackay hinterland. There again, large tracts of brigalow lands are being cleared and developed for cropping.

Similar triggering factors for rapid development can be seen in the two regions. Some of these include the availability of appropriate agricultural technology, reduction in property size, provision of transport, storage facilities and other services, and favourable commodity prices.

The development of the southern brigalow region has identified the need for the integrated planning of regional services and facilities in order to realize the agricultural potential of the region.



Since the early 1960s, about 250 000 ha of the brigalow country in the southern part of Queensland have been transformed into wheatfields like that in the lower picture. These developed brigalow and brigalow-belah lands are making a substantial contribution to the State's grain production.



Historical series

This article is the first in a series dealing with subjects of general historical interest. Articles of this kind will be published from time to time over the next few years leading up to the Department of Primary Industries' centenary in 1987.

Preparation of the articles has been arranged by Extension Officer Mr Peter Lloyd, of Agriculture Branch, who is secretary of the Department's Centenary Committee.

Growing new lucernes in Queensland

by D. Gramshaw, D. L. Lloyd and K. F. Lowe, Agriculture Branch

Deciding which cultivar of lucerne (*Medicago sativa*) to grow for hay or grazing has become more difficult. The reasons for this difficulty have been the appearance of spotted alfalfa and blue-green aphids, and the subsequent availability of a considerable number of imported, aphid-resistant lucernes.

The Queensland Department of Primary Industries has completed 2 years of research and observation on the new lucernes and can now offer advice. The aim of this article is to help lucerne growers choose the best cultivar for their situation by providing information on:

- Plant attributes to consider in selecting a cultivar.
- Specific attributes of the imported compared to Australian cultivars.
- Performance of imported lucernes in D.P.I. field trials.

Management practices particularly relevant to the use of new lucernes, future cultivar prospects, and current D.P.I. research are also explained.

Criteria for choosing cultivars

The life of a lucerne stand is shorter in Queensland (figure 1) than in the southern States. This is due to the warm and periodically wet conditions which favour fungal diseases and, at times, lead to plant injury attributable directly to soil waterlogging.

Cultivars adapted to, or bred for, southern Australian or overseas conditions therefore may not be well adapted to Queensland. An ideal cultivar for the subtropics would have the following characteristics:

- Disease resistance.
- Aphid resistance.
- Tolerance of both waterlogging and drought.
- A growth rhythm suitable for both hay and grazing.

Disease resistance

The fungal organisms *Phytophthora megasperma* f. sp. *medicaginis*, causing root rot, and *Colletotrichum*

trifolii, causing first anthracnose and later crown rot, play a major role in reducing lucerne plant populations.

As phytophthora root rot is favoured by wet soils, cultivars resistant to this disease should be selected for the heavier, slow-draining soils. Irrigation can

intensify the problem on these soils. Even in drier regions, periodic wet spells can result in an outbreak of the disease.

Anthrachnose and crown rot develop most rapidly when humid conditions occur within the lucerne canopy during the warmer months.

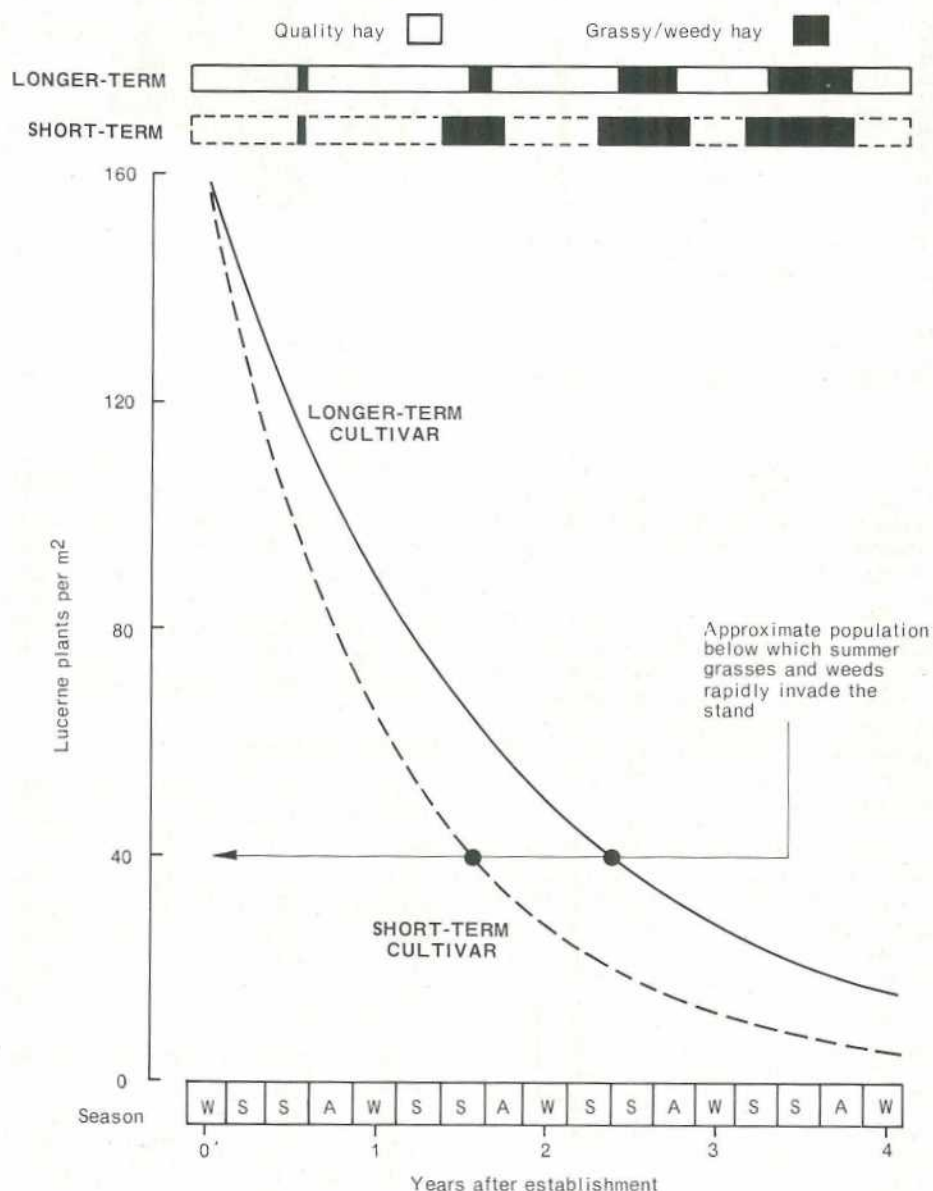


Figure 1. Typical decline of lucerne populations under irrigation in Queensland for short and longer term cultivars. The effects of lucerne population reduction on hay quality are also illustrated.

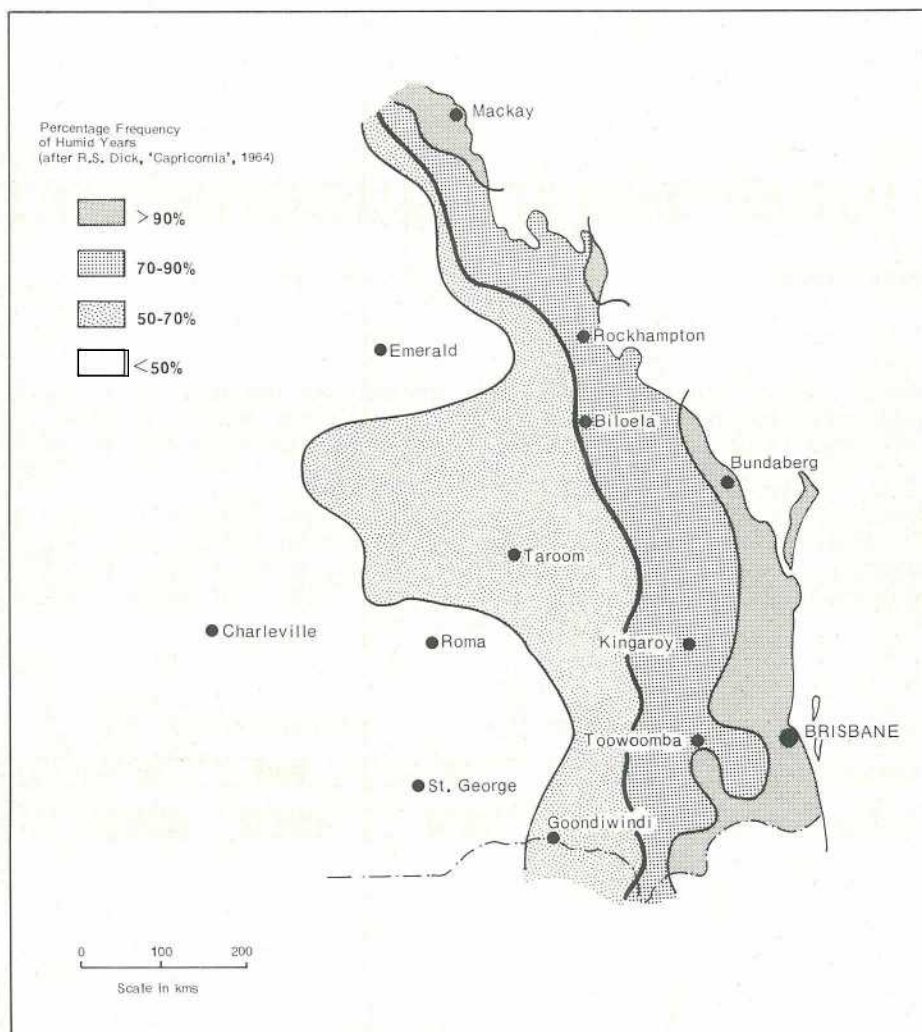


Figure 2. Humidity zones in south-east and central Queensland.

Lucerne grown in the humid eastern regions is likely to be more seriously affected by these disorders than lucerne grown in the drier regions further west.

The line separating these regions can be seen in figure 2. It passes just west of Biloela, Kingaroy and Toowoomba. A cultivar having some resistance to *Colletotrichum trifolii* is considered essential in the humid regions if a longer-term stand is desired.

Root canker, caused by the fungus *Rhizoctonia solani*, is also present in some areas. This disease is confined principally to soils with restricted drainage in areas receiving less than 650 mm average annual rainfall.

It has been found commonly on heavy soils in open downs country of the Balonne-Maranoa basin and sometimes on brigalow lands. It rarely occurs in irrigated stands, and no epidemics have so far been reported for stands on well-drained alluviums. Lucerne breeders have not specifically selected for resistance to *Rhizoctonia*, and the reaction of new cultivars to this disease is unknown.

A number of different leaf diseases occur widely in Queensland. They can contribute to leaf drop which decreases quality and, to a lesser extent, quantity of hay. These diseases rarely kill plants. Their effects are normally only severe when mowing is delayed well past the optimum growth stage of cutting.

Aphid resistance

Spotted alfalfa aphids and blue-green aphids are the most damaging pests of lucerne in Queensland.

Devastation followed their first appearance in 1977. Aphid infestations have subsequently been mainly light to moderate, with severe outbreaks occurring in a sporadic and often localized pattern.

The Department recommends the use of aphid resistant lucernes to:

- Provide increased protection in the seedling stage, when lucerne is extremely susceptible to aphids.
- Decrease the use of insecticides in established hay stands, which helps to retain natural enemies of the aphids.

- Reduce the chance for the development of insecticide-resistant aphid biotypes.
- Protect lucerne used in extensively grazed pastures where chemical control of aphids is usually uneconomic.

Both aphids infest and damage lucerne stands in the humid regions, but spotted alfalfa aphid causes most damage in drier regions.

It is stressed that cultivars possessing lower levels of resistance to aphids may require some chemical protection against even small numbers of aphids at the seedling stage, and against severe infestations after establishment in high-value hay stands. A decision to plant lucerne susceptible to spotted alfalfa aphid damage implies a commitment to chemical control of damaging populations, should they occur.

Lucerne leafroller can also damage stands. So far, there is no evidence to suggest that the new lucernes react differently from Hunter River to attacks from this pest.

Waterlogging and drought

Lucerne plants can be weakened and killed by physiological stresses associated either with excess water in the soil or prolonged dry periods. The potential for these stresses is greatest where lucerne is grown on heavy clays or shallow-surfaced soils possessing water-impermeable subsoils. The relative susceptibility of cultivars to both waterlogging and drought has yet to be determined.

Growth rhythm and winter dormancy

Cultivars can have winter growth potential ranging from dormant through to highly non-dormant (or highly active). The expression of winter dormancy is determined by the ability of a cultivar to grow at low temperatures during shorter days.

Seedling growth and regrowth from established plants of non-dormant cultivars in winter is faster than that from semi-dormant cultivars. The highly non-dormant lucernes are therefore an attractive proposition for hay because they grow well when hay prices are normally the highest.

Semi-dormant cultivars have a growth rhythm like Hunter River and in winter take longer to regrow between hay cuts compared with the non-dormant cultivars. Dormant cultivars grow very slowly in winter and are not recommended for a purely hay enterprise. Dormant

cultivars are also inferior to semi-dormant cultivars for grazing because they are unable to produce well at a time of the year when high-protein feed is at a premium.

Dormant and semi-dormant lucernes have lower crowns and more numerous and finer stems than non-dormant lucernes. Many growers consider that these characteristics are advantageous for persistence of plants subjected to grazing, but the experimental evidence is inconclusive. Non-dormant cultivars have one advantage for grazing by growing quickly in response to light to moderate rains in winter.

Attributes of new lucernes

Table 1 presents the attributes of imported and Australian cultivars. Except where otherwise indicated, the information was obtained from D.P.I. field plantings at Gatton, Toowoomba and Biloela.

Cultivars are listed in order of increasing winter growth potential. Comparisons of cultivars for resistance to diseases and aphids are based on four categories ranging from susceptible through to resistant. These categories indicate only the relative degree of resistance and it is emphasised that resistant lucernes are not totally resistant or immune.

None of the lucernes available have high levels of resistance to all the attributes previously indicated as desirable for lucerne in Queensland. Therefore, in choosing a cultivar, a decision needs to be reached as to which attributes are most important for each particular situation.

For example, if a short-term, irrigated hay stand is required on slow-draining soil, the emphasis ought to be on a highly non-dormant and phytophthora-resistant lucerne. Should a longer-term hay stand be preferred on a similar soil situated in a humid region, then resistance to anthracnose would be an additional requirement. For a longer-term grazing stand in drier regions, resistances to spotted aphid and phytophthora root rot would be most important. Growers needing assistance to define their specific requirements are advised to consult their local D.P.I. extension officer.

Performance of new cultivars

Imported and Australian lucernes have been compared for production and persistence in D.P.I. experiments since 1978. In these experiments, aphids were controlled during the seedling phase. Also, all cultivars, once well established, were

compared with and without spraying to control potentially damaging aphid infestations. No response to spraying occurred, however, due to the reduced aphid populations experienced after 1978.

Irrigated experiments

Two irrigated sites were established, one on a reasonably free-draining loamy clay at Biloela, and the other on a slower-draining heavy black clay, known to contain *Phytophthora megasperma* at Gatton. The main points from the results obtained over the first 2 years and presented in table 2 are:

- Reduced yields from all cultivars associated with the phytophthora root rot epidemic at Gatton, where differences in yield among cultivars were related mainly to their relative resistance to that disease.
- A 10–15% annual (25% in winter) yield advantage only during the first year after planting for highly non-dormant compared to semi-dormant cultivars at Biloela, where root rot was a minor factor.

- A longer-term persistence pattern approaching that shown in figure 1 exhibited by only Matador in the highly non-dormant category, and by all of the semi-dormant lucernes at Biloela; notably, the most persistent cultivars have some resistance to both root rot and crown rot (table 1).

- Similar production among cultivars within the same dormancy category in the absence of severe root rot.

Research results have not been presented for non-dormant cultivars. These had lower yields and no better persistence than the least persistent of the highly non-dormant cultivars. Therefore, they would be an inferior choice for hay or grazing.

Rain-grown experiments

Planting was on three different soil types—a basaltic, red clay loam at Toowoomba, a sedimentary clay at Mitchell and an alluvial, loamy clay at Biloela.

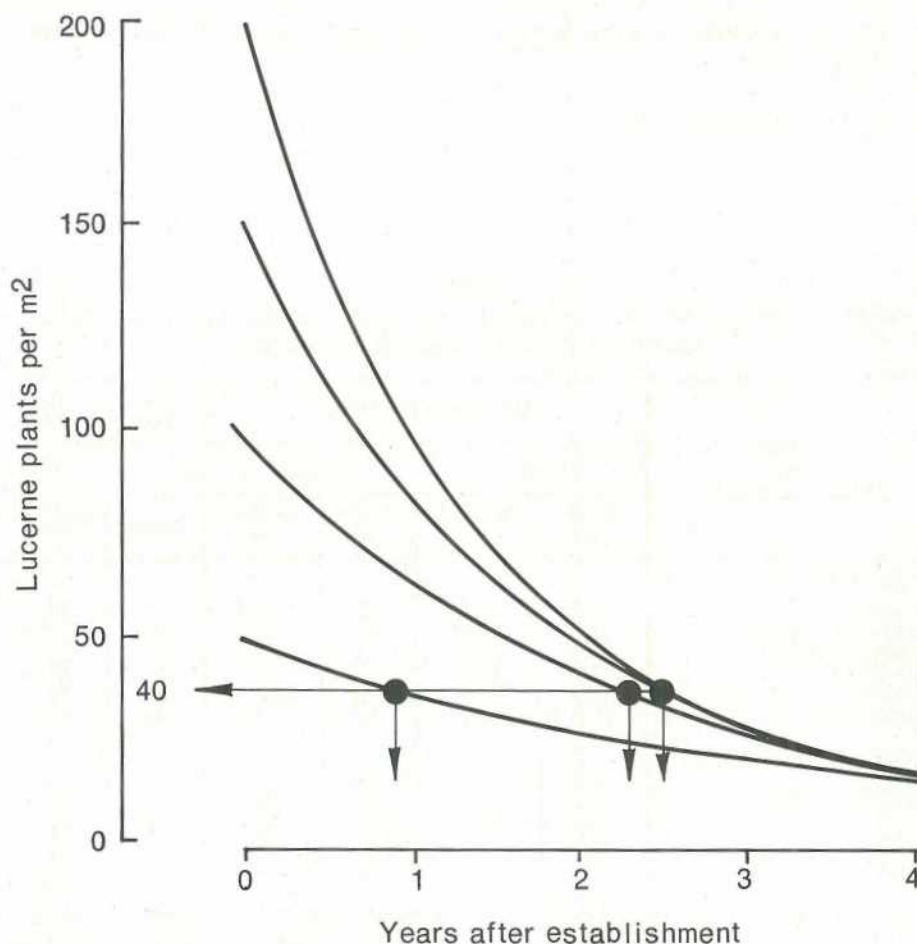


Figure 3. Lucerne population decline from different established populations under irrigation. The time population remains above the critical 40 plants per m^2 is maximized provided that established populations equal or exceed 150 plants per m^2 .

TABLE 1

Winter dormancy, aphid and disease resistance of imported and Australian lucernes. Numbers indicate increasing relative resistance from susceptible (1) to resistant (4)

Cultivar	Spotted alfalfa aphid	Blue-green aphid	Phytophthora root rot	Anthracnose
DORMANT				
Pioneer Brand 545.....	3	2	4	3
AS 49R.....	3	1	2	1
Pioneer Brand 531.....	2	1	2	3
WL 311.....	2	2	2	2
SEMI-DORMANT				
Nova*.....	4†	1†	n.a.	n.a.
Falkiner*.....	2	1	4	2
DeKalb 167.....	3	2	4	2
Condura 73 Brand.....	3	1	2	2
Pioneer Brand 581.....	3	2	3	2
Hunter River*.....	1	1	1	3
DeKalb 185.....	3	2	3	2
NON-DORMANT				
AS 13R.....	3	2	3	1
WL 318.....	3	1	2	2
Amador.....	2	1	4	1
WL 451.....	3	1	3	2
WL 514.....	4	3	2	1
WL 512.....	4	1	2	1
HIGHLY NON-DORMANT				
WL 508.....	4	2	2	1
Siriver*.....	4	3	n.a.	n.a.
Matador.....	3	1	3	2
Pioneer Brand 572.....	4	1	2	1
Maxidor.....	4**	2**	n.a.	n.a.
Paravivo*.....	1	1	1	1
CUF 101.....	4	3	4	1

* Australian cultivars. Note that Siriver is highly non-dormant and not a Hunter River type.

** United States data.

† New South Wales data.

n.a. Information not available.

At both Toowoomba and Biloela, the cultivars Matador, CUF 101, Pioneer Brand 581 and Falkiner performed best. Condura 73 Brand, WL 451, DeKalb 167 and 185, and Pioneer Brand 545 also showed some merit at one or the other of the two sites, but not at both. Extreme drought conditions unfortunately precluded comparisons at Mitchell.

Some growers have experienced difficulty in managing imported lucernes. This has led to a trend back to Hunter River, particularly since aphid numbers have moderated. The management problems seem to have arisen because the first plantings after the aphids appeared were mainly with highly non-dormant cultivars, and these certainly require different management to semi-dormant types like Hunter River.

Our results clearly show that a number of aphid-resistant, semi-dormant lucernes offer growth characteristics and stand persistence at least equal to, and in some instances superior to, Hunter River. It would be wise to plant these cultivars in preference to Hunter River in most situations where a semi-dormant lucerne is desired.

Hunter River definitely cannot be recommended where chemical control of aphids is uneconomic or impracticable, or where phytophthora root rot is known to be a problem.

TABLE 2

Production and persistence over 2 years of the best imported lucernes at two irrigated sites. Australian* cultivars are included for comparison.

Cultivar and Winter dormancy	Dry matter yield (t/ha)				Plants/m ² after 2 years††	
	Biloela		Gatton†			
	First year	Second year	First year	Second year	Biloela	Gatton
SEMI-DORMANT						
DeKalb 167	22.3	23.1	12.0	11.3	37	24
Condura 73 Brand	22.3	22.8	10.9	10.9	40	20
Pioneer Brand 581	23.0	24.5	12.5	12.9	44	26
DeKalb 185	22.5	23.6	11.6	11.5	35	27
Falkiner*	22.3	23.3	12.9	13.2	42	18
Hunter River*	22.9	22.1	6.8	7.2	40	10
HIGHLY NON-DORMANT						
Matador	25.7	23.8	12.3	12.4	35	29
Pioneer Brand 572	25.3	23.3	12.4	11.6	22	23
CUF 101	25.3	23.8	16.1	15.4	26	26
Paravivo*	25.8	24.0	8.9	7.9	25	11

† Severe epidemic of phytophthora root rot occurred at Gatton within 3 months of planting.

†† Establishment populations among cultivars and between sites were similar and averaged 160 plants/m².

Management

Important aspects of lucerne management are summarized in table 3. This will be a help particularly to growers planting lucerne for the first time. There are, however, three areas of management relevant to the use of new lucernes which warrant additional information.

Seeding rates

Research has shown that the persistence of hay stands is maximized when established populations are 150 plants per m² or more (figure 3). This can be achieved with 9 to 10 kg per ha of seed if seedbeds are well prepared and irrigation is adequate for germination.

Seeding rates as high as 20 kg per ha have been used commercially in the past—principally to combat weeds. However, with the higher cost of imported lucerne seed, the use of appropriate herbicides is a cheaper way to control weeds.

TABLE 3

Lucerne Management Check-list

General recommendations for lucerne growing and management are summarised in the following table. For more detailed advice, particularly on rates, methods and timing of applications for herbicides and insecticides, consult your local D.P.I. extension officer.

MANAGEMENT FACTOR	RECOMMENDATION			
Soil	Preferably deep, fertile, well-drained, neutral to alkaline (pH 6.5–7.5). Acid soils with pH 6.0–6.5 can be used with liming.			
Planting	Intended Use	Pure Lucerne for Hay	Pure Lucerne for Grazing	Lucerne/Grass Mixtures for Grazing
	Seed rate	8–10 kg/ha	6–8 kg per ha (4–6 kg per ha if in rows) Use lower rates for drier districts.	1–3 kg/ha
	Companion grasses	None	None	Green, Gatton and makarikari panics, Rhodes grass or buffel grass.
	Sowing depth	0–2 cm, harrowed	1–4 cm depending on soil type and depth of seed-bed moisture.	
	Seed treatment	Group A peat inoculum in situations where lucerne or annual medics not previously grown. Lime pelleting if soil is acid or seed sown with acidic fertilizer.		
	Seedbed	Fine, firm, weed-free and moist.		
	Sowing time	Preferably April to June. Avoid summer period when weeds compete strongly against lucerne seedlings.		
Fertilizer	Lucerne requires a highly fertile soil to attain its production potential. The need for fertilizer varies with soil type and paddock history.			
Irrigation	A total annual supply of irrigation plus rainfall of 1 500 mm allows potential hay yields to be attained. Frequency of application decreases from summer to winter and varies according to soil type. Avoid over-watering slow-draining soils. Risk of waterlogging injury in summer can be reduced by applying irrigation at times other than during the 5 days on either side of cutting.			
Mowing	Mow at either one-tenth bloom or when new shoots emerge from the crown, but before these exceed the cutting height. Allow new stands to become well established before the first cut, except where a severe weed problem necessitates earlier cutting.			
Hay curing	Avoid raking hay that is too dry to minimize leaf shattering. Potassium carbonate applied at cutting hastens drying and preserves good colour. Baling when too moist causes moulding and increases the risk of fire in storage.			
Grazing	Strategic spelling or rotational grazing is necessary. Bloat of cattle can occur on pure lucerne and is most severe when growth is immature, especially if damp from irrigation or dew.			
Weed control	Herbicide(s)		Weed Species	
	Benfluralin Chlorthal		Most annual grasses and some small-seeded broad-leaved weeds.	
	Atrazine		Broad-leaved weeds, in particular mint weed.	
	2,4–DB		Broad-leaved weeds.	
	2,2–DPA		Most annual grasses and seedling perennial grasses in established lucerne. Seedling grasses less than 8 cm tall in seedling lucerne at a lower rate of application.	
Insect control	Insecticide(s)		Insects	
	Disulfoton		Protection from spotted and blue-green aphids for 4–6 weeks in the seedling stage. Granules drilled in with the seed.	
	Pirimicarb (3)* Thiometon (3) Demeton-S-methyl (3) Dimethoate (7)		Spotted and blue-green aphids on seedlings or established plants.	
	Carbaryl (1) Methidithion (7)		Leafroller. Methidithion will kill both leafroller and aphids and should be used when both pests are present in damaging numbers. The preferred treatment for leafroller is early cutting.	
	Carbaryl (1) Methomyl (3)		Heliothis. This pest is rarely a problem. Carbaryl is the preferred chemical.	

* The withholding period (number of days) after spraying is indicated in brackets.

Mowing

Traditional advice for producing hay is to cut at early bloom when about one-tenth of the shoots are in flower. This advice is of limited use in winter when flowering does not occur readily. A second criterion, generally applicable throughout the year, is to cut after the next crop of shoots commences elongating from the crown but before these exceed the height of cutting. This stage extends over some 5 days in summer increasing to about 10 days in winter. Timing of cuts according to these guidelines ensures that yield and quality of hay and persistence of stand are all optimised.

Non-dormant lucernes generally reach and pass through the optimum stage for cutting faster than semi-dormant lucernes, particularly in winter, and consequently there is less flexibility for cutting. Delaying mowing for too long after the optimum stage usually results in leaf drop before cutting and the formation of thicker stems which take longer to cure. These factors seriously reduce hay quality. Consistently mowing too early will jeopardise long-term production and stand life.

A new technique in which a weak solution of potassium carbonate is sprayed onto the sward during mowing has reduced drying time and is now being used successfully by some hay producers.

Grazing

Some form of spelling or rotational grazing is essential to maximize the productive life of lucerne pastures. Heavy and continuous stocking results in the premature death of stands of all currently available lucernes, irrespective of their winter dormancy characteristics. If non-dormant cultivars are used in pastures, grazing management must be strict, with a short grazing duration and a recovery period that permits the stand to commence flowering.

Prospects and current research

Lucerne growers can expect to see a number of new cultivars become available over the next few years. These will come from breeding programmes initiated by the Queensland D.P.I., other State Departments of Agriculture and CSIRO, as well as from private companies. The principles explained in this article for selecting a cultivar can be applied to lucernes released in the near future.

A joint D.P.I./CSIRO lucerne breeding programme was commenced in Queensland in 1974 with the initial objective to develop cultivars with superior resistance to both phytophthora root rot and anthracnose. Following the occurrence of the aphids, the Queensland breeders recognized that the development of cultivars lacking high levels of combined resistance to aphids and diseases would have limited impact on the Queensland lucerne industry.

The breeding objectives were therefore revised to produce multiple

aphid and disease resistant lines likely to be better adapted to Queensland conditions. Development of a semi-dormant line based on Hunter River has now reached the field testing stage prior to release, and a non-dormant line is expected to reach the same stage within a year.

Other research being conducted by D.P.I. includes:

- Continuing field evaluation of new lucernes throughout the State's lucerne growing areas.
- Testing of selected new cultivars under grazing near Toowoomba.

- Assessment of the effects of a range of cutting frequencies on lucernes with different dormancies under irrigation at Biloela.
- Studies on the reactions of lucernes to waterlogging.
- Assessment of new herbicides for broadleaf and grass weed control in lucerne at Gatton.

Acknowledgements

Funding for research was provided by the Australian Meat Research Committee.

Evaluating cash and deferred payment alternatives

by R. J. Donnet, Economic Services Branch

PRIMARY producers are often faced with the decision to sell produce for cash now, or to sell on the basis of a part payment now with the balance as a deferred payment or payments.

This article gives basic guidelines for evaluating cash and deferred payment alternatives. It also provides an example of a ready-reckoner for converting deferred payments to their current cash equivalent.

The typical problem

A producer is faced with the alternative of selling a commodity on-farm for \$110 per tonne (cash now) or selling to another buyer and receiving a first payment \$95 per tonne (net on-farm after all transport and handling costs) with further payments of \$30 to follow (\$20 at the end of year 1 and \$10 at the end of year 2).

Which alternative should be selected; the cash price or the deferred payment alternative?

Selecting the correct alternative

A rational decision can be made only after calculating the current cash equivalent of the deferred payment alternative and comparing it with the cash price.

The current cash equivalent is calculated by discounting the deferred or future payments by a nominal interest rate which reflects your opportunity cost for money; that is, the current interest rate for borrowing or investment, depending on whether you are in overdraft or have a credit balance.

Discounted values (at 12% nominal)

Table 1 serves as a ready-reckoner for determining the current cash equivalents for various amounts of

TABLE 1

Current Cash Equivalent for Amounts to be Received in the Future
(Discount rate of 12% nominal)

Amount (\$)	Amount received at end of year (\$)			
	Year 1	Year 2	Year 3	Year 4
5.00	4.46	3.98	3.56	3.18
10.00	8.93	7.97*	7.12	6.36
15.00	13.39	11.96	10.68	9.53
20.00	17.86*	15.94	14.24	12.71
25.00	22.32	19.93	17.80	15.89
50.00	45.05	40.58	36.56	32.94
100.00	89.29	79.72	71.18	63.55

* Amounts used in the following example.

money to be received at different times in the future, using a nominal discount rate of 12%.

Interpreting discounted values

From table 1 the current cash equivalent of \$100 received at the end of 3 years is \$71.18. That is, if you invested \$71.18 at 12% (nominal) compound interest it would accumulate to \$100 by the end of the third year.

Alternatively, if you borrowed \$71.18 at 12% (nominal) you would have to repay a total of \$100 at the end of 3 years (principal plus interest).

Completing the calculation

To calculate the current cash equivalent of the deferred payment alternative quoted above, add the following amounts:

	\$
1. First Payment (now).....	95.00
2. Values from table 1	
\$20 (end year 1)	17.86
\$10 (end year 2)	7.97
	\$120.83

The current cash value of \$120.83 is \$10.83 better than the cash price of \$110.00

Consequently the commodity should be sold by the deferred payment option.

Implications

Care must be taken to ensure that the prices compared are identical in that they have been adjusted for any differences in handling, insurance and transport costs.

The amount of deferred payments, and their timing, are not always readily available and estimates may have to be used (based on local and export market information, and experience).

The selection of an appropriate discount rate is important. The rate must reflect the real opportunity cost or return for money. Therefore, an understanding of real and nominal interest rates is required.

The current cash equivalent value of deferred payment alternatives must be calculated before comparing them to 'cash price' offers.

Proper comparison of alternative prices implies good management and the opportunity for success.

Factors limiting lucerne production

by D. Gramshaw, Agriculture Branch

Diseases

Anthracnose and crown rot (*Colletotrichum trifolii*)

Anthracnose appears as oval lesions up to 25 mm long on stems. At first, lesions are brown or black but later they become bleached in the centre and speckled with dark fruiting bodies of the fungus causing the disease. Crown rot occurs when the fungus invades the crown from a lesion at the base of the shoots. Eventually the whole crown and the upper tap-root may be invaded, and plants are killed. Crown rot shows as a bluish-black discoloration merging into brown at the margins.

Single, dead shoots scattered throughout a stand indicate that the disease is active. Susceptible plants in the stand may die soon after crown invasion occurs, but more resistant plants are slowly weakened and die throughout the life of the stand. Infection is favoured by temperatures between 20 to 30°C and high humidity.

Root rot (*Phytophthora megasperma f. sp. medicaginis*)

This fungus produces a light-brown, constricted lesion up to 5 cm long on the tap-root. The discoloured areas may be close to, or as much as 30 cm away from, the crown. In severe cases, the tap-root is damaged to an extent that the lower part rots off. Shoot symptoms are yellowing, stunting and wilting.

Severe epidemics can quickly devastate a stand, but the disease often reduces production and causes a slow decline in plant numbers. Root rot is active when there is

excess water in the soil and soil temperatures are between 15 to 25°C, such as in spring and autumn. It is favoured in soils with poor internal drainage and is commonly found in depressions where irrigation water ponds for short periods.

Root canker (*Rhizoctonia solani*)

Symptoms include dark, sunken, circular spots on the tap-root and large lateral roots, with yellowing and wilting of the shoots.

Wet conditions following hot, dry weather favour this fungus. It is associated with decaying organic matter in the soil and consequently outbreaks seem to be confined to the first 12 to 18 months after planting. The disease occurs mainly in rain-grown stands on slow-draining soils and is rarely found on well-drained alluviums.

Insect pests

Spotted alfalfa aphid (*Therioaphis trifolii f. maculata*)

This aphid feeds mainly on the underside of lower leaves. It is pale yellow, with rows of black spots along its back. Damage is seen initially as yellowing or whitening of the leaf veins, followed by yellowing, curling and death of the lower leaves. Finally, the remaining terminal leaves may be killed.

Severe infestations lower production and thin stands. Sticky honey dew secreted by this aphid makes hay-making difficult, and a black mould that grows on the honey dew reduces hay quality.

Blue-green aphid (*Acyrtosiphon kondoi*)

The blue-green aphid prefers to feed on the upper portion of lucerne shoots. It varies in colour from pale greyish-green to dark greenish-blue.

Damage typically appears as retarded growth, shortened internodes and stunting, distorted leaves and yellowing.

Lucerne leafroller (*Merophyas divulsana*)

This pest is the larva (caterpillar) of a small moth. The larvae are 10 to 14 mm long and green with brown to black heads. They web the terminal leaves together for a shelter, where they also feed.

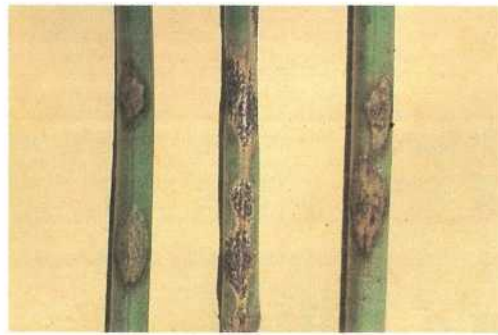
Severe infestations cause considerable defoliation and reduce yields, but plants are rarely killed.

Physiological injury

This type of injury is associated with the plant's inability to cope with extremes of soil moisture and is not caused by disease.

Waterlogging injury

Damage is caused by the production of cell-destroying substances in the root when oxygen supply is restricted during periods of severe waterlogging or flooding. Early symptoms are yellowing and wilting of shoots and the presence of localized, watery and soft areas on the tap-root.



Discrete and merging anthracnose stem lesions (*Colletotrichum trifolii*).



Single, dead shoots caused by anthracnose.

Factors limiting lucerne production



Crown rot (*Colletotrichum trifolii*).



Healthy, well-nodulated root.



Root rot (*Phytophthora megasperma*).



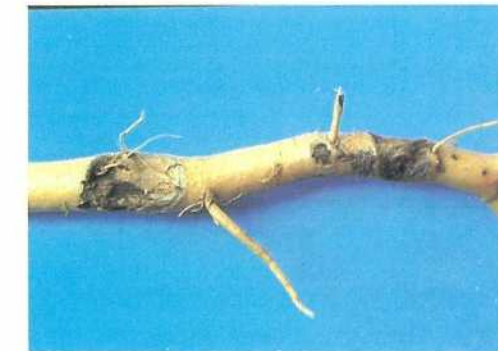
Severe root rot caused by *Phytophthora megasperma*.



Waterlogging injury.



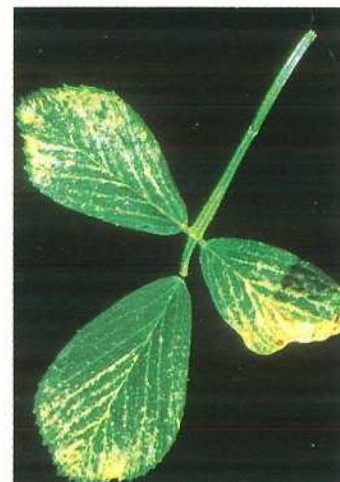
Root canker (*Rhizoctonia solani*).



Degenerate root cankers (*Rhizoctonia solani*).



Spotted alfalfa aphid (*Therioaphis trifolii* f. *maculata*).



Leaf damage caused by spotted alfalfa aphid.



A stand severely damaged by spotted alfalfa aphid. Photograph courtesy of Department of Agriculture, Victoria.



Blue-green aphid (*Acyrtosiphon kondoi*). Photograph courtesy of Department of Agriculture, Victoria.



Shoot infested by blue-green aphids.



Distortion, yellowing and stunting of the shoot tip caused by blue-green aphid



Lucerne leafroller (*Merophyas divulsana*) larva and pupa.

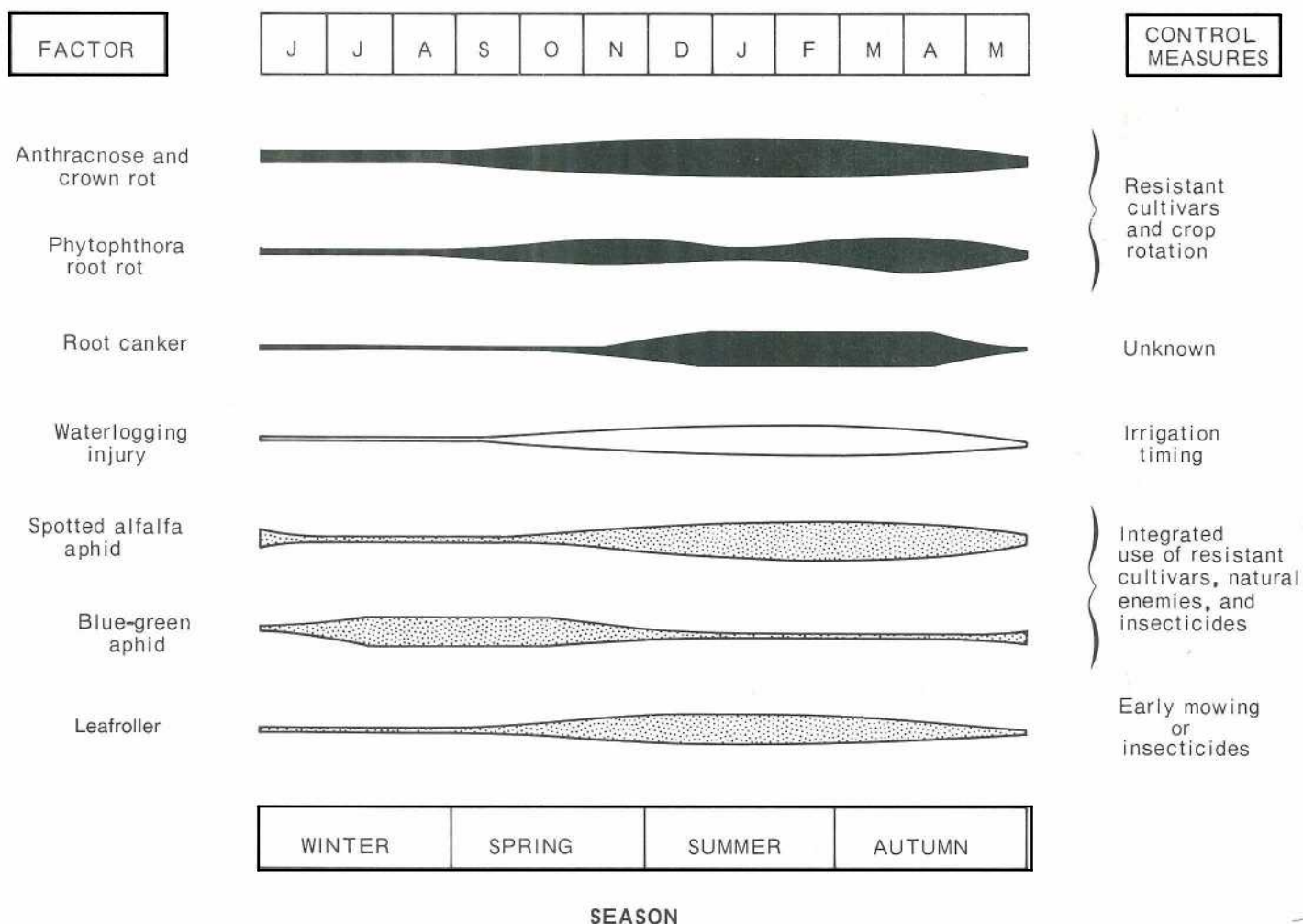


Terminal leaves webbed together by lucerne leafroller.



Severe infestation by lucerne leafroller.

MONTH



SEASON

Usual seasonal occurrence of important factors influencing the performance of lucerne

If waterlogging persists, shoots eventually take on a fawn-coloured, scorched appearance and most of the tap-root becomes pulpy and putrid. Plants approaching this stage seldom recover. The surface of affected roots sometimes has a greyish to black discoloration.

Injury becomes worse as the degree and duration of waterlogging increases and occurs most rapidly when soil temperatures are high. Plants with high root carbohydrate levels and small amounts of shoot are particularly susceptible. Stands approaching cutting and those recently cut are generally the most at risk.

Drought injury

Plants are desiccated to such a degree that they cannot function normally, even if favourable soil moisture conditions are restored. Following relief from prolonged drought, plants may produce weak shoots and then die.



Wildflowers of South-east Queensland

by Beryl A. Lebler, formerly of Botany Branch

Hymenosporum flavum is the native frangipanni

Allan Cunningham discovered this very beautiful plant just north of Newcastle at Port Stephens. Two Greek words *hymen* which means a membrane and *spora* meaning a seed, are combined to form the genetic name.

It describes the seeds which are flattened and surrounded by a membranous wing. The specific epithet means yellow and refers to the petals.

It is the seed structure which distinguishes this genus from the closely-related species of *Pittosporum*. In fact, this plant was originally described from flowering material only as *Pittosporum flavum*.

DESCRIPTION—This can be a handsome large scrub or a slender tree growing to a height of 20 cm in the rain-forests of north Queensland. The growth habit can vary, some plants having a short trunk and a moderately dense crown, while others have a slender erect trunk and widely-spaced whorls of branches.

The leaves are ovate-oblong or oblanceolate, with pointed tips. They can be up to 16 cm long and are dark green and shining on the upper surface and paler beneath. They are alternate and are arranged in a tight spiral on the new growth.

This plant flowers profusely with the flowers in loose terminal inflorescences. They are sweetly perfumed with a fragrance similar to that of the cultivated frangipanni, which is the reason for the common name of native frangipanni. Freshly-opened flowers have little perfume but the fragrance intensifies as the flowers age.

The buds are about 3 cm long and are on pedicels almost as long. Short, spreading hairs cover the young stems and are scattered over the young leaves and the peduncles. The calyx lobes are about 0.8 cm long and are green and pointed. The petals are united into a cylindrical tube about 2 cm long. At the end of

this tube, the free lobes spread to form a flat star up to 4 cm wide. The lobes are shorter than the tube and the blunt tips can be almost 1 cm wide. Five cream filaments extend beyond the end of the corolla tube and end in small anthers.

Magnification is necessary to see the short, silky hairs which form a dense covering on the outside of the corolla tube. This extends in a point up to the petals. The hairy style is longer than the corolla tube and ends in a green stigmatic point.

Freshly-opened flowers are the colour of rich cream. As the flowers age, the colour deepens to yellow and finally to a rich golden-yellow, often with a reddish flush at the base of the free lobes. When the petals fall from the flowers the silky hairy, cylindrical ovary can be seen.

The fruits are capsules which are, roughly pear-shaped, 3 to 4 cm long, and brown in colour. When

mature, they split into two thin leathery valves. Each capsule is tightly packed with numerous golden-brown seeds. These are flattened, with a nucleus which is longer than broad and surrounded by a thin, papery wing.

FLOWERING TIME—Native frangipanni flowers during spring.

HABITAT—It is a fairly common plant in rain-forests and is frequently found near creeks.

DISTRIBUTION—This plant grows in New South Wales and Queensland from as far south as the Hawkesbury River to as far north as the Atherton Tableland. It is also reported from New Guinea.

GENERAL REMARKS—Native frangipanni has been in cultivated for many years and is a favourite because of its brightly coloured, perfumed flowers.



Hymenosporum flavum

Regional milk production 1971-1980

by P. L. Lloyd, Extension Officer, Agriculture Branch

IN the 1980 Agricultural Census, Queensland dairy farmers were asked to report details of milk production during the year ended 31 March 1980. This information was last collected in 1971 and these figures provide the first regional break-up of milk production and production per cow since then.

In the regional pattern of total milk production, the two major changes since 1971 have been in the Wide Bay-Burnett where the share of State milk production dropped from 28 to 20%, and the Atherton Tableland which increased its share from 6 to 12%.

The regional pattern of production per cow has shown little change since 1971, with the greatest increases in productivity over the 10 years being recorded in the Moreton and Mackay regions.

Over the last 10 years, the industry has become more concentrated in the main producing Shires which are, in order of production, Beaudesert (Moreton Region), Eacham (Far Northern), Rosalie (Darling Downs), Widgee (Wide Bay-Burnett), and Albert (Moreton).

REGIONAL MILK PRODUCTION IN QUEENSLAND

Statistical Division (Region)	Total Production ('000 L)		Production per cow (L)		
	1971	1980	1971	1980	% increase
Moreton.....	288 331	208 020	1 708	2 223	30.2
Darling Downs	164 012	125 854	1 974	2 332	18.1
Wide Bay-Burnett	205 671	104 358	1 516	1 759	16.0
Far North	46 358	62 685	2 142	2 605	21.6
Fitzroy	32 307	14 888	1 354	1 603	18.4
Mackay.....	8 576	11 144	1 331	1 715	28.9
Other.....	2 306	295	..	..	..
QUEENSLAND TOTAL	747 561	527 344	1 695	2 132	25.8

Source: Australian Bureau of Statistics.



Cattle ticks more resistant to chemicals

THE discovery of a new strain of chemical-resistant tick had again shown that it was unwise to rely solely on chemicals for the control of cattle ticks.

A tick extension officer with the Department of Primary Industries at Laidley, Mr Trevor Reid, said that ticks from a central Queensland property were resistant to the Amidine group of dipping chemicals. This group included Dipofene, Taktic and Tifatol.

'The more frequently ticks are treated with a particular chemical, the sooner resistance will develop to that chemical. There is every chance that this new strain of resistance could develop in other areas in the near future,' said Mr Reid.

'Cattlemen will have to make more use of alternative methods of controlling cattle ticks and not rely so heavily on chemicals. Two avenues open to them are the use of tick-resistant cattle and pasture spelling,' he said. 'If chemicals are necessary, they should be used in a planned and effective manner. Indiscriminate over-use will quickly lead to resistance problems.'

He pointed out that, in south-east Queensland, ticks had been controlled effectively in susceptible herds by dipping five or six times between mid October and January at intervals not exceeding 21 days. Tick numbers then remained relatively small until autumn, when dipping was necessary only if tick numbers showed a marked increase.

Mr Reid said that surveys had revealed that many Zebu and tropical breed cattle were being over-dipped.

'Their natural tick resistance should enable them to go without dipping for most of the year, provided they have a 50% *Bos indicus* content,' he said. 'The small numbers of ticks they do carry should not cause any large build up of ticks on the pasture.'

Mr Reid emphasized that the success of any dipping programme depended on the use of an effective chemical at the correct strength and an efficient method of application.

He concluded, however, that in the light of the latest discovery of chemical-resistant ticks more emphasis would have to be placed on the non-chemical control of cattle ticks.

Water-table salting on the central coast

by V. G. Cummins and the late M. K. Benn, Soil Conservation Branch.

Water-table salting is a direct threat to the continued agricultural production from land on Queensland's Central Coast.

The productivity of some 5 000 ha of pastoral land and 500 ha of agricultural land has already been severely reduced by water-table salting. The original vegetation has been replaced by a sparse cover of less palatable salt-tolerant plants, restricting land use to grazing only.

Causes of salting

Three factors contribute to water-table salting on the Central Coast. These are:

- The partial clearing of large areas and/or the complete clearing of smaller areas of timber on upper slopes of deeply weathered rock types.
- Restricted subsurface and surface drainage.
- Overgrazing in potential salt out-break areas.

Overclearing

Deep-rooted trees on upper slopes transpire most of the soil water available. Removal of trees causes an excess of water in the soil profile, which moves downhill and raises the water-table at the base of the slope. Where there are dissolved salts in the groundwater and the water-table approaches the surface, wetting-up and drying-out of the surface throughout the year accumulates salt at the surface.

On the Central Coast, salt out-breaks have occurred in several land types. Saline seepages are associated only with deeply weathered rocks. No occurrences have been found with unweathered rocks. The largest out-breaks have been noted in broad depressions around the red lateritic scrub soils which have been cleared for cropping. The main areas where these lateritic soils are found are in the Barmoya and Rossmoya districts about 25 km north of Rockhampton.



The value of this land has been severely reduced by water-table salting.



Salt accumulates where drainage is restricted.

Extensive outbreaks have occurred along drainage lines, where widespread clearing of ironbark forest has occurred on deeply weathered granodiorite (a grey-coloured granite-like rock containing sodium feldspar). For example, salt outbreaks have occurred around Marlborough, north of Rockhampton; Ridglands and Gracemere, west of Rockhampton; and Marmor, south of Rockhampton.

Restricted drainage

Restricted drainage in lower parts of catchments contributes to the establishment of salt outbreaks in cleared susceptible land types.

Deeply cut streams on the lower slopes reduce salting problems by removing excess saline water in the stream flow.

Overgrazing

Overgrazing leaves the soil surface bare. This creates the conditions for increased upward movement (capillary rise) of saline water in the soil profile. As the bare surface dries out, salt will accumulate. This capillary action is more pronounced in heavier clay soils than in the more porous sandy soils.

The resultant surface accumulation of salt reduces plant cover even further and the increase in salt accumulation becomes progressively worse. Until the cycle is broken, rehabilitation of the affected area is impossible.

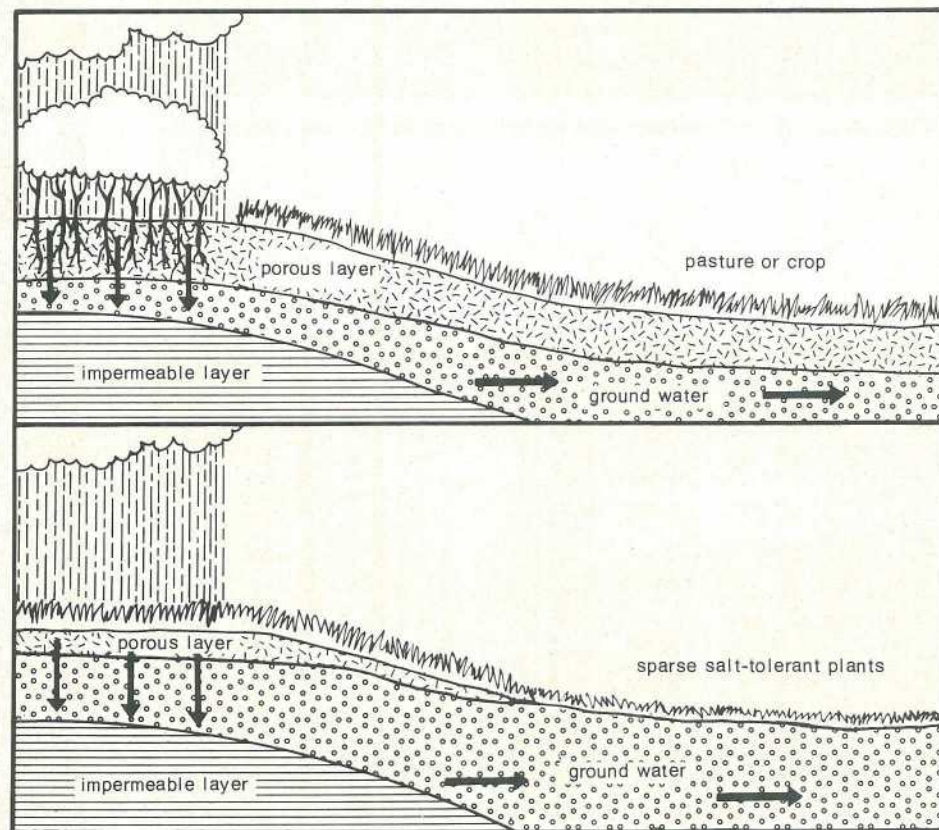
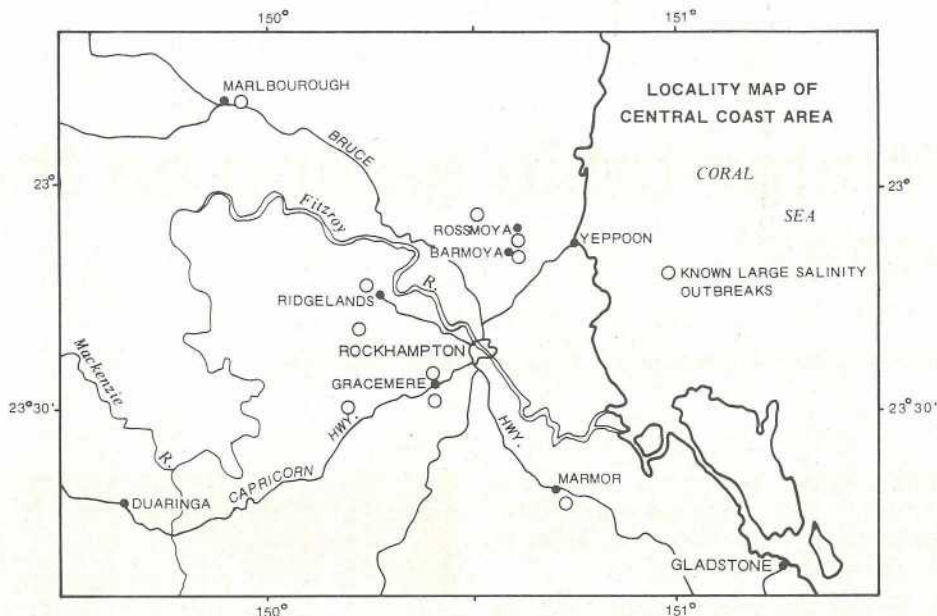


Diagram 1. When trees are cleared from upper slopes, less water is used up by the vegetation. The water-table rises and salt accumulation may occur.



Map 1.

Effects of salting

Loss in productivity

In excess of 500 ha of actual and potential cropland around Barmoya has been reduced to inferior grazing land due to the effects of water-table salting. This would represent a reduction in potential net cropping returns of about \$100 000 per annum.

It is difficult to assess economic losses to grazing land from salting due to the varying degrees of degradation. Scalded, bare areas and waterlogged areas are completely unproductive. The replacement of useful grass species by less productive salt-tolerant vegetation also causes an overall reduction in carrying capacities.

Estimates of the reduction in carrying capacities range from 30% in speargrass country to 70% for the more fertile scrub soils.

Increase in soil erosion

Saline areas are very susceptible to erosion because the soil is exposed to raindrop impact and run-off is increased. Erosion is accelerated because sodium in the soil reduces its structural stability so that it disperses or 'melts' readily when wet. The loss of soil structure and the hard-setting surface associated with the presence of sodium salts also increases run-off and predisposes the soil to gully erosion. These gullies, which are difficult to stabilize, often extend into adjacent productive areas.



Effect of overgrazing on salt accumulation.



An unproductive salt-affected area.

Prevention of salt damage

Prevention of water-table salting is much easier than the rehabilitation of salt-affected areas. Susceptible catchment areas should be preserved in their original state or at least 50% of the original vegetation, including the larger eucalypt trees, should be retained.

To prevent salt outbreaks in brigalow country, the clearing of upper slopes carrying softwood scrub should be avoided, as these are the known intake areas. Where extensive areas have been cleared, stocking rates must be adjusted to ensure that the valley floors always have a good grass cover.

Treatment of affected areas

The objectives of any treatment programme in affected areas are:

- To lower saline water-tables as much as possible.
- To reduce capillary action which brings dissolved salts to the surface.
- To establish useful salt-tolerant plant species in outbreak areas.

Lowering water-tables

Saline water-tables can be lowered by revegetating intake areas with deep-rooted trees or shrubs which utilize more water on the upper slopes. The density and placement of such vegetation particularly in large, cleared catchments is still an unknown factor but it seems likely that revegetating large areas will be difficult and costly.

It may be necessary to restore 50% or more of the original vegetation, either by a replanting programme or by allowing regrowth to reach maturity. Replanting of trees anywhere on hill crests and upper slopes will have an appreciable effect on the amount of water that enters the water-table and contributes to saline seepage on valley floors.

The revegetation of small catchment areas with productive, fast-growing, deep-rooted trees may reduce or at least arrest the spread of saline seepages. The browse legume *leucaena* (*Leucaena leucocephala*) has a worthwhile role in beef production on the Central Coast. The recommended management procedure of allowing the tree to reach maturity before grazing makes it a particularly useful species for water consumption on upper slopes.



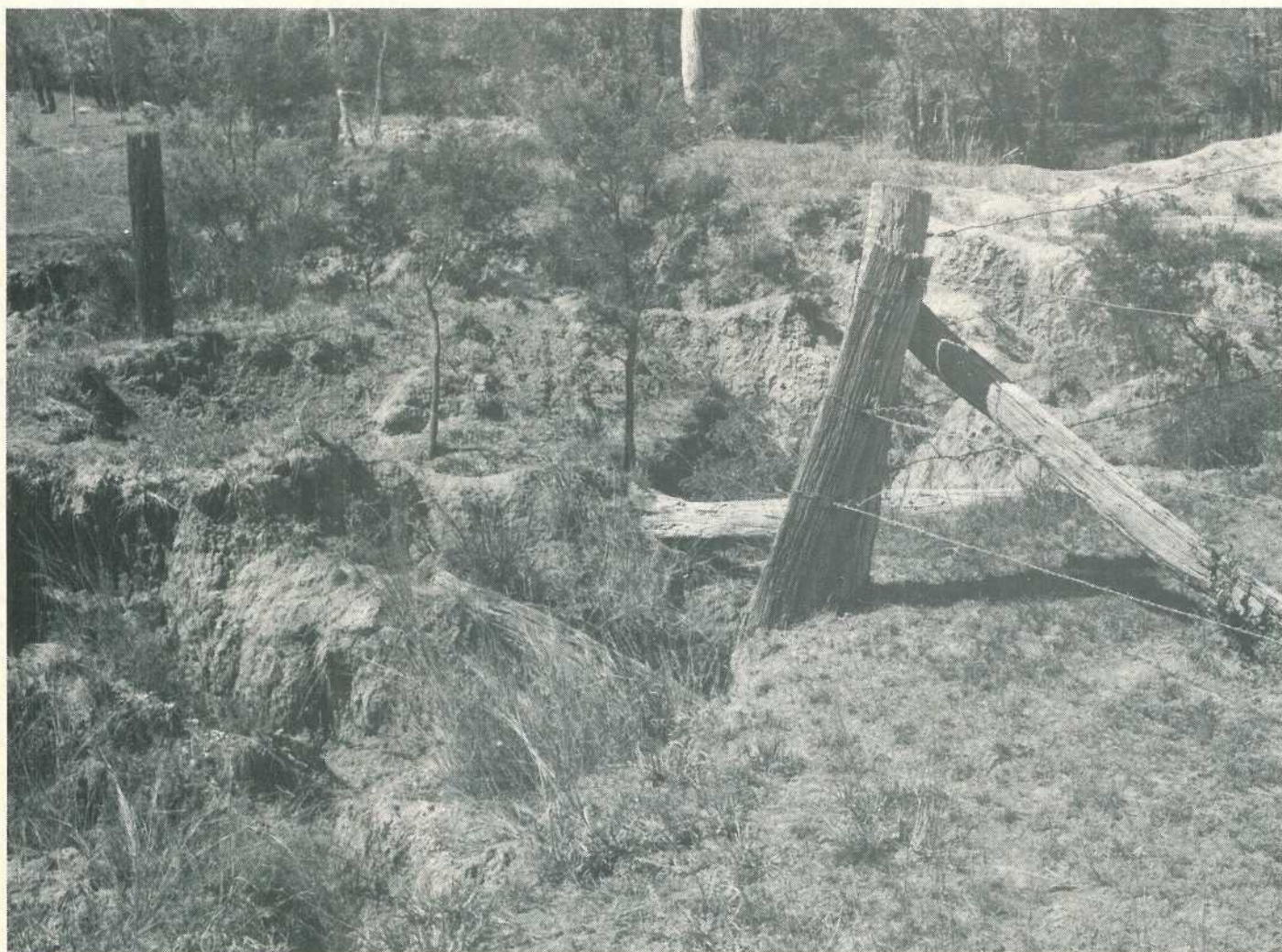
Salt accumulation increases gully erosion.



Mature leucaena trees tap soil water and are a valuable legume source for cattle.



Salt water and marine couches thrive in saline areas and can be grazed by stock.



Black tea-trees help stabilize gullies in salt land.

A trial to determine the effectiveness of leucaena in lowering a saline water-table in a small catchment is being undertaken at Tanby, east of Rockhampton. It will be some time, however, before any definite conclusions can be drawn from this project.

Reducing capillary rise

Maintenance of a dense ground cover is essential if capillary rise of saline water to the surface is to be avoided.

Ground cover can be maximized by limiting grazing. This will require fencing of the affected area.

In severely affected areas, total exclusion of grazing animals and the establishment of salt-tolerant vegetation may be necessary to reduce capillary rise.

A continually wet soil surface increases capillary rise of saline water. Run-off control structures such as diversion banks can redirect surface run-off water from potential trouble spots. Sub-surface drains such as tile drains and drainage pipes can remove excess water from seepage areas but are only an economic proposition on valuable horticultural land.

A further problem is the disposal of the drained saline water. Unless it can be run into an inlet of the sea, the drainage water will create a problem wherever it is taken.

Establishment of salt-tolerant species

Factors to consider when selecting the most suitable species for revegetation include: depth of rooting, fodder value, shade provided for animals, value for soil conservation, tolerance to salinity and resistance to frost, wind and heat damage.

On the Central Coast, black tea-tree (*Melaleuca bracteata*) is quite common along saline drainage lines. These trees prevent the formation of gullies because their roots bind the soil together.

Other tree species that may have application include she-oak (*Casuarina glauca*), Athol trees (*Tamarix aphylla*) and *Tamarix plumosa*. The latter two species have reserve fodder value for use during dry periods.

Salt-tolerant trees can be used in a small, developing saline seepage to contain the spread of the affected area. A large outbreak, however, may necessitate such an extensive planting programme that it may be impractical.

On the Central Coast, saltwater couch or seashore paspalum (*Paspalum distichum*) thrives in saline seepages; marine couch (*Sporobolus virginicus*) is dominant on the drier scalded areas. Both species are reasonably palatable to cattle and are grazed extensively in the absence of alternative pastures.

Pigweed (*Sesuvium portulacastrum*) commonly occurs in salt-affected areas but has negligible value for stock. Saltbush (*Arthrocnemum* spp.) also grows in the wetter areas. Cattle will graze the young tips of saltbush but only when other feed runs out.

On the margins of affected areas where salinization is less severe, Rhodes grass (*Chloris gayana*) replaces the highly susceptible native grasses, and green couch (*Cynodon dactylon*) readily colonizes bare, scalded areas. Both grasses provide valuable feed for stock but overgrazing must be avoided.

Conclusion

The expansion in agricultural and pastoral development on the Central Coast will result in more pressure being placed on the clearing of timber from land types which are susceptible to water-table salting.

Clearing timber from these areas can cause serious losses in productivity due to rising saline water-tables and the accumulation of salt in the soil.

As saltland development is almost impossible to reverse and rehabilitation is difficult, it would be wise for producers to seek advice from Departmental officers should they have any doubt on the susceptibility of any area which they intend to clear.

Slaughter cattle chemical survey

A random survey of slaughter cattle conducted over the last 2 years by the Department of Primary Industries has revealed a satisfactory low level of pesticide residues.

Mr Bryan Woolcock, Deputy Director of the Division of Animal Industry with the D.P.I., said that to date more than 15 000 fat samples from more than 5 600 properties had been analysed.

'The results have revealed that there is a high compliance with the statutory limits for pesticide residues,' he said.

'Results are improving all the time, mainly due to an active extension and information campaign by officers of the Department and a greater degree of awareness of this type of problem by producers.'

Mr Woolcock explained that all samples were identified to the property of origin through the tail tagging system. Traceback was undertaken by field officers in all cases of non-compliance with the statutory limits and, in the case of the persistent organo-chlorine compounds, when residues were above half the legal limits.

Mr Woolcock stated that the level of compliance varied with the 21 chemicals for which the samples were screened. The lowest level of compliance was 99.3% for dieldrin.

'Australian farming is efficient by any standard and a significant part of this productivity is due to the availability of efficient agricultural chemicals,' he said.

'However, many of these chemicals represent a potential threat to our export and domestic markets, both of which place statutory limits on the residual pesticide levels which will be tolerated in farm products.'

'The compliance with these quality standards is particularly important in beef and other animal products. For this reason the law in this State prohibits the use of many chemicals for treatment of animals and specifies which chemicals may be so used.'

He said that a few problems remained. Certain dip compounds caused residue problems in cattle if they were dipped in over-strength dips or too close to slaughter. Action had been taken to minimize this source of residues and there was now evidence of a market fall in residue levels from these sources.

A more difficult problem arose from the close association of cattle fattening with certain forms of crop production in which persistent chemicals such as dieldrin and BHC remained in use because of the absence of suitable alternatives.

Mr Woolcock said: 'Manufacturers and Governments have a role to play in the responsible use of chemicals. However, it is the users of agricultural chemicals who need to ensure that every product is used with care and good agricultural practices are followed.'

'If they fail to do so they risk losing, not only the advantages provided by these efficient chemicals, but also Australia's most lucrative markets.'

Field experience dispells tick fever fears

by T. Brazier, Veterinary Services Branch

Deaths due to tick fever (red water) cause problems for graziers and dairy farmers in the tick-infested areas of Queensland. Over the years, this disease has been responsible for heavy cattle losses.

Owners often blame ephemeral fever or three-day sickness for stock losses caused by tick fever. Three-day sickness can produce widespread sickness when it is about, but is seldom fatal.

As well as obvious losses from death, production on many dairy farms is seriously affected by tick fever. Most tick fever occurs in this State in the period from January until July. This time coincides with the months when dairymen are striving for high production to maintain quotas. Many farmers have overcome the problem by using the Department of Primary Industries' tick fever vaccine. Memories of the vaccine of yesteryear, however, still worry some farmers.

The two main fears are:

- Possible severe reaction in susceptible cattle.
- Loss of milk production from the inoculation reactions.

In view of these fears, it was decided to make a field study of the effect of the Department's modern tick fever vaccine in milk producing herds during 1976.

Field study

Observations were made on four dairy herds in the Lockyer Valley after inoculation following a tick fever outbreak.

The following action was taken on the worst affected herd.

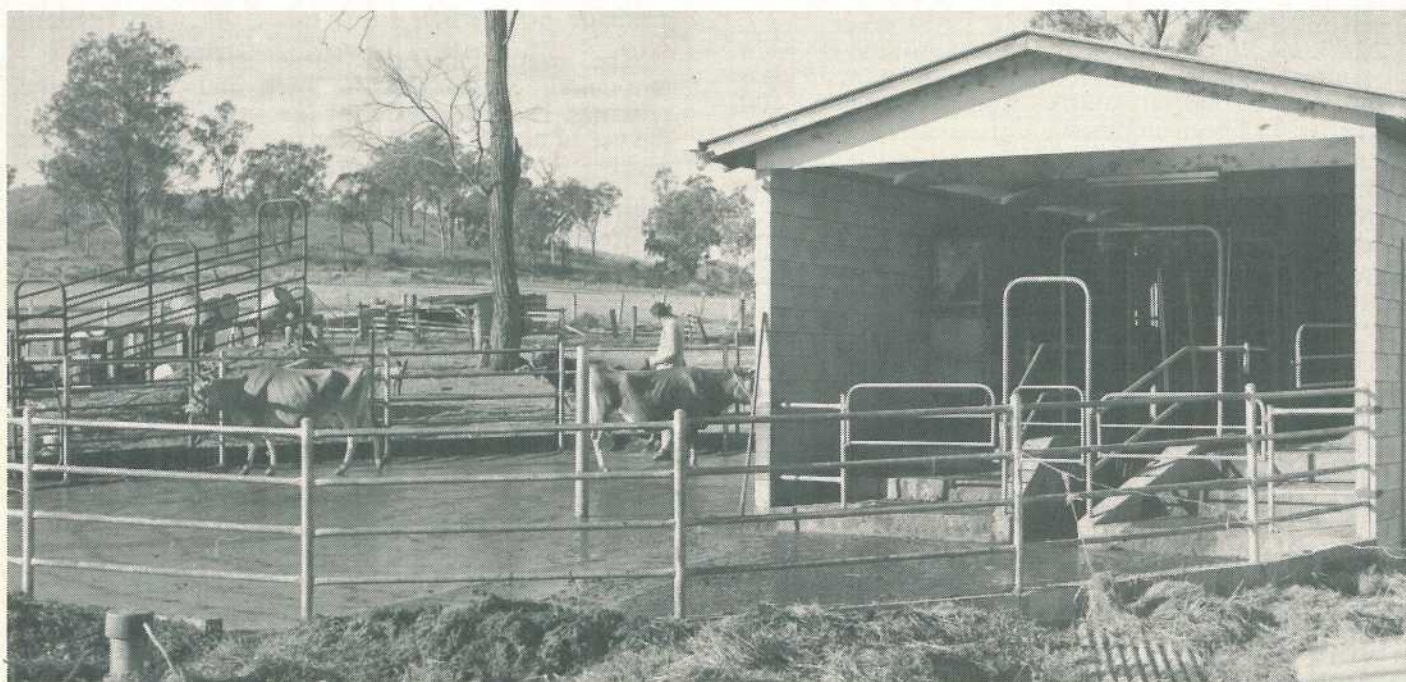
Blood smears were forwarded to the laboratory on 10 March 1976 to confirm the diagnosis of tick fever. *Babesia bovis* infection, the cause of the most common form of tick fever was identified. The owners were advised to treat all sick animals immediately with a tick fever medication between March 10 and April 2.

Reactions from vaccine

As the milking animals were seen daily, it was decided to vaccinate the dry cattle first to give an indication as to what reaction to expect. Four animals of 100 did show slight reactions and were treated when they recorded temperature rises up to 40°C.

The milking cows were inoculated on March 26. As reactions can be expected between the seventh and the fourteenth day, temperatures were taken daily in the mornings during that period. When the temperature rose to 40°C, or the animal showed early clinical symptoms, it was treated with a tick fever drug. Seven cows were treated once on the eleventh or twelfth day after inoculation using this guideline. Only one treatment was necessary.

No tick fever was sighted on this property after the inoculation programme was started. The owners are continuing to vaccinate replacement heifers.



The profits of dairy farmers have been seriously affected by death and sickness caused by tick fever. With the use of modern vaccines, this loss can be avoided.

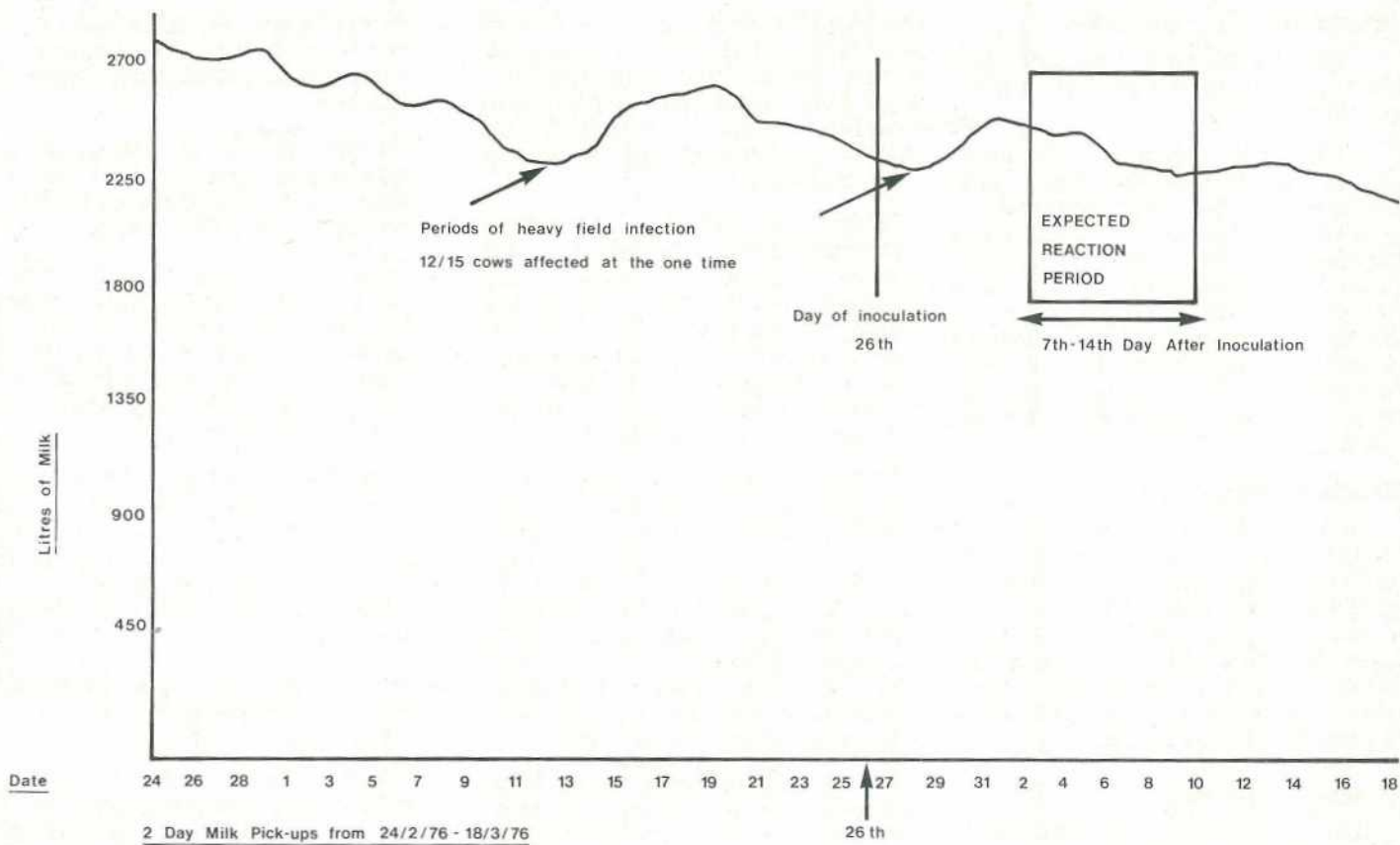


Figure 1. Harrington Brothers' herd. Stock were well supervised during the reaction period and were treated immediately any signs of sickness appeared. This herd's production was on a normal seasonal downtrend. As can be seen, there was no significant drop in production during the reaction period. There were no abortions.

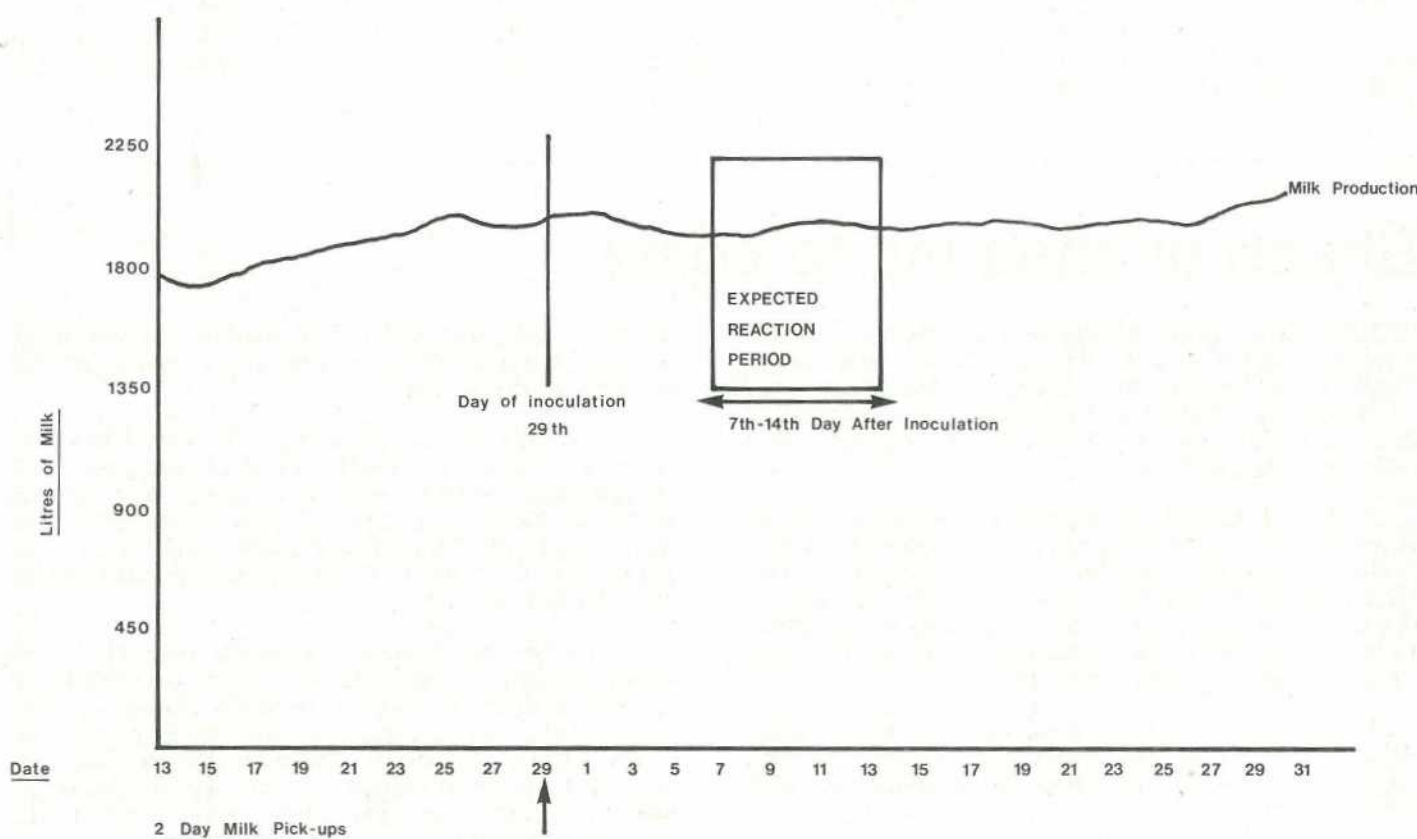


Figure 2. D. Vietheer's herd. Stock were well supervised during the reaction period. Production was on a normal upward trend. Four cows were treated (Imizol) for reaction on the seventh day after inoculation. Three cows were treated (Imizol) for reaction on the fourteenth day after inoculation. As can be seen, there was no significant drop in production during the reaction period. A few cows in this herd were about 10 days off calving. There were no abortions.

Effect on milk production

The loss of milk was extremely small, as is shown by the accompanying figures.

The herd already mentioned above which had the most cattle affected in the field outbreak is shown in figure 1. This herd's production was on a normal seasonal downtrend. The herd shown in figure 2 was on a rising production level and reactions caused no significant fall in milk production. The results from the other two were consistent with these findings.

Stage of pregnancy

As the tick fever outbreak in herd 1 was severe, a decision to inoculate all cows regardless of the stage of pregnancy was made. The cows were considered to be of far more value than the unborn calves. Not one cow aborted from the inoculation reaction, and calves were born normally during the reaction period.

Results confirmed

Since these trials concluded, other Departmental work has confirmed the results of these investigations. Several valuable Friesian cows that were in the later stages of pregnancy or just calved were introduced into a South Coast dairy from Victoria.

The cows were vaccinated for tick fever. Daily temperatures were taken from the first day. Although reactions would not be expected until

the period between the seventh and the fourteenth day after inoculation, it was decided that daily temperatures beforehand were necessary to establish normal temperatures so that a temperature rise would be easily detected.

When this base line of normal temperatures was established, it was planned that severe reactions and resultant loss of milk production would be prevented if a cow was treated as soon as a rise in temperature of between 0.5°C and 1°C occurred. Similar results to the Lockyer work were achieved.

Farmers should be aware that temperatures must be taken at the morning milking. The body temperature of healthy animals is subject to slight variations within 24 hours. During the day, the temperature may rise, falling again during the night. Seasonal variations also occur. In cold weather, the rectal temperature recorded may be well below the normal summer level.

Young animals appear to be more susceptible to fluctuating body temperatures than older animals. Therefore, taking temperatures from at least the fourth day after inoculation is warranted to determine the normal temperature.

Recommendations

From the results of these investigations, it is possible to make the following recommendations and comments:

- Severe reactions, milk loss and abortions from tick fever vaccinations can be avoided with proper supervision.
- Owners should be prepared to take temperatures of cows for at least 3 days preceding, as well as during the reaction period.
- Owners must treat animals when their body temperatures rise between 0.5°C and 1°C, or if they show early signs of sickness. This treatment does not appear to interfere with the production of tick fever immunity.
- Imizol at 1 mL per 100 kg live-weight is effective. Although Diampron is not now on the market, some farmers may still have it stored. It is effective when used at 1 mL per 45 kg liveweight.
- If cows are not being hand-fed they should preferably be on a rising plane of nutrition.
- These situations can be avoided by adopting a recommended programme. Inoculate young stock at approximately 6 months of age with two germ vaccine and 6 months later with single germ vaccine to give lifetime immunity.
- Assistance can be sought from the local veterinary practitioner or Stock Inspector to distinguish three-day sickness from tick fever.

Shape of shearing to come

BIOLOGICAL and chemical defleecing, sheep shearing robots and other push-button technology destined to shape the future of the Australian woolgrowing industry were discussed in Sydney at the second national Wool Harvesting and Development Conference.

Dr Peter Hopkins, Director of the Sheep and Wool Branch, Queensland Department of Primary Industries, said conference delegates were from the State Departments of Agriculture, the C.S.I.R.O. and various Australian universities. They were told significant improvements were also being made with conventional shearing combs, cutters and methods.

'A great deal of interest was shown in the three papers presented by the D.P.I. which examined both chemical and biological approaches to defleecing,' said Dr Hopkins.

A chemical called calcium thioglycolate was being used to weaken the staple just above skin level so the wool could then be plucked from the sheep. The treatment left the sheep with a stubble to protect them

from the cold and sunburn. The method of application, however, needed further refinement to realize the full potential of this system.

The biological work centred on the fleece shedding ability of first cross Wiltshire Horn-Merino sheep and of laboratory rabbits. Primitive sheep such as the Wiltshire Horn shed their fleeces completely each spring while the Merino had almost continuous wool production. Changes in daylength and adrenal function were the factors studied.

'A number of automated shearing research robots with capabilities beyond that of present equipment are on trial around the country,' said Dr Hopkins. 'They are basically mobile computers with mechanical arms, elbows, wrists and fingers. An interesting development presented at the conference is the use of ultrasonic pulses of energy to guide the robot's hand in the shearing operation.'

Other types of computer-controlled equipment were being used to catch sheep and transfer them in a restraining cradle automatically to the shearing area.

Aquatic plants of Queensland— part 6

by T. D. Stanley, Botany Branch

Hydrilla and leafy elodea

These two species are submerged, rooted aquatics with leaves grouped in whorls. They both belong to the family Hydrocharitaceae.

Hydrilla (*Hydrilla verticillata*)

Hydrilla is a native species. It is a submerged much-branched perennial, rooting from the lower leaf nodes.

DESCRIPTION—The plant produces much-branched stems up to about 3 m long, but mostly less than 1 m long, with many whorls of three to eight leaves. The leaf whorls are spaced along the stems at intervals of 0.5 to 7 cm. Each leaf is 0.5 to 4 cm long and about 2 to 3 mm broad. The leaf margins have many fine, translucent teeth. These are usually readily visible to the naked eye.

The species has separate male and female flowers on the one plant or sometimes on separate plants. Each flower has three sepals and three petals, all of which are greenish-translucent. The male flowers are about 1 to 3 mm long, have three stamens and are enclosed in membranous tissue called a spathe. Male flowers do not have a stalk but are sessile in the leaf axils. Female flowers are similar to male flowers in size and have the same number of petals and sepals but have a slender, specialized stalk called an hypanthium which can be up to 10 cm long. Fruits of this species are cylindrical, are up to about 8 mm long and 1.5 mm wide and are formed in the leaf axils at the base of the hypanthium.

Female flowers of this species are pollinated at the surface of the water. The unopened female flowers are carried to the surface by elongation of the hypanthium. Once there, the petals open. The unopened male flowers become detached from the plant and rise to float on the water surface where their petals open. Once these flowers have opened, the

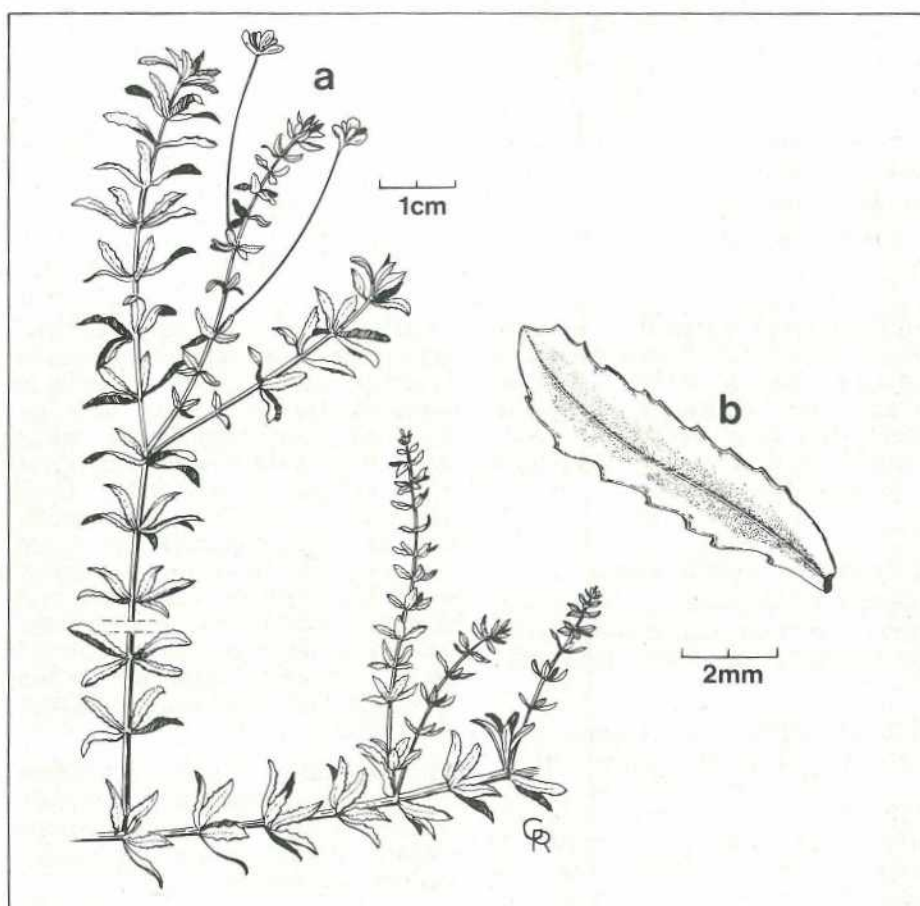
anthers open explosively and disperse pollen for up to 20 cm. If a female flower is within range it may be pollinated.

The species also spreads by vegetative means. Small sections of the stem readily produce roots when in a suitable location.

DISTRIBUTION AND HABITAT—Hydrilla is found in still to slow-flowing fresh water in ponds, dams, rivers and streams and will tolerate a wide range of water temperatures. During winter, in cold

water, the plants often die back to the lower branches. Maximum growth occurs in midsummer when the water temperature is high.

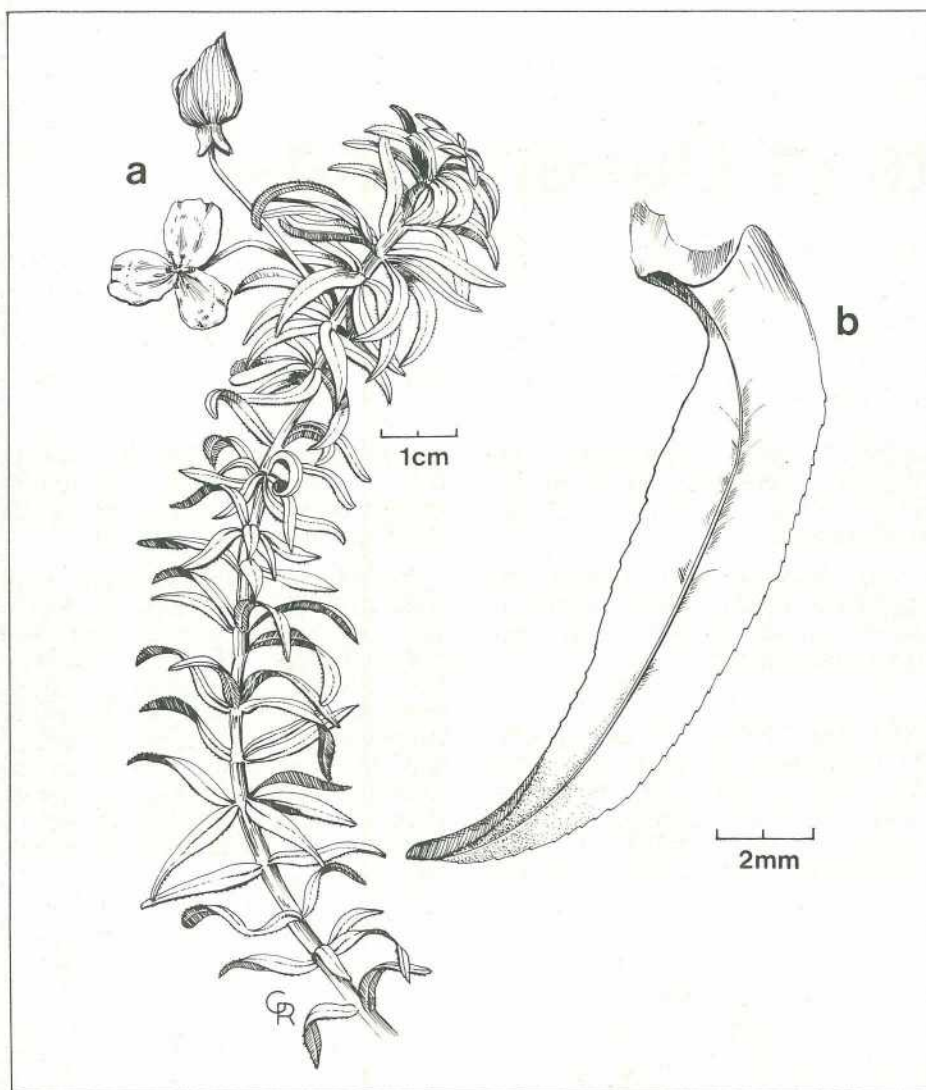
Hydrilla verticillata is found in all Australian States except Tasmania and also occurs in southern and eastern Europe, Africa and southern and eastern Asia. It has been introduced into the south-eastern United States where it has become a pest. In Queensland, it is found in coastal parts of the State, mostly east of the Great Dividing Range and in northern parts to as far south as Mt. Isa.



Hydrilla verticillata

a-portion of flowering plant

b-leaf



Elodea canadensis

a-portion of flowering plant

b-whorl of three leaves

IMPORTANCE—Hydrilla is capable of rapid growth and can be a nuisance in irrigation systems, streams and ponds, although in Queensland it is usually not considered a pest. It is sometimes used as an aquarium plant.

Leafy Elodea (*Egeria densa*)

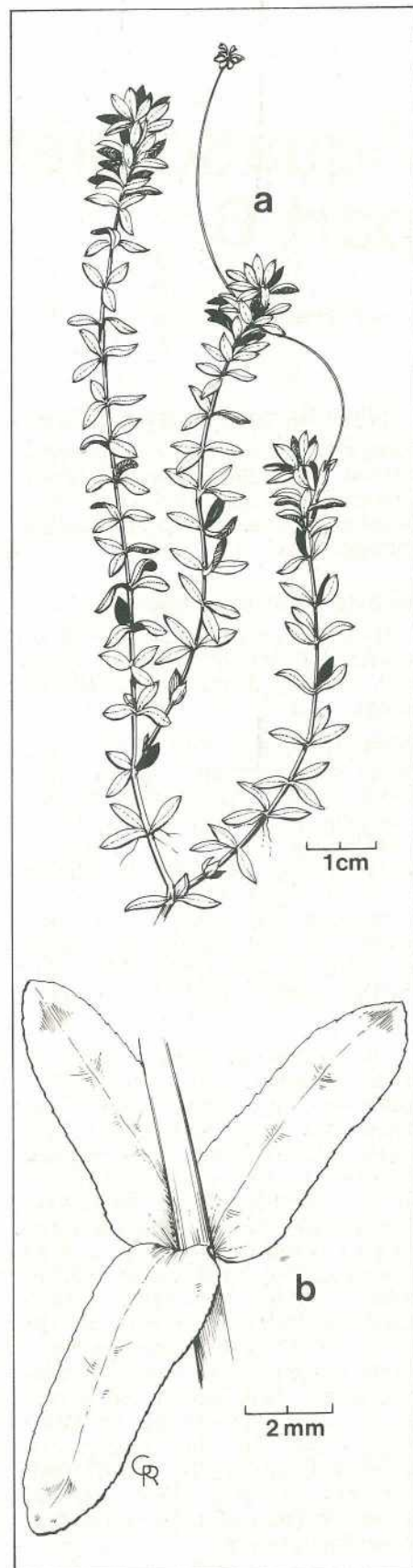
This is an introduced submerged, rooted perennial with dense foliage. It is also known as dense waterweed.

DESCRIPTION—The species produces much-branched stems up to about 2.5 m long with dense whorls of three to seven leaves. It often forms dense masses just below the water surface. The whorls are spaced along the stems at intervals of mostly less than 0.5 cm. Each leaf is 1 to 4 cm long and 2 to 5 mm broad. The leaf margins are minutely toothed, the teeth scarcely visible to the naked eye.

Leafy elodea produces male and female flowers on separate plants. In Australia, female flowers are seldom produced. However, when they are produced they have three white petals 6 to 8 mm long, and three sepals about 3 mm long. Each female flower is solitary in a spathe with an hypanthium 4 to 6 mm long. The male flowers usually occur two to four together in a spathe, and have an hypanthium 2 to 8 cm long. Each male flower has three recurved sepals 3 to 4 mm long, three white petals 0.9 to 1.2 cm long and about nine stamens.

In Australia, seeds are seldom produced and propagation is mainly by vegetative means. Small portions of the stem root readily and quickly produce new growth.

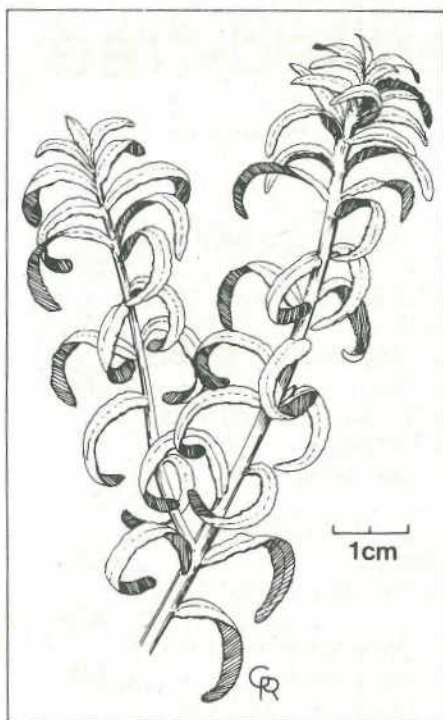
DISTRIBUTION AND HABITAT—Leafy elodea is native to Brazil, Argentina and Uruguay and was probably introduced into Australia as an aquarium plant. It is a



Egeria densa

a-portion of flowering plant

b-leaf



Lagarosiphon major

freshwater plant and has been reported from a few places in New South Wales and Victoria. In Queensland, the only naturalized population known is in Stable Swamp Creek at Rocklea in Brisbane. The population was reported in 1978. A survey in January 1981 showed the species was still present

in the creek but not in large amounts. Leafy elodea is naturalized in several countries including Britain, the United States and New Zealand.

IMPORTANCE—*Egeria densa* is sometimes sold in aquarium supply shops under a number of different common names including egeria, elodea and anacharis. Because of its capacity for rapid spread, the species has the potential to become a pest in Queensland waterways, especially in the cooler parts of the State. Care should be taken that it is not introduced into channel systems.

NOTE—There are two other species of submerged aquatics which resemble the above species and which if introduced into Queensland waterways could become pests. These are Canadian pondweed or elodea (*Elodea canadensis*) and lagarosiphon (*Lagarosiphon major*).

Canadian pondweed is native to North America and is now naturalized and considered a pest in several countries including Britain and New Zealand as well as in South-eastern Australia. The species has become a pest in irrigation systems along the Murray River in New South Wales and Victoria. It is cultivated in aquariums and care should be taken to ensure that it is not introduced into Queensland waterways, especially those in the cooler parts of the State. Particular care should

be taken that it is not introduced into channel systems.

Lagarosiphon is an African species which has become naturalized and a pest in New Zealand and while not yet recorded from Australia could possibly extend to this country in the future. In Queensland, it could cause problems in the cooler parts of the State.

The field key gives the distinguishing features of Canadian pondweed and lagarosiphon as well as hydrilla and leafy elodea.

Illustrations of Canadian pondweed and lagarosiphon are also included in the hope that should these species become introduced to Queensland they may be identified early and eliminated before they become pests.

If you think you know of a population of leafy elodea, Canadian pondweed or lagarosiphon please send a dried pressed specimen of it to: The Director, Botany Branch, Department of Primary Industries, Meiers Road, Indooroopilly, Q. 4068.

Alternatively, you may ask at your local Department of Primary Industries office to have the specimen forwarded to Botany Branch.

Please include full details on when, where and by whom it was collected.

Field key

1. Leaves alternate, rarely sub-whorled..... *Lagarosiphon major*
 Leaves in whorls of three or more 2
2. Leaves always in whorls of three *Elodea canadensis*
 Leaves in whorls of three to eight, the number of leaves per whorl
 varying on the one plant 3
3. Leaf whorls usually less than 5 mm apart; leaf margins with minute teeth
 scarcely visible to the naked eye *Egeria densa*
 Leaf whorls usually more than 5 mm apart; leaf margins with small but
 conspicuous teeth easily visible to the naked eye... *Hydrilla verticillata*

Bovine Brucellosis Accredited-free Herd Scheme

The following list contains all herds which have been given accredited-free status under the Bovine Brucellosis Accredited-free Herd Scheme as at 31 May 1981.

Brisbane Division

Anderson, F. J. & M. I., Currumbin Creek Road, Currumbin.....	JS, FS-JSX
Andrew, E. R., Woodford Road, Peachester	FS
Ardrey, P., 'Veresdale', Veresdale Scrub School Road, Veresdale, via Beaudesert	AIS
Arthy, H. R., 'Beauvale', Laravale, via Beaudesert.....	JS
Animal Husbandry Research Farm, Dept. of Primary Industries, Rocklea	M
Arababy Angus Stud, 'Arababy', Moore	AG
Artificial Breeding Centre, c/- Dept. of Primary Industries, Grindle Road, Wacol...	M
Bachmann, R. J. & L. A., 'Mulgowie', M.S. 182, Laidley	PH
Badcock, W. S. & E. M., 'Wandall Estates', Serpentine Creek Road, Redland Bay.....	MG
Bando Past Company, c/- P. B. & C. M. Schmidt, 'The Homestead', Yandina	BM
Bando Past Co., c/- P. B. & C. M. Schmidt, 'Avonell Park', Kenilworth	BM
Banff Bros, Clinton, Coominya.....	DM
Barnes, R. & M., 'Echo-Dell', Diamond Valley, Mooloolah	HF
Barnett, A. W. & B. A., Crusader Downs Stud, Commissioners Flat, P.S. 1253, Woodford	DM
Bassingthwaite, A., Yabba Past Co., Yabba, Junica, via Kilcoy.....	SG
Bauer, A. V., 'Warralea' Droughtmaster Stud, M.S. 825, Ipswich.....	DM
Bauer, W. R. & G. W., 'Grampians' and 'Amaroo', Cannon Creek, M.S. 484, Boonah.....	BM
Beattie, P. M., 'Nobby View', M.S. 861, Fernvale.....	JS
Beck, G. W., 'Banbeck', Blenheim Road, Laidley	DM
Beckingham, C. H., 'Cosme Jersey & Hereford Stud', 'Bridgeman Downs', Darien Street, Aspley	JS, HF
Behrendorff, E. C., 'Inavale Stud', M.S. 488, Boonah	FS
Bell, A. G., 'Aroo', Boonah	HF
Bell, R. G. & E. J., 'Nallaview AIS Stud', Commissioners Flat Road, Woodford	AIS
Benstead, H. G. & C. M., 'Analwon', Wonglepong, via Tamborine.....	AIS
Berlin, V. N., 'Vernell', M.S. 292, Marburg ..	FS, JS
Betts, J. H. W. & T., & Perry, R. K. & B. E., 'Nindethana', 12 Camp Mt. Road, Samford.	DM
Beutel, H. R. & F. A., 'Warrillee Stud', M.S. 21, Kalbar.....	SG
Biggs, R. & Sons, 'Dulong', P.S. 1096, Nambour.....	FS

Birch, N. J. & J. F., 'Bonny J' Stud, River Road, Peachester	BF
Bischoff, L. A. & C. R., 'Taminnis' Stud, P.S. 1978, Beaudesert	FS
Bischoff, R. A., 'Buaravale', Buaraba Creek, Coominya	DM
Blanche, P. G. & C. A., 'Blanson' Stud, Stock Route Road, Fernvale	BF
Blokland, J., Apollo Stud, M.S. 231, Laidley	JS
Blumel, N. J. & E. B., 'Willow Glen Farm' Stud, Farm Road, Bunya	DM
Bond, G. C. & L. D., 'Willow Valley', Kings Scrub, Dayboro.....	AIS
Bougoure, Mrs. E., 'Narellan Park', 16 Old Mt. Beppo Road, Toogoolawah	CB
Bridger, J. J. & S. L., 'Kenmar' Stud, Cryna, M.S. 1916, Beaudesert	FS
Brittain, B. W. & B. M., 'Durundur', Cedarton, via Woodford	SM
Brown, H. D. & P. R., 'Westerngailes' Stud, Wight's Mountain Road, Samford.....	SG
Buchanan, G. A. & J. L., 'Airdrie' Brahman Stud, 242 Holmes Street, Brighton.....	BM
Buchanan, R. W. & T. R., 'Clarinnis Droughtmaster Stud', Steinhardt's Road, Marburg.....	DM
Buchbach, K. & C., 'Dingelee Dell', Wootha Road, Maleny.....	FS
Buckingham, D. R. & S. A., Estate, 'Banyak-Suka', Daguiar, via Woodford	BM, CL
Burridge, A. H. & M., 'Hatari Lodge', Mutdapilly	CH
Butler, J. A. & A. W., 'Coochin', Old Gypie Road, Beerwah.....	BF
Butterfield, D., 'Barcoo Stud', M.S. 944, Karrabin, via Ipswich	DM
Byrne, D. E., 'Agostine Brahman Stud', 11 Glindeman Dve., Holland Park	BM
Byrne, John & Company, G.P.O. Box 1677, Brisbane.....	BM
Callaghan, R. J. & G. E., 'Canowindra', Upper Camp Mt. Road, Samford.....	DM
Campbell, J. D. & H., 'Hilden', Burpengary Road, Narangba	MG, LM
Challen, R. H., 'Chalhaven Droughtmaster Stud', 52 Haven Road, Pullenvale	DM
Chater, K. W. & B. E., 'Cedarview Friesian Stud', Dayboro Road, Closeburn	FS
Chesworth, L. A. & C. M., 'Willette', Cryna Road, Beaudesert	FS, AFS
Christensen, B. L. & M. O., 'Elavesor' Poll Hereford Stud, Rosevale, via Rosewood	PH
Christensen, G. E., 'Double E', Moorang, via Rosewood.....	SG
Christensen, M. R., Santa Gertrudis Stud, Santa Rio, Rosevale, via Rosewood.....	SG
Christensen, T. & W., 'Omaha', Tarome, via Kalbar	PH

Christoffel, M. A., Veresdale, via Gleneagle	AY	Duhs, V. L., Murray Grey Stud, Image Flat	
Clancy, B. H., Callaghan Road, Narangba ..	SW	Road, Nambour	MG
Clapham, G. R., 'Amazon Brahman Stud',		Dunn, W. H., 'Ranorwen', New Country	
D'Aguilar, via Woodford	BM	Creek, Kilcoy	MG
Clarke, C., CHO, SH, M.S. 825, Peak			
Crossing, via Ipswich	JS, FS	Earl, D. P. H. & C. G., 'Boolaroo', Boyland,	
Clinch, A. H., 'Beauden' Poll Hereford		via Tamborine Village	MG
Stud, Nindooibah, Beaudesert	PH	Eaton, C. E., 'Mary Smokes Creek',	
Cochrane, B. J., 'Braeside', Closeburn, via		Woodford	PH
Samford	FS	Eaton, N. & C., Mary Smokes Stud,	
Collard, W. A. & Sons, 'Cedar Park', M.S.	FS, GS,	Yedina, via Kilcoy	PH
16, Witta Road, Maleny	AFS	Evans, E. G., 'Lauraven', Mountain View	
Colley, K. J. & G. J., 'Mirondi', Kiamba	PH	Road, Maleny	AIS
Collins, N. A. & R. J., 'Kuloe', Ocean			
View, via Dayboro	BM	Falkenhagen, W. R. & L. M., 'Lynnwill	
Conochie, I. S., 'Brookland', M.S. 461,		Stud', M.S. 794, Warwick Highway, Kalbar	GS
Kalbar	JS	Falls, G., 'Karinga Valley', M.S. 1096,	
Conroy, B. M., 'Logan View', via Coominya	CL	Nambour	JS
Cottee, T. J., 'Tallegalla Stud', 1 Bygott		Ferrar, E., Anthony Murray Grey Stud,	
Road, Samford	CL	Roadvale	MG
Craig, R. T. & P. A., 'Dulong' Stud, M.S.		Ferguson, J. A. & D. P., 'Dorallah' Jersey	
1096, Nambour	MG	Stud, Veresdale, via Beaudesert	JS
Crane, D. B. & E., 'Keglsugl', P.O. Box 7,		Finden, R. J., 'Knightsbridge Green',	
Dayboro	PH	Bradley Street, Dayboro	CB
Crombie, J., Woodlyn Properties,		Fisher, J. W. & Bond, C. E., 'View Fair',	
'Woodlyn', Glen Esk Road, Esk	DM	River Road, Peachester	JS
Crombie, Mrs. M., 'Old Hidden Vale Santa		Fleming, P., 'Wundaburra', Mt. Archer, via	
Gertrudis Stud', 'Old Hiddenvale',		Woodford	PH
Grandchester	SG	Flynn, M., 'Normanby', Wilsons Plains,	
Crouch, M. A. & R. M., 'Mt. Mee',		Harrisville	DM
Dayboro	FS	Fogg, D. J., 'Den-Dia', AIS Stud, M.S. 336,	
Cummins, G. & M. A., Waubra Park,		Toogoolawah	AIS
Thagoona	SM	Freeman, W. A., 'Trevlac Stud', Walloon	
		Road, Rosewood	CL
		Freer, G. J. & M., 'Coottha Coottha	
		Charolais', 445 Simpsons Road, Bardon	CL
		French Bros & Company, 'Rivervale', Mt.	
		Pleasant, via Dayboro	FS
		Friedland, J. & Son, 'Glen-Opal', Obi Obi,	
		via Nambour	JS
Daniels, R. J. & J. M. & L. C., 'Jandella		Gibbons, P. & J., 'Wara Stud', 4 Penambul	
Friesian Stud', Woodford Road, Mt. Mee ...	FS	Cres., Ferny Hills	DM
Davis, B. H., Petrie Creek Road, Nambour .	MG	Gillingham, P., 'Jerra Marumba', Witta,	
Davis, B. J. S. & P., 'Barradinbah', M.S.		via Maleny	RP
546, Forest Hill	BF	Gilmour, K. J. & M. S., 'Ridgegrove',	
Dawley Partnership, c/- R. Tomlinson,		Oakey Creek, Kenilworth	HF
'Montwood' Stud, Kirbys Road, Palm-		Goldsworthy, Ian & Angus Pastoral	
woods	MG	Company, 'Wollowdilly Lodge', Woodford	
Deans, T. W. & M. D., 'Dino Glen',		Road, Peachester	DM
Watson's Lane, Reesville, Maleny	FS	Gooding, T. H. & D. D., 'Booboogan' Stud,	
Delroy, F. G. & L. M., 'Wandarri', Boonah .	BM	'Merrimac', via Nerang	PH
Delroy, M. D. & D. J., Old Mt. Alford		Goodrich, R. T., 'Glenhome' Stud,	
Road, Boonah	BM	Perwillowen Road, Nambour	DM
Dent, D. V., 'Rosemount' Stud, M.S. 16,		Gorsch, T. E., 'Rhodesvale' Guernsey Stud,	
Conondale Road, via Maleny	SM	Thorton, via Laidley	GS
Dept. of Primary Industries, S.E.Q.		Gould, R. A. & T. M., 'Shannon Vale', Lot	
Research Station, M.S. 825, Ipswich	FS	6, Coominya	DM
Dieckmann & Son, 'Keystone' Stud,		Granzien, L. R., 'Caboombah Stud', 40	
Running Creek, Rathdowney	SG	Harding Street, Raceview	FS, HF
Dignan, M. J., Herron Road, Closeburn, via	MG, JS,	Grech, A. J. & A. G., 'Shady Oakes Friesian	
Samford	FS	Stud', Post Office, Oxenford	FS
Dippel, H. J. & L. G., 'Thornton Mountain		Grigg, J. C., 'Bethonga' Braford Stud, P.O.	
Crest', M.S. 182, Laidley	GS	Box 4, Wamuran	BF
Dodd, W. A., 'Glengannon Stud', M.S. 435,		Guppy, N. J. & H. N., M.S. 150, Pittsworth.	FS
Rosewood	PH	Guppy, S. K. & S. M., 'Lynstarr', M.S. 956,	
Donnelly, L. J. & L. E., 'Cedar Grove' Poll		Nambour	FS
Hereford Stud, Cedar Creek Road,			
Wolfdene, via Beenleigh	PH		
Doyle, D. C. 'Aspel', Lacey's Creek,			
Dayboro	FS		
Duhs, H. F. & W. H., 'Green Valley',			
Kiamba, via Yandina	GW		

Haigh, D. H., 'Cardisa', Cunningham Highway, Moogerah	SG	Jameson, R., 'Narich', Narich P/L, Buaraba Creek Road, Coominya	HF
Hancock, R. N. & L. J., 'Gundaroo Poll Hereford Stud', Lower Mt. Walker, via Rosewood	PH	Jenkinson, W. K., 'Elualanbi', Limousin Stud, Kenilworth Road, Belli, via Eumundi	LM
Harris, H. R., 'Temora Park' Stud, M.S. 33, Cedar Creek, via Samford	PH	Jess, G. R., 'Adnamira Stud', Old North Road, Strathpine	DM
Harrison, N. & F. M., 'Oakridge Stud', Bartholomew Road, Elimbah	BS	Jimora Grazing Co., c/- F. N. & K. Brandon, 'Morden', Toogoolawah	BM
Harsant, R. & R. I., 'Oaklea', Warrill View, via Harrisville	PH	Johns, H. N., 'Alouette Stud', M.S. 435, Rosewood	LM, FS
Heard, J. H., 'Toddbrooke', Townson Road, Thornton, via Laidley	SM	Johnson, J. E. & M. T., 'Logan River Stud', Woodhill	FS
Heck, V. A. & D. A., 'Peterview AIS Stud', Glamorgan Vale, M.S. 861, Fernvale	AIS	Johnson Bros, 'Aratula', Kents Pocket, via Boonah	BM
Herd Improvement Laboratory, Q.D.P.I., Grindle Road, Wacol	M	Johnston, F. S., 'Jon-Dene', Obi Obi, via Mapleton	AIS
H.M. State Farm, Numinbah Valley, Numinbah, via Nerang	FS	Jones, R. L. & S. S., 'Valley View' Stud, Samford Road, Samford	AY
Prisons, H.M., 'Wolston Stud', Station Road, Wacol	FS		
Superintendent, Her Majesty's Prison, Neurum Road, Woodford	JS	Keavney, C. L., Kerry, via Beaudesert	HF
H.M. State Farm, Palen Creek, Rathdowney	JS	Keir, W. A., 'Keirs Charolais Stud', 63 Upfield Street, Burbank	CL
Herron, A. T., R. E. & J. A., M.S. 16, Conondale, via Maleny	FS, AFS	Kengoon Pastoral Co., 'Kengoon' Studs, Kengoon, Kalbar	BM, CL, DM, AF, PH
Herron, W. F., 'Bundaleer Stud', Herrong Road, Closeburn, via Samford	FS	Kenman, G. D., 'Corang', Armstrong Creek, via Dayboro	FS
Heslip, R. S. & E. M., 'Shamrock Friesian Stud', Sommerville Road, Beechmont, via Southport	FS	Keong, C., Woodhill Springs, Undullah Road, Woodhill	BF
Hewitt, C. J., 'Judel' Friesian Stud, Delaney's Creek, via Caboolture	FS	Kerle, A. B., 'Sunnyvale Braford Stud', Marburg	BF
Hickey, K. A., 'Limerick' Stud, Bunya Road, Bunya	FS	Kerswell, W. G. & C. A., 'Wybalena', Harlin	M
Hirn, F. J. & Sons, 'Glen Avon', Peachester Road, Beerwah	JS	King, J. L., 'Ridley Park', 79 Bridgeman Road, Bridgeman Downs, Aspley	PH
Hodby, R. H., 'Hurst View' Stud, 100 Ewing Road, Woodridge	JS	Kingston, Miss T. J., 'Kingston Place Ayrshire Guernsey Stud', M.S. 435, Tallegalla, via Rosewood	AY, GS
Hodgens, G. & J. F., 'Bunyeris', Peachester, via Beerwah	JS	Kirby, L. B. & M., 'Kalanga' Stud, Wesley Road, Kallangur	CL
Holt, A. T. & Son, 'Karowara Santa Gertrudis Stud', Hartley Road, Tamborine Mt.	SG	Knight, D. V., 'Bonnieview', Old Fernvale Road, Vernor, via Lowood	JS
Hooper, M. K. & M. R., 'Kareela', Plainland, via Laidley	DM	Knight, K. R. & M. S., 'Mt. Mee', via Dayboro	FS, AFS
Hopper, H. W., 'Ellendean' Guernsey Stud, P.O. Box 4, Maleny	GS		
Hulme, Sir Alan, 'Alcheringa Droughtmaster Stud', Highlands Road, Eudlo	DM	Lacey, R. & G., 'Gretorex Brahman Stud', P.O. Box 192, Indooroopilly	BM
Hung, S. P. & L. I., 'Mandarin Brahman Stud', cnr. of Middle & School Roads, Purga	BM	Lane, T. & J. A., 'Wivenhoe AIS Stud', Wivenhoe Pocket, via Fernvale	AIS
Hunt, S. E. & Doyle, D. J. & M., 'Kudo Stud', 'Komirra Pastures', Glasshouse Mountains	PH	Langley, E. W. & L. M., 'Charolong Charolais Stud', Langlands, via Kallangur ..	CL
Hunt, T. M., Bald Knob Road, Peachester ..	AIS, FS	Lawler, K. R. & E. A. B., 'Coolibah' Stud, M.S. 292, Marburg	AIS
Huth, R. B. & S. R., M.S. 23, Moorang, via Rosewood	FS, GS	Lawley, A. E., 'Arley AIS Stud', Reeseville Road, Maleny	AIS
		Lawrence, R. C. & J. E., 'Lorandale Droughtmaster Stud', Lot 31V, Boyles Road, Belli	DM
Innisplain Cattle Co., c/- I. W. Wightman, Myola Running Creek Road, Innisplain, via Rathdowney	SG	Leacy, K. G. & E. J., 'Coominga', P.O. Box 282, Caloundra	DM
Inverstanley Pastoral Co., 'Inverstanley', Esk	BM, DM	Ledger, N. F. & A. A., 'Dulong', 71 Image Flat Road, Nambour	JS
Isbell, R. F. & G. P. & G. C., 'Figtree', Coulson, via Boonah	DM	Leis, O. G. & P. J., 'Mountain View Stud', Kings Scrub, Dayboro	FS
		Lenorco Past. Co., Pierce Ave., P.O. Box 143, Caloundra	CL

Little, K. D. & J. K., 'Woodleigh' Stud, Beaudesert.....	JS	Mogg, R. C., 'Raymount' Freisian Stud, Dulong, via Nambour.....	FS
Lobegeiger, G. L. & A. E., 'Sunny Grove' Jersey Stud, Moorang, via Rosewood.....	JS	Morgan, M. C., 'Almara', Mt. Beppo, via Toogoolawah.....	PH
Lobley, N. E., 'Neloby', Mt. Pleasant, via Dayboro.....	FS	Montevideo Past. Co., P/L., 'Winya', Kilcoy.....	DM
Logan, D. D., 'Pine View', Kilcoy.....	CL, BS, BM	Mort, P., 'Franklyn Vale' Braford Stud, Franklyn Vale, Grandchester.....	BF
Logan, Mrs J., 'Jay-El Stud', 'Callemondah', Tarome, M.S. 21, Kalbar.....	BM	Muir, H. A., Church Road, Bethania.....	PH
Logan, W. J. & R. J., 'Emma Josey Stud', Murrays Crossing Road, Mt. Walker West, via Rosewood.....	SM	Muller, A. C. & G. A., 'Quamby', P.S. 1767, Maleny.....	FS
Lostroh, R. H. & B. M., 'Springlands' Stud, M.S. 366, Rosewood.....	FS	Muller, L. J. Pty. Ltd., 'Illoura', M.S. 21, Kalbar.....	SG
Lowe, R. D., 'Willola', P.S. 1406, Caboolture.....	BM	Mumford, A. J. & Son, 'North Pine Stud', Toods Road, Lawnton.....	PH
Loweke, C. R., 'Willowside', Kenilworth...	JS	Murphy, K. J., 'Ka-Amm' Stud, 'Homeleigh', Mt. Walker, via Rosewood.....	BF
Ludwig, K. D. & D. R., 'Sun Valley', Tarragalba, M.S. 411, Beaudesert.....	FS	Murray, H. J., 'Greydale', Upper John Street, Rosewood.....	MG
Ludwig, L. H., 'Riverview', Boyland, via Tamborine.....	FS	Murtagh, N. B. & D. M., 'Kenleigh', P.O. Box 29, Kenilworth.....	FS
Ludwig, S. H. & R. L., 'Glenvale', Boyland, via Tamborine.....	GS	M.V. Pastoral Development P/L., 'Nooramunga', Mutdapilly.....	MG
MacIntyre, J., Dulong Road, Dulong, via Nambour.....	JS	Newton, J. C. & A., 'Merry Vale Stud', M.S. 2132, Upper Caboolture.....	JS
MacIntyre, P. D., 'Ti Tree Springs', P.S. 1096, Dulong, via Nambour.....	JS	Niebling, G. & V., 'Thornton', M.S. 182, Laidley.....	HF
McConnel, D. C., 'Cressbrook', Tooloolawah.....	HF, FS, AIS	Niethe, A. & K., 'Lockrose', M.S. 546, Forest Hill.....	DM
McConnell, W. R., M.S. 435, Lowood.....	JS	North, 'Winenhoe Simmental Stud', Wivenhoe, via Fernvale.....	HF, SMX
McCosker, E., 'Braehead Limousin Breeders', Delicia Road, Mapleton.....	LM	Nutt, N. F., 'Ferry Vale', Canungra.....	FS
McCulkin, K. J., Nivek Pastoral Company, McCulkins Lane, Fernvale.....	BM	O'Dwyer, M. J., 'Renmark Poll Hereford Stud', Grey Street, Roadvale.....	PH
McGregor, T. D., 92 McGinn Road, Ferny Grove.....	GS	Pacific Cattle Breeders, R. Dowe, 'Telemon', Innisplain, via Beaudesert.....	CL
McGuire, M. M. & G. E., 13 Burton Street, North Booval.....	CL	Pagel & Hayes, 'Trafalga' Stud, Tarampa, via Lowood.....	AIS
McInnes, Bros., Inverclyde, M.S. 126, Harrisville.....	AFS	Patrick, K. S. R. & E. M., 'Boyland', via Tamborine.....	GS
McLaughlan, A. & R. D., 'Brightview' & 'Akubra' Studs, Old Rosevale Road, Warrill View, Harrisville.....	BF	Paulger, S. & S. M., 'Adadale', Kenilworth...	JS
McNamara, B. F., Woodford Road, Peachester, via Woodford.....	PZ	Peden, A. J., 'Warroolaba Stud', Warrill View, via Harrisville.....	AIS
McShane, V. P., 'Maree Vale' AIS Stud, Lacey's Creek Road, Dayboro.....	AIS	Penglis, J. W. & B. F., 'Pendale Poll Hereford Stud', Nioka Street, Brookfield....	PH
Magee, C., 'Merindah Willows', Station Road, Bethania.....	PH	Perrett, D. M., 'The Cedars', Harrisville....	M
Mallinson, F. A., 'Ganbeer AIS Stud', M.S. 438, Boonah.....	AIS	Perrin Enterprises Pty. Ltd., 'Mascott Park' Stud, Gilston, via Nerang.....	BM
Marshall, A. G., E. B. & L. G. J., 'Yurunga', Beechmont, via Nerang.....	JS	Philp, P. A., 'Teviotville', M.S. 488, Boonah.....	CL
Martin, J. W. & I. J., 'Kirkton Frieston Stud', M.S. 411, Beaudesert.....	FS	Pickering Bros., 'Granite Vale' Stud, Sellins Road, Mt. Mee, via Dayboro.....	FS
Martin, R. J. P., 'Jacaranda' Friesian Stud, M.S. 546, Forest Hill.....	FS	Pipi Holdings P/L., c/- R. G. Bell, 'Gindibah', P.O. Box 37, Caloundra.....	AIS
Mayo, F. D. & P. A., 'Logan Park' Simmental Stud, Pacific Highway, Loganholme.....	SM	Plucknett, K., 'Morven', Reesville Road, Maleny.....	FS
Mecklem, S. J., 'Calgai', Toorbul Road, Caboolture.....	HF	Pocock, R. J. & R. R. J., 'Maroon', M.S. 488, Boonah.....	BF
Melrose, C. A., Cedar Grove, M.S. 185, Cedar Grove Road, via Beaudesert.....	GS	Pointon, C. E. & M. L., 'Melford Park', Lanefield, Rosewood.....	BF

Pugsley, B. & D., 'Aikira', Landsborough Road, Maleny	SM, HFX	Sharp, D. R., 'Khancoban Stud', News paper Hill Road, Belli, via Cooroy.....	SG
Pyle, J. G., 'Fairlawn Stud', Settlement Road, Mt. Mee	BF, CL, SM	Simon, J., 'Broshami' Stud, Maleny	BM
Quast, H. D. N. & C. K., 'Lincolnfield', P.O. box 150, Beaudesert	SM	Simpson, R. E., 'Tangarine Springs', 25 Waraba Cres., Caboolture	MG
Rahane Pastoral Co., c/- A. O. Clarke, Innisplain, via Beaudesert.....	SG	Sinnamon, R. L., 'Robenlea Stud', Robenlea, Harlin	SG
Raine, O. A., 'Raine Drops Poll Hereford Stud', 43 Dunbeath Drive, Burpengary	PH	Skerman, B. S., 'West View' and 'The Highlands', Booroobin, via Maleny.....	AIS
Ramsay, J. L., 'Binowee', Currawong Place, Caboolture	CL	Smith, E. J., 'Hillcrest' Ayrshire Stud, Borallon, via Ipswich	AY
Reberger, R. F. & B., 'Rose Meadows Stud', c/- Post Office, Rosewood.....	BS	Smith, F. J., H. R. & Sons, 'Rubyvale' Angus Stud, 'Bralea', Burnside Road, M.S. 1096, Nambour.....	AG
Reck, I. H. & J. P., 'Robynlea', Laidley	GS	Smith, G. E., 'Koolpari Stud', Rifle Range Road, Glenoregrove	JS
Redgen, H. M. & N.F., 'Bonnie Brae', Palm Street, Maleny	M	Smith, J. F. & J., 'Double J. Red', Mt. Walker Road, Mt. Walker, via Rosewood...	DM
Redlands Licensed Semen Export Centre, c/- Q.D.P.I., Horticultural Research Station, Ormiston.....	SW, AMZ, RS, AIS	Smith, L. D. & G. L., 'Sweetacres' AIS Stud, Lot 6 Rossmore Road, Kingston	AIS
Reinhardt, K. G., 'Kenway' Red Poll Stud, M.S. 906, Mapleton.....	RP	Smith, S. S., 'Charnu Freisian Stud', Laidley Creek West	FS
Richardson, N. E. & B. G., 'Matabraka Friesian Stud', Mt. O'Reilly Road, Samford	FS	Solomon, N. D., 'Springwood', Kureelipa, Mapleton.....	GS
Rimington, J. G. & F. F., 'Sangaree', Verrierdale, via Eumundi	DM	Sorensen, E. W. & M. W., 'Farmlands Jersey Stud', Montville Road, Palmwoods ..	JS
Roberts, K. O., 'Purga Pastoral Co', 9 Woodgate Street, Churchill	CL	Southern, R. K., 'Birubi Park', Coolabine Creek, Kenilworth	RP
Ross, A. J. T. & I. M., 'Rosdale Stud', Dayboro Road, Samford	FS	Spesser, W. & Sons, 'Carnation', Mt. Walker Road, Rosewood.....	JS
Ross, G. R., R.J. & D.B., 'Starview', M.S. 523, Rosewood	AIS	Spring, M. K., 'Fernyhurst', Ruckers Road, Harlin	GS
Rostedt, M. A. Mrs, M.S. 1916, Cryna Road, via Beaudesert.....	HF	Stanton, A. E. & Sons, 'Stanton's Dairy', South Pine Road, Strathpine	FS
Ruckman, F. & G., 'Sarabah', M.S. 413, Beaudesert.....	BF	Stephenson, Dr J. A., 'Sahwalid Sahiwal Stud', 'Belli Downs', Kenilworth Road, Belli, via Eumundi.....	SW
Russell, L. D., 'Courtleigh' Brahman Stud, Woodford Road, Peachester.....	BM	Stevens, S. R. & I. B., 'Lasswade' Stud, Peak Crossing	RS
Savage, J. R., 'Bromelton House', P.O. Box 180, Beaudesert.....	CL	Stitz, M., Ocean View, Dayboro.....	BF
Sawley, R. M., J. S., G. B., S., D. K., & M., 'Nakara Poll Hereford Stud', P.O. Box 46, Boonah.....	PH	Stokes, M. D., P.O. Box 56, Laidley	JS
Sawley, T. D. & I. F., 'Glengallan Poll Hereford Stud', P.O. Box 46, Boonah.....	PH	Stubbings, J. G., 'Stratton Vale', Lacey's Creek, Dayboro.....	FS
Schlofeldt, K. W. W. & V. J., 'Wyandah', Kargorum Road, Beaudesert	SM	Stumer, K. F. & A. R., 'Glen Rock Stud', Frenches Creek, via Boonah.....	MG
Schmidt, J. C., 'Cordell County', Winn Road, Mt. Sampson, via Dayboro	FS	Stumer, R. L. & V. M., 'Lavron Nook' Freisian Stud, M.S. 484, Boonah	FS
Schossow, W., L. W. & D. J., 'Teviot Brooke', M.S. 488, Boonah.....	FS	Summerville, L. R. & P. M., 'Fairy Bower', Cryna, via Beaudesert.....	FS
Scott, D. I., 'Shepherd Hill Stud', Beechmont Road, Nerang.....	JS	Sutton, K., 'Startwell', Basin Road, Wamuran	BM
Scott, E. I., Edwards, J. S. & Randall, L. M., c/- J. N. Scott, 'Auchenflower Stud', Camp Mountain Road, Samford	AY, FS	Tantallon Grazing Co., 'Tantallon', Darlington, via Beaudesert	HF, JS, FS
Scott, J. N. & Son, 'Auchen Eden', Camp Mountain Road, via Samford	AY	Taylor, A. J., 'Glen Alpine', Veresdale, via Gleneagle	JS, FS
Searle, H. D., 'Karralbel', 807 Upper Brookfield Road, Upper Brookfield		Taylor, C., 'Pat-Char Murray Grey Stud', Monash Road, Redbank	MG
Sellin, B. L. & J. D., 'Kurrajong Park', Kings Scrub, Dayboro	PH	Taylor, 'Bianca Jersey Stud', Eagle Street, Harrisville.....	JS
Sellin, L. & E. F., 'Pasture Glen', Kings Scrub, Dayboro.....	FS	Taylor, M. S. & H., 'Hazeldean Stud', M.S. 182, Laidley	FS
		Teese, J. & B. J., 'Lyndith Stud', Veresdale, via Beaudesert	AIS
		Thomson, J. R. H. & R. V., 'Dewrang', Natural Bridge, via Nerang.....	JS, AIS, GS

Thomson, M. A. S. & Michael G. J., 'Meltowia Stud', M.S. 336, Toogoolawah...	FS	Westerway, C., 'Meridan', Meridan Plains, P.S. 1170, Mooloolah.....	HF
Thorne, H. G. M. & B. V., 'Dewhurst Stud', Hatton Vale, via Laidley, c/- Saunders Street, Raceview, Ipswich.....	JS	Westphal, A. C. & V. J., 'Alun Jersey Stud', M.S. 342, Roadvale.....	JS
Thornton, H. A. & Sons, 'Bellmore', Woolmar Road, Kilcoy.....	FS	Wheildon, K., 'Good Luck', Lower Cressbrook, Toogoolawah.....	FS
Tidswell, I. G. & D. E., 'Lake View', via Tewantin.....	CL	White, A. & V. R., 'Tonyvale', Menary Road, Woombye.....	MG
Todd, J. R. 'Aberfoyle', Laravale, via Beaudesert.....	JS	White, E. D. & H., 'Wombbalano Stud', 29 School Road, Lagan Reserve, via Beaudesert.....	DM
Toururrong Past Co., P. N. Thurbon & Lee, A. D., 'Tour-Ur-Rong', Christmas Creek Road, Beaudesert.....	DM	Wieland, C. I. & G. J., 'Alhaven', Allandale, via Boonah.....	MG
Towner, N. R. & M. A., 'Poinciana', M.S. 182, Laidley.....	FS	Wild, L. R. & M. M., 'Parraweena', Bald Knob, via Landsborough.....	BF
Towner, R. N. & C. M., 'Par Deux Droughtmaster Stud', Thornton, M.S. 182, Laidley.....	DM	Willey, F. A., 'Mar-sel Stud', M.S. 292, Lowood Road, Glamorganvale.....	AIS
Townsend, K. J., 'Terrah's Park', Ocean View, Dayboro.....	AIS	Williams, I. G. R., 'Spion Kop', M.S. 1136, Toogoolawah.....	FS, AFS
Trier, J. P. & V., 'Tamrookum Valley' Braford Stud, Rathdowney.....	BF	Williams, J. C., 'Attunga Stud', Mt. Mee Road, Ocean View, via Dayboro.....	SG
Tutton, T. J. & A. C., Hopkins Street, Beaudesert.....	COM	Willsford, D. R. & M., 'Hobby Farm Stud', 58 Boscombe Road, Brookfield.....	JS
University of Queensland, Vet. Science Farm, Moggill Road, Pinjarra Hills.....	M	Wilson, D. N. & J. J., Kenilworth Road, Maleny.....	PH
Unthank, M. G. & D. R., 'Jabiru', Norwell, via Beenleigh.....	CL	Wilson, G., 'Koora-Namoona Guernsey Stud', 'Adina', 'Boyland', via Tamborine...	GS
'Valley View Droughtmaster Stud', c/- G. T. C. Farrawell, Landershute Road, M.S. 956, Palmwoods.....	DM	Wilson, J. C., 10 William Street, Buderim ..	SM
Van Popering, P. & B. H., 'Brunetta Jersey Stud', Coominy Road, Lowood.....	JS	Winkel, B. J. & I. M., 'Gibba' Stud, Sellins Road, Mt. Mee.....	FS
Venz, M. S., 'The Mar-Venz Ranch Pty. Ltd.', 'Benwerrin', Kerry Road, Beaudesert.	M	Winks, J. & L. M., 'Allenbrae', Laidley.....	HF
Voight, E. M., 'Chelmadale' Stud, M.S. 825, Ipswich.....	BF, AIS	Wiseman, P. W., 'Clover Grove', P.S. 1973, D'Aguilar, via Woodford.....	JS
Voss, W.T. & L., 'Mt. Vista Stud', M.S. 292, Glamorganvale, Ipswich.....	AIS	Wolter, D. B. & V. M., 'Cobba Poll Hereford Stud', Beenleigh.....	PH
Wadley, P. F., 'Nindethana and Bendemeer Stud', M.S. 21B, Kalbar.....	JS, FS	Wood, J. R. & A., 'Jarmal', M.S. 16, Maleny.....	DM
Wainwright, O. S., 'Rosevale', via Rosewood.....	AFS	Woods, G. T. & H. E., 'Hazelwood Jersey Stud', M.S. 906, Mapleton.....	JS
Waldron, D. E. & J. M., 'Farleigh Friesian Stud', Stanmore Road, Woodford.....	FS	Wright, K. V., 'Wattle Vale', M.S. 288, Boonah.....	FS
Walker, R. A. & M. L., 'Blackrose', M.S. 366, Rosewood.....	SM	Wright, M. G., 'Bethany Stud', Mapleton Road, M.S. F.956, Montville.....	FS
Walther, R. & M., 'Roseborough', P.S. 1790, Lowood.....	BM	Yarrow, G. W., 'Alvington AIS Stud', M.S. 366, Rosewood.....	AIS
Wandarri Cattle Co., c/- F. G. & L. M. Delroy.....		Yeates, Dr B. R., 'Ugarapul', Boonah.....	DM
Warren, R. C. & S. A. 'Carrendenny', 77 Hope Street, Kilcoy.....	FS, AFS	Young, G. S. & Cooper, M. J., 'Coograli', Nth Maleny Road, Maleny.....	BF
Watkins, D. C., 'Kinwat Charolais Stud', G.P.O. Box 2256, Brisbane.....	CL	Young, W. J., 'Willverra Friesian Stud', Browns Road, Narangba.....	FS, AIS
Weier, M. G. & G. E., 10 Wickham Street, Laidley.....	PH	Zanow, No. 4 Oxford Street, North Booval ..	HF
Wells, B. G. & B., 'Bundilla Murray Grey Stud', Thorton M.S. 182, Laidley.....	MG	Ziebarth, A. R., 'Lynton Brahman Stud', 35 Campbell Street, Laidley.....	BM
Wenzel, N. R. & G., 'Gwen Ray Stud', M.S. 342, Roadvale.....	AIS	Zischke, C. A., 'Balara Stud', Coominya....	M
West, E. E. W., 'Belmadochie' Freisian Stud, 19 Oatlands Court, Samford.....	FS	Zischke, E. F. & I. M., 'Lynview' Jersey Stud, M.S. 231, Laidley.....	JS
Westaway, C., 'Sarner ALP', Colinton.....	BF		
		Toowoomba Division	
		Abraham, J. L. & S. E., 'Kaho' Stud Farms, M.S. 892, Meringandan.....	AIS, JS, SM
		Achilles, E. J. & D. R., Hills Road, Oakey ..	HF
		Alexander, R. N., 'Trefoil Park', Warra.....	HF
		Allan, R. M. & E. M., 'Quarrion Park', P.O. Box 45, Jondaryan.....	MG

Hayward, G. H. & L. F., 'Nashville', M.S. 1840, Greenmount	PH	Kildonan Partnership, c/- M. H. Gunn, 'Seven Bardot PH. Stud', Kildonan, Goondiwindi	PH
Hemming, C. R. & M., 'Birra Birra', Thallon	SG	King, C. G. P., 'Bonnington', Goombungee	SM
Hemmings, M. F., 'Bileena', Canningvale Road, Warwick	AIS	King Ranch (Aust) Ltd., 'MacQuarrie Downs', Leyburn	SG
Hemmings, N. T. & Sons, 'Murrays Bridge Stud', Murrays Bridge, M.S. 128, via Warwick	AIS	Klein Bros, 'Kapleton', Ma Ma Creek, via Grantham	AIS
Henderson, V. A., 'Barkala Stud', Greenmount Road, Cambooya	HF	Koehler, J. W. & M. J., 'Wattleview', Yamsion	HF
Henry, A. W. & Son, 'Green Valley', The Gums	HF	Krinke, A. F., 'Plain View', c/- Box 92, Pittsworth	HF
Henry, J. & J. L., 'Rocky Ponds', Massie, via Warwick	HF		
Henry, L. J., A. M., & M. J., 'Tara and Camtara Stud', M.S. 465, Cambooya	AIS, HF	Lange, P. A. & J. L., 'Cerana', M.S. 222, Oakey	AIS
Henschell, W. G., 'Yarranvale', M.S. 1444, Brookstead	PH	Larkwood Pastoral Co., c/- A. & M. Lark, 'Larkwood', P.O. Box 11, Dulacca	
Hodgson, C. F. & V. M., 'Wingfield, P.O. Box 35, Dalby	DM	Lawrie, D. C., 'Croxley', M.S. 918, Toowoomba	DM
Hoey, G. F. & N. E., 'Coolalinga Jersey Stud', M.S. 74, Clifton	JS	Lax, F. & Sons, 'Wyroona', M.S. 212, Oakey	FS
Hoey, J. L., Z. P., & L. M., 'Emoh-Ruo' and 'East Lynne', M.S. 74, Clifton	SG	Lee, K. J., 'Brigalow Park', Kurrumbul	HF
Hoey, N. T. & M. A., 'Merrawah' Stud, M.S. 371, Greenmount	JS	Lee, S. R. & J. M., 'Reservoir' Braford Stud, P.O. Box 60, Allora	BF
Holmes, J. R. & M. R., 'Benbecula', Charlton, M.S. 1497, Toowoomba	AY	Leeson, N. F. & J. A., 'Janel Park', Gowrie	FS
Hoopert, L. R. & E. E., 'Happy Valley', M.S. 212, Oakey	SG	Leonard, W. M. & Sons, 'Welltown', Goondiwindi	SH
Hudson, J. W., 'Wesslings', Gatton	DM	Lester Brothers, 'St. Andrews Stud', M.S. 623, Warwick	AIS
Hughs, M. E. & V. E., 'Mi-Von', Hopelands, via Chinchilla	HF	Lewis, C. J. & W. T., 'Medland', Toowoomba Road, Crows Nest	HF
Hunt, E. B. & S. Y., 'Springfield', P.O. Box 26, Chinchilla	MG	Lewis, P. M. & R. H., 'Greenstock', P.O. Box 37, Goombungee	FS
Hynes, W. J. & J. T., 'Billagal', Riverton, via Texas	HF	Leibke, C. P. & E. G., 227B, West Street, Toowoomba	MG
		Litster, L. J. & L. V., 'Hillside', M.S. 912, Malakoff Road, Dalby	FS
Irwin, W. J. T., 'Wynwood', 'Glendale', Koondai Road, Bell	DM	Little, B. J. & J. N., 'Linvale Park', M.S. 150, Pittsworth	FS
Ivan Doljanin Past Co., 'Bonni Foi', P.O. Box 125, Inglewood	PH	Little, C. L. & H. L., 'Barcolette Freisian Stud', M.S. 499, Toowoomba	FS
		Little, G. W., 'Glengarry', Jimbour	MG
Jackson, E. P. J. & M., 'Rotherham Stud', 'Ennismore', Nobby	PH	Littleton, H. V. & N. A., 'Lanacoora', Bowenville	LM
Jannusch, M. D. & B. E. R., 'Albion Park', c/- P.O. Box 25, Pittsworth	FS	Lloyd, W. J. & A., 'Wriembilla', Chinchilla	SG
Jensen, G. D. & B. M., 'Kuyura', Jimbour	BF	Logan, W. M. & A., 'Logan Hereford Stud', 'Rose Farm', Gatton	HF
Johnston, S. K., 'Bondoos Charolais Stud', Toowoomba	CL	Lostroch, L. K., 'Shamrock Vale', M.S. 212, Oakey	AIS
Jones, C. H. & D. N., 'Glen Wilga', M.S. 423, Hopeland, via Chinchilla	HF	Lowther, J. P. & A. M., 'Silverleaf Hereford Stud', M.S. 355, Chinchilla	HF
Just, M. E., 'Double Dee', Bergen	CH	Lynn-Eden Braford Stud, 'Warrigac', Columboola	BF
Kajewski, L. C., 'Glenroy', Mt. Marshall, P.S. 623, Warwick	AIS, FS	MacDonald, D. J. & W. E., 'Rosneth' Jersey Stud, Goombungee	JS
Kanowski, S. E., M.S. 357, Crows Nest	AIS	MacLean, R., c/- Kerwee Pastoral Co., 'Berwick', Jondaryan	SG
Karminya Pastoral Co., 3 Herronbee Street, Toowoomba	HF	MacNeill, L. & M., 'Miamba', Condamine	HF
Kath, L. K., 'Kathleigh', M.S. 1049, Gowrie Junction	JS	McCarthy, J. S., 'Glen Evin', M.S. 371, Greenmount	JS
Kemph, J. E., 'Bunya Vale', M.S. 222, Oakey	CL	McClelland, Pty Ltd., 'Oakland', Jandowae	HF
Kerwee Past Co., 'Argyle', Kingsthorpe	SG	McDowall, A., Logancrail Cement Mills ..	HF
Kerr, G. H., 'Glenora', Chinchilla	HF		
Kiepe, Mr J. J., 'Candy Downs', Ayrshire Stud, 1/30 McIntyre Street, Toowoomba ..	AY		

McDowall, A. & M., 'Theebone Stud', Meandarra	PH	Nolan, D. M. & M. T., 'Maydan', M.S. 848, Warwick	BF
McErlean, W. D. & M. M., 29 Rowbotham Street, Toowoomba	PH	Noller, D. G. Pty Ltd., 'Cunnadoo', Oakey	CL
McKee, I. R. & L. M., 'Belmont Park', M.S. 501, Dalby	LM	Norgaard, M. J. & B. F., 'Yarrabine', P.O. Box 61, Yarraman	FS
McLennan, R. J. & Co., 'Fairview and Orana', M.S. 360, Bell	BM	Nothdurft, R. J. & B. M., 'Glenheath', Yalangur, M.S. 918, Toowoomba	AY
McNamara, B. W. & L. J., 'The Glen', Bell	BF	O'Connor, P. D., 'Mountain Camp', M.S. 26, Crows Nest	PH
McNamara, D. J., 'Holmwood', M.S. 360, Bell	BF	O'Dwyer, A., Mt. Manning Past Co., M.S. 422, Clifton	SG
McNamara, G. N. & V. M., 'Strath-Vale', M.S. 360, Bell	BF	Officer, J. M., 'Warrawee', Miles	DV, PD
McNamara, J. & T., 'Athol Pines', Athol, via Westbrook	PS	Old Talgai Pastoral Co., 'Old Talgai', M.S. 422, Clifton	SM
McNamara, N. J. & Sons, 'Strathgyle', Bell	BF	O'Leary, M. J. & Sons, 'Remolea', M.S. 422, Clifton	PH
Major, M. & G. J., 'Rosewood Downs', Limevale	PH	O'Sullivan, J. D., 'Navilloween', M.S. 371, Greenmount	PH
Mann, B. L. & S. L., 'Mylo', P.O. Box 27, Chinchilla	AIS, AG, HF	O'Sullivan, P. W., 'Navleigh' AIS Stud, M.S. 371, Greenmount	AIS
Manteufel, R. C. & L. E., Unity Friesians, M.S. 223, Nobby	FS	Pacholke, E. I. & S., 'Sunnylawn', M.S. 74, Clifton	BF
Margrie, C. G., 'Redvale', M.S. 767, Yarraman	CL	P.J.R. Partnership, 'Remlap Poll Hereford Stud', M.S. 371, Greenmount	PH
Mason, V. & D., 'Deejay', M.S. 150, Pittsworth	AIS	Palmer, R. L., L. F. & F., 'Cloverdale', M.S. 371, Greenmount	FS
Matthews, J. B. & J. M., 'Mt. Moriah', P.O. Box 15, Jondaryan	SM	Pain, L. R., 'Cabandah', Jandowae	BF
May, A. P., 'Mirrabook Jersey Stud', Old Paling Yard Road, Wallangarra	JS	Palahra Farming Pty Ltd. (N. Rose), P.O. Box 19, Grantham	BF
Mayne & Sons, 'Gibraltar', Texas	AG	Park, L. S. & Co., 'Parkland', MacLagan	MG
Melrose, B. J. & B. F., 'Glen Eildon Braford Stud', 'Glen Eildon', Highfields	BF	Patch, G. R. & B. J., 'Kiara', P.O. Box 52, Bell	AIS
Miller, R. G. & M. D., 'Mt. White Stone', M.S. 428, Grantham	BF	Paterson, P. A. & J. T., 'Wheel Park', M.S. 852, Hodgsonvale, via Toowoomba	FS
Miller, S. J. & H. L., 'Nardoo', Miller Street, Warwick	SM	Paton, E. A., 'Sherdale', M.S. 30, Millmerran	SG
Moran, J. P. & G. E., 'The Belahs', Kumbarilla, M.S. 902, Dalby	HF	Paton, K. G., Wallanba Past Co., 'Sherglen Stud', Wallanba, Meandarra	SG
Moran, M. W. & J. D., 'Ferndale' P.S. 1014, Bell	HF	Pearce, M. C., R. C. W. & I. M., M.S. 582, Toowoomba	JS
Morgan, G. E., 'The Grove', Myall Grove, Condamine	PH	Pedler, G. N., S. L. & Sons, 'Athol Park Braford Stud', Box 10, Jimbour	BF
Morris, A. E., 'Hillsdale', Gowrie Junction	JS	Perrett, G. A. & K. L., 'Esmerelda Jersey Stud', Spring Street, Toowoomba	JS
Morris, H. J. & D. J., 'Gaiview', M.S. 29, Clifton	PH	Perrett, K. J. & D. M. C., 'Forest Springs', M.S. 74, Clifton	MG
Morris, R., Piccadilly Past Co., 'Cotswold Hills Stud', Gowrie Road, Toowoomba	CL	Peters, A. V., 'Gladwyn Angus Cattle Co.', M.S. 892, Meringandan	AG
Mowat, G. W., 'Town View', James Street, Yarraman	AIS	Peters, L. W., M. J. & G. F., 'Wilmington A.I. Stud', M.S. 212, Oakey	AIS
Mundell, J. T., 'Redmarley Stud', Redmarley, Condamine	SH	Peters, P. J. & V. R., 'Ripple Vale Angus Stud', M.S. 582, Toowoomba	AG
Mungall, H. J., 'Llagnum Acres', Ballandean	FS	Pharoah, R. G., 'Merroo Encourage Stud', P.O. Box 34, Chinchilla	HF, SM
Nauschutz, K. E. & D. M., 'Gold Park', M.S. 118, Warra	SM	Phillips, C. W., 12 Lavena Drive, Toowoomba	AIS
Neal, F. H., 'Oaklee Hall', Oakleigh, Tara	HF	Potter, C. J. & J., 'Uandi', Inglewood	MG
Neale, J. R. & S. H., 'Weerona Charolais Stud', Weerona, Brookstead	CL	Potter, N. R. & Sons, 'Acton Vale Stud', Wellcamp	PH, AIS
Newton, M., 'Malland', Kaimkillenbun	PH	Potts, G. J., 'Aratree Jersey Stud', Kings-thorpe	JS, FS
Newton, M. R. & D. E., 'Royelle', Kaimkillenbun	PH	Prescott, C. J., 'Minimi', c/- Minimi Past Co., St. George	HF
Nielson, D. J. & E. M., 'Kintyre', Mt. Tyson	MG	Price, D. A. & Co., 'Deloraine', P.O. Box 7, Jimbour	CL
Nixon, A. B., 'Devoncourt Stud', Dulacca	HF, PH	Prosser, C. & E. L., 'Thuruna Stud', Tara	HF

Talana Pastoral Co., 'Talana', M.S. 960, Roma	PH
Tomkins Pastoral Co., 'Stuart's Creek', Roma, P.O. Box 479, Roma	HF
Wallangra Pastoral Co., 'Wallangra Angus Stud', Wallangra, M.S. 851, Wandoan	AG
Whitney Past Co., 'Claverton Stud', Wyandra	SH
Wilshire, E. J. & G. E., 'Turra Den', Wandoan	SG
Wippell, S. J. & N. E., 'Morocco', Roma	HF
Woodside, I. S. & E. J., 'Wallace Brae', Guluguba	MG
Woodside, W., 'Kiewa', Guluguba	BF
Woodside, W., 'Wallace Bank', Guluguba	BF
York Bros, 'Mount Leigh Stud', 'Mount Leigh', Wallumbilla	PH
York, A. J., 'Grain Farm Stud', 'Grain Farm', Wallumbilla	PH, HF
York, A. J., C. J., I. G. & J. E., 'Yorkaringa Stud', 'Taunton', Wallumbilla	PH
York, N. W., 'Mt. Leigh', Wonga Park, Wallumbilla	HF
York, N. W. & B. E., 'Yorkaringa Stud', 'Kundabung', Wallumbilla	PH

Maryborough Division

Agar Pastoral Co., P.M.B. 3, Murgon	SG
Agnew, D. A. M., 'Mikobe Poll Hereford Stud', Imbil	PH
Ahern, M., 'Bandon', Gayndah	BS
Alcheringa Pastoral Co., 10 Coomber Street, Bundaberg	CH
Avis, J. & L., M.S. 979, Monto	JS
Bayliss, D. E. & Co., 'Delspring', M.S. 537, Kingaroy	MG
Bentley, E. J. & P. A., 'Jedda Park', No. 1 Pope Road, Mothar Mtn., Gympie	AG
Bishop, P. R., 'Garglen', Southside, Gympie	BM
Black, A. E. & C. S., 'Ventnor', M.S. 90, Kingaroy	AIS
Black, R. E. & Co., M.S., 243, Kingaroy	HF
Black, T. G. & M. K., 'Hazeldean Stud', M.S. 692, Nanango	SG
Boyd, F. H. & F., 'Robin Vale Stud', Neusa Vale, via Gympie	JS
Brian Pastures Research Station, Gayndah	HF, SW, HFXSW
Bronte Grazing Co., 'Bronte', M.S. 1256, Gayndah	BF
Brown, M. R. K. & Smith, I. W., 'Silverdeen', M.S. 979, Monto	JS
Browne, J. M., 'Achil Stud', Achil, M.S. 660, Proston	HF
Buchholz, C. E., 'Baron Downs', P.O. Box 175, Maryborough	SG
Burnham, B. A. & B. J., 'Bimbadeen Brangus Stud', 'Upson Downs', Abercorn	BS
Burnham, H. E., 'Boolgalgopal', Abercorn	BM

Cameron, F. & E. L., 'Evelor AIS Stud', M.S. 767, Yarraman	AIS
Campbell, M. P., 'Tiaro Park', Tiaro	BM
Carlyle, D. I. & J. C., 'Wonga Hills Stud', M.S. 355, Chinchilla	PH
Charbray Farms, 'Bells Bridge', Gympie	CL, CB
Clarkson, D. W. & D. L., Watson's Road, Gympie	CB
C.S.I.R.O., 'Narayan Research Stn.', Mundubbera	BF
Cotter, C. & G., 'Adina', Upper Widgee, via Gympie	BF
Cotter, C. V. & J. R., 'Narrabri', P.S. 1030, Gympie	BF
Craig, R. T. & P. A., 'Dulong', M.S. 1096, Nambour	MG, HF
Crawford, G. L. & Sons, 'Glenvillan', Mannuam Road, M.S. 90, Kingaroy	JS
Crombie, J., 'Woodlyn Stud', 'Mellera', Blackbutt	DM
Cudlipp, R. A., 'Beaver Rock', 'Granville', M.S. 781, Maryborough	CB
Dandilla Pastoral Co., 'Dandilla', M.S. 514, Kingaroy	BF
Daniells, W. F. & I. C., 'Weens', M.S. 780, Kingaroy	HF
Dau, I. G. & M. H., Parkyn Road, Mothar Mt., via Gympie	CL
Dean, G. F. & A. M., 'Gadfield Stud', Home Creek, Wooroolin	CH, SM
Dingle, N. J. & E. J., 'Dingleville Braford Stud', Dingleville, M.S. 221, Maryborough	BF
Dolding, C. M. & B. E., 'Dilston', Gayndah	DM
Downes, R. W. & J. A., 'Roween Charolais Stud', M.S. 285, Bauple	CL
Eidsvold Station Holdings Pty Ltd., 'Belvedere', Eidsvold, c/- Douglas, Heck & Burrell, G.P.O. Box 35, Brisbane	SG
Ellis, N. R. & J., 2 Purcells Road, Bells Bridge, Gympie	FS
Fisher, E. M., 'Tambookie', 36 Bath Tce., Gympie	BM
Ford, S. R. & Sons, 'Wattlebrae', S. M. 514, Kingaroy	CL
Forman, N. & L. F., 'K-Lyn Jersey Stud', 27 Gympie-Brooloo Road, Kandanga	JS
Forman, V. & S., 'Laguna Jersey Stud', Gympie	JS
Frohloff, I. E., 'Charland Stud', M.S. 648, Yarraman	CL
Garthe, E. F., 'Far End Hereford Stud', P.O. Box 8, Cooroy	HF
Gauld, C., 'Moongana', Brooweena	SG
Gayview Past Co., 'Reids Creek', M.S. 1255, Gayndah	DM
Gear, H. H. & P. E., Takura, via Maryborough	MG
Gibson, W. W., 'Glencrest', Mooloo, via Gympie	GS
Gleeson, M., 'Mudjimba Murray Grey Stud', P.O. Box 184, Noosa Heads	MG
Glenrae Pastoral Co. Pty Ltd., 'Bowenfels', P.O. Box 54, Kingaroy	PH

Goonoona Pty Ltd., 'Kemsdale', M.S. 612, Kingaroy	HF	Lind, O. H. & W. L., 'El-Jaycee', Gordon Brook South, M.S. 780, Kingaroy	BF
Graham, L. M., 'Glenmore' & 'Glenlea' Studs, P.S. 1494, Nanango	BF, HF	Lobegeiger Farmlands Pty Ltd., 'Lagoon Park', Wallaville	BF
Groves, K. W. & K. M., 'Groveleigh', 17 Sorensen Road, Southside, Gympie	BF	Logan, P. G. & P. E., M.S. 305, Innes Park, Bundaberg	BM
Haigh, A. C. & R., 'Lagoonside', M.S. 979, Monto	GS	Louttit, J. R. & M. D., 'Lagoon', M.S. 979, Monto	BM
Hannant, B. & M., 'Croalah Stud', M.S. 243, Kingaroy	PS	Lowther, J. P. & A. M., 'Silverleaf Hereford Stud', M.S. 355, Chinchilla	HF
Hardgrave, D. & P. F., 'Arrawatta', 2 Traveston Crossing Road, Kybong, via Gympie	FS	Lucas, R. L. & J. H., 'Aeroview', M.S. 243, Kingaroy	JS
Hardgrave, D. & P. F., 'Arrawatta', M.S. 650, Biggenden	FS	McGuckin, D. D. & J. L., & Francis, I. D. & B. J., M.S. 790, Monto	HF
Hare, B. M. & J. R., 'Wahpunga', Kin Kin	BF	McIntosh, L. M., M. B. & I. D., 'Widgee Homestead', Widgee, via Gympie	AG
Harrington, 'Winnington Stud', 93 Sorensen Road, Southside, Gympie	CH	McIntosh, W. R., 'Roadvale AIS Stud', 1 Tipman Road, Gympie	AIS
Hazelton Pastoral Co., 'Hazelton', Gayndah	BM	McKewen, M. L. & R. G., Tansey, Goomeri	GS
Higgs, H. L., 'Bangalla', River Road, Tinana	BR	McNaught, R. M. & E. C., 'Kenjame Park', Abels Road, Woolooga	FS
Hinchcliffe, D. W. & J. A., 'Cane Lands', Sexton	DM	Marquardt, C. R. & J. L., 'Cedar Valley Stud', Box 69, Wondai	AIS
Horton, A. E., 'Springfair', M.S. 1382, Wondai	JS	Matheson, R. G. & M., 'Miolo', Owan-yilla, M.S. 221, Maryborough	DM
Hoy, R. S., 'Bungana Park', Belli	DM	Matheson, R. G. & M., 'Inabui', Eaton-vale Road, Tinana	DM
Ibbott, P. J. & R., 'Buffel Vale', M.S. 1132, Mundubbera	JS	Mimosa Stud & Cattle Co., 'Mimosa', Gayndah	DM
Innes Past Co., 'Wyalla Stud', Gin Gin	DM, SG, BM	Moore, P. A., 'Bell Tower', South Isis, Childers	BF
Jensen, L. G., 'Towertown Stud', 'Glenwood', Gunalda	FS	Morris, N. S., 'Goomong Valley Friesian Stud', 'Tarcoola', 8 Goomong Road, Kandanga	FS
Jobling, F. M. & K. W., 'Karalee' & 'Karanga' Studs, M.S. 979, Monto	AIS, PS	Mulholland, J., 'Widgee Crossing Santa Gertrudis Stud', Widgee Crossing, Gympie, c/- 50 Leichhardt Street, Brisbane	SG
Johnson, N. & D., 'Binda Charolais & Charbray Stud', Caulley Road, Sexton, via Gympie	CL, CB	Mullins, J. C., 102 Alford Street, Kingaroy	SW
Joyce & Joyce, 'Barrule', c/- Eidsvold Station, Eidsvold	SG	Norgaard, M. J. & B. F., 'Yarrabine', Box 61, Post Office, Yarraman	FS
Kennedy, D. D., P. E. & M. H., 'Bellwood', M.S. 1550, Cootharaba, via Pomona	MG	Nunn, K. R. & J. A., 'Tecoma', M.S. 243, Kingaroy	JS
Kenny, B. W. & M. A., 'Abernethy Braford Stud', M.S. 1256, Gayndah	BF	Olsson, R., 'Wooden Hut Braford Stud', M.S. 612, Wooden Hut, Kingaroy	BF
Kenny, W. T. & G. M., 'Shirley', Meson Street, Gayndah, P.O. Box 15, Gayndah	BF	Orphant, G. & K. G., 'Westbank', Paterson	HF
Kerr, R. & M., 'Maryview', Miva	BF	Overton, B. W., 'Galaxy Stud', 5 Gap Road, Cedar Pocket, via Gympie	CL
Kerri, R. R., 'Sunnyside', M.S. 117, Monto	GS	Pain, S. J. & L. J., 'Taitlands Braford Stud', M.S. 708, Jandowae	BF
Kinbacher, A. J., 'Garthowen', P.S. 1216, Biggenden	DM	Paine, B. M., 'Tolga', Yengarrie	DM
Kirk, E. & Co., & Mt. Lawless, 'Hazelton', Gayndah	BM	Pearson Bros, M.S. 1184, Murgon	COM
Kirk, J. F. F., 'Caringya', Gayndah	BM	Perkins, M. J. & E. M., 'Byce Jersey Stud', M.S. 692, Nanango	JS
Knight, S. G. & Co., 'Baalgammon', Manumbar Road, Nanango	AIS	Phillips, J. & Sons, 'Sunny View Stud', M.S. 90, Kingaroy	DM
Kunst, L. H., 'Sunnyside', Miva	BS	Pickles, J. R. & R. E., 'Saldanha', Coolabunia, via Kingaroy	PH
Leacy, C. F., 'Comminga Droughtmaster Stud', 93 Summit Road, Pomona	DM	Plant, S. A., 'Trevanna', Cooyar	PH
Learmont, R. S. & R. I., 'Scotlea', P.O. Box 102, Monto	SG		
Leu, R. M. & G. E., Taabinga Pastoral Co., P.O. Box 323, Kingaroy	MG		

Powell, F. W., 'Camelot', P.O. Box 73,
Maryborough..... **DM**
Price, G. D. & P. L., 'Golden Pines Stud',
Yabba Road, Imbil..... **PH**

Queensland Sub-Normal Children's
Welfare Association, P.O. Box 10, Gympie **BM**

Radel, G. R., 'Happy Valley Stud',
Coalstoun Lakes, Biggenden..... **AIS**
Radunz, R. D. & G. R., 'Cool Hill',
Wooroolin..... **SG**
Rose, W. E. & R. M., 'Rosevale Friesian
Stud', M.S.I. 1184, Murgon..... **FS**

Sanders, A. G., 'Dundowran', M.S. 763,
Pialba..... **SG**
Sawtell, M. L. & D. M., M.S. 346,
Nanango..... **AG**
Schloss, C. J., 'Tra-Lee' M.S. 648,
Yarraman..... **BF**
Schloss, K. G. & M. A., 'Tarlaitin
Hereford Stud', M.S. 648, Yarraman..... **HF**
Schroeder, E. A. & R. E., 'Elverum Jersey
Stud', Farm 21, Dagun, via Gympie..... **JS**
Scott, C. N., M.S. 1471, Manumbar Road,
via Nanango..... **FS**
Seawright, T. J., 'Stoneridge Guernsey
Stud', M.S. 301, Monto..... **GS**
Shelton, N. K. & S. B., 'Vuegon', Hives-
ville..... **BF**
Smith, Mrs M. G., 'Sunday Creek
Hereford Stud', Hivesville..... **HF**
Sommerfeld, R. M., 'Brahrock', Beaver
Rock, Granville, Maryborough..... **CB**
Springall, A. H. & B. J., 'Beralan Braford
Stud', Imbil..... **BF**
Stone, C. J. & Y. M., 'Stoneleigh', M.S.
514, Ironpot, via Kingaroy..... **MG**
Stone, Y. M., 'Passchendale', M.S. 514,
Kingaroy..... **HF**
Sutherland, A. E., 28 MacIntosh Creek
Road, Gympie..... **BM**

Taylor, M. R., 'Inverglenn', M.S. 346,
Nanango..... **JS**
Thompson, W. H. & D. M., P.O. Box 20,
Nanango..... **AIS**
Tigell, A. J. & E. A., 'Avondale', Googa
Creek, Blackbutt..... **MG**
Tranberg, N. C., 'Loloma Brahman Stud',
Upper Pin Barren Road, M.S. 626,
Pomona..... **BM**
Tranberg, N. C. & M. R., 'Loloma
Brahman Stud', M.S.F. 115, Gympie..... **BM**
Tunstall, D. C., 'Hi Valley', M.S. 692,
Nanango..... **SH**
Turner, E. G. & J. F., 'Lugenor Brahman
Stud', P.O. Box 307, Maryborough..... **BM**
Tyquin, J. G. M., 'Tuncul Park',
Tuchenoi Road, Imbil..... **PH**

Watts, N. T. & L. J., 'Perseverance', Kin
Kin, M.S. 626, Pomona..... **AY, FS**
Webster, B. E., 'Kamaruka', P.O. Box
403, Kingaroy..... **BS**
Webster, G. C. & C. A., Gympie..... **BF**

Wilson, J. N. & Son, 'The Valley',
Blackbutt..... **DM, BM**
Woodgate, G. J. & J. M., 'Robin Vale
Stud', Neusa Vale, via Gympie.....

Rockhampton Division

Allawah Stud Partnership, 'Allawah',
Theodore..... **BM**
Ambrose, H. J., 'Lime Quarries', Brahman
Stud, Marmor..... **BM**
Appleton, P. J. & D. M., 'Windradene',
Clermont..... **BM**
Atkinson & Co., 'Glenavon', Yaamba..... **SG**
Atkinson, P., P.O. Box 1, 'Coorumburra',
Marlborough..... **SG**
Atkinson, S. J., 'Wairuna Brahman Stud',
'Bundarra', Nebo..... **BM**
Bath, J. W., 'Nahoose', Banana..... **BM**
Beak, C. R. & V. M., Mt. Miller, Yarwun..... **BM**
Bell, J. W. H., 'Bilandra', Jambin..... **BM**
Bergstrom, B. & E., 'Chrisaelgy Brahman
Stud', 'East End', Mount Larcom..... **BM**
Bolingbroke Pastoral Co., 'Bolingbroke',
via Sarina..... **SG**
Bowkett, C. A., 'Bowville Stud', P.O.
Box 221, Biloela..... **DM**
Brieffies, F., Blue Mountain, via Sarina.... **AFS**
Brieffies, F. J., M.S. 1298, Sarina..... **AFS, AM**
Brigalow Research Station, Dept. of
Primary Industries, M.S. 1586, Theodore.. **HF**
Broadlea Partnership, 'Broadlea', Box
35, Theodore..... **BM**
Browne & Son, 'Cooberrie', Woodbury.... **BF**
Bundaberg Sugar Co., 'Avondale',
Brahman Stud, 'Marlborough Station',
Marlborough..... **BM**
Calliope Cattle Co., 'Calliope Station',
Gladstone..... **HF**
Carter, D. A., 'Mirra', Banana..... **BF**
Cavanagh, R. P., 'Elsewhere', Braford
Stud, Jambin..... **BF**
Childs, E. & A. B., 'Glenlands', 'Valuee
Stud', Bouldercombe Road, Rock-
hampton..... **DM**
Christensen, G. A., 'Boomaroo Stud',
'Glenreagh', Banana..... **BM**
Claytons P/L., 'Pinelands', P.O. Box
120, Yeppoon..... **BS**
Cole, W. C. & C. B., 'Alligator Creek'..... **FS**
C.S.I.R.O., 'Belmont Research Station',
P.O. Box 542, Rockhampton..... **BR**
Coombe Bros, 'Roxborough', Greenlake
Road, Rockhampton..... **BM**
Currant, J. M. & E. A., 'Rio Station',
Duaringa..... **BM**
Deguara, V., 'Savannah Brahman Stud',
Post Office, North Eton..... **BM**
DeLandelles, L., 'Cherokee', Tanby, via
Yeppoon..... **BM**
Dickson, D. A. & E. I., 'Eton Park',
Dululu..... **FS**

Douce, H. L., 'Cleveland', Alpha.....	BM	Kirwan, B. F., 'Colston Park Stud', via Sarina.....	DM
Dudarko, N. & H., 'Callide Poll Hereford Stud', P.O. Box 234, Biloela.....	PH	Kummerfield, B. R. & J. H., 'Lonley', c/- P.O. Box 7, Goovigen.....	GS
Edgar, D. & Co., 'Armagh', Morinish.....	BF	Lamb, B. G. & R. M., 'Abbottsford Brahman Stud', Dingley Dell, M.S. 1017, Biloela.....	BM
Emerald Pastoral & Agricultural College, c/- K. J. Hacker, P.O. Box 257, Emerald..	BMX, HF, BRX	Lang, M. K., 'Narweena', P.O. Box 100, Moura.....	DM
Eulogie Partnership, 'Eulogie', Dululu.....	BF, PH	Lewis, C. M. & D. V., 'Bramleigh', Baralaba.....	BM
Fig Tree Farming Co., c/- F. J. & J. L. Dawson, Ridgeland, Rockhampton.....	AIS, FS	Lund, C. H., 'Namlin', Milman.....	BF
Doyce, F. & D., 'Waterhole', Bloomsbury..	BM	McCamley, G. E., 'Tartrus', Marlborough..	BM
Fraser, F. & I. C., 'Dundee Stud', Raglan..	BM, BS	McCamley, J. R. & A., 'Lancefield' Brahman Stud, Dululu.....	BM
Freegard, G., N. & A., 'Hillalong', Crediton, Dalrymple Heights.....	AFS	McCartney, A. M. & E. H., 'Maroomba' and 'Lomalinda' Studs, 'Maroomba', Marlborough.....	BF
Garle, T. P., 'Warragun Brahman Stud', Kilblane, Bajool.....	BM	McDonald, J. D. & D. B., 'Kolonga', M.S. 656, Habana, via Mackay.....	BS
Grace, R. G., Portion 9 and 15, Barfield...	BS	McFadzen, F. W., 'Glenvale Friesian Stud', M.S. 1598, Sarina.....	FS
Green Global Trading Co., 'Global Belmont Red Stud', 'Daisy-Dell', via Bororen.....	BR	McKenzie, J. W., 'Rhudanna Brahman Stud', 'Rhudanna', Comet.....	BM
Green, L. B. & R. B., 'Isla Downs', Theodore.....	HF	McMillan, C. A., 'Pine Avenue Stud', Rockhampton.....	BM
Greiss, K. F. & K. P., 'Glendon Friesian Stud', The Caves.....	FS	May, J. L. & A. M., Gracemere.....	BM
Harch, M., M. T. & Sons, 'Lane Park', Coreen.....	LM	Maynard, R. F. & R. H., 'Greenfields', Jambin.....	BM, CL
Hardwick, C. R., 'Charlyn', Marlborough..	BM	Meldrum, A. R., 'Brackyn Hills', Parkhurst.....	BM
Harsant, 'Greenroc', Dawes, via Thangool.	AG	MV Pastoral Development P/L, 'Woolton', Theodore.....	HF
Hay, T. R. & Co., Pindi Pindi.....	BM	Naree Pastoral Co., c/ H. A. & N. E. Bloodworth, 'Merriwin', Longreach.....	BF
Hendy, F. R., 'Glenlee', P.O. Box 3, North Rockhampton.....	BF	Nielsen, S. E., 'Netley', P.O. Box 590, Biloela.....	DM
Prisons H.M., 'Etna Creek', via Rockhampton.....	M	Nobbs, P. E. C. & V. K., 'Lyndhurst', Biloela.....	BM
Hicks, D. J., 'Alanray', P.O. Box 222, Moura.....	BM	North, A. F. & J. E., 'Northbrook', Millman.....	BM
Hinz, Estate H. & F. H., 'Glenmoya', Rossmoya Road, The Caves, via Rockhampton.....	BF	Nott, G. C. & D. L., 'Burwood Brahman Stud', 'Belconnen', Milman, M.S.I. 1244, Rockhampton.....	BM
Hobbs, A., Birkdale, Dartmouth.....	CL, CH, SG	Ogden, L. & N. M., 'Red Hill Brangus Stud', M.S. 1017, Biloela.....	BS
Howlett, J. L. & J. C., 'Carinya', Bracewell, via Mt. Larcom.....	AIS	Olive, A., 'Nullegai', Marlborough.....	BM
Hughes, A. L. & P., 'Woodlea', Bluff.....	BM	Osbourne, D. A. & M., 'Granville', M.S. 588, Alton Downs.....	BF
Jackson, C. J. & M. E., 'Jaffra', Gogango, Fairy Bower Road, Gracemere.....	BM	Paddy's Plains, Bungandara, via Yeppoon..	SG
Jeppeson, K. E. & E. J., 'Taranga', Bloomsbury.....	BM	Parker, T. P. D. & P. M., 'Grazzi', M.S. 656, Barcoo, via Mackay.....	BS
Johnson, K. E. & K. J., 'Elsinore', M.S. 1396, Biloela.....	DM	Pask, C. W. W., 'Beacon Pastures Brahman Stud', 33 Perry Street, Mackay..	BM
Kajewski, P. G. & A., 'Newlands', Duaringa.....	SG	Princhester Grazing Co., 'Princhester', Princhester Siding, N.C. Lince.....	SG
Keating, J. F., 'Sequen', Baralaba.....	BF	Pullen, M. D., W. L. & A. M., 'Tannock', Mirani.....	BF
Kenrol Brahman Stud, c/- E. G. Cole, 'Matcham', Gracemere.....	BM	Rasmussen, A. W. Pty Ltd., 'Prague Lands', Alligator Creek, via Mackay.....	DM
King, E. W., 'Comanche', Morinish, via Rockhampton.....	DM	Rea, W. J., M. & Co., 'Clifton', Marlborough.....	BF
King, E. W., c/- Kengoon Pastoral Co., Dingley Dell, M.S. 1017, Biloela.....	DM, AF, BM		
King Ranch Development Co. P/L, 'Elgin Downs', Clermont.....	SG		
Kirk, A., M. & C., 'Rockley', Bajool.....	BM		

Redman, J. G., 'Illa-Lang', Baralaba.....	BF	Thurgood, G., c/- Post Office, Dalrymple Heights.....	AFS
Rio Pastoral Co., J. M. Currant, Allandale, Theodore.....	M	Titmarsh, J. F., 'Wattlevale', Ridgeland, via Rockhampton	AIS
Rowe, F. C., 'Cheyenne', Banana.....	BM	Walker, I. E., M. A. & P. L., 'Strathmore Santa Gertrudis Stud', 'Strathmore', Longreach, c/- Post Office Box 166, Longreach.....	SG
Rowe, F. T., 'Greenacres', Banana	BM	Walker, Sir James, 'Camden Park', Longreach.....	SG
Royston Park Grazing Co., c/- Mr W. Fordyce, Kuttatubul, via Mackay.....	BS	Walker, Sir James, 'Cumberland', Longreach.....	SG
Scantlebury, J. A., 'Badminton', M.S. 1855, Theodore	HF	Walker, M., 'Avoca', Barcaldine.....	SG
Schottelius, C. L. & A. R., 'Willawa', P.O. Box 149, Theodore.....	BF	Walker, M. A., 'Camelot', Griffdale, Dartmouth	SG
Schultz, G., 'Hillview', c/- Post Office, Mt. Larcom	BM	Watts, K., M. E. & D., 'Keimar', Hamilton Creek, Mt. Morgan	BF
Scott, V. G., 'Wiluna Friesian Stud', Wiluna, Wowan.....	FS	Westcott, H. L. F., 'Olympus', Munbura, via Sarina	BM
Semple, J. H., 'Braeview', Biloela.....	SG	Wharton Creek Past Co., 'Wharton Creek', Springsure.....	BF
Semple, K. H. & R. M., 'The Meadows', P.O. Box 495, Biloela	SG	White, R. T. & B. A., 'Wilangi', Brahman Stud, Wumalgi	BM
Shannon Partnership, Cardowan Grazing Co., 'Cardowan', via Sarina.....	BF	Yarra Yarra Braford Stud, c/- F. M. Hendy, 2 State Farm Road, Biloela.....	BF
Sherriff, J. G. & L. G., 'Wheeler View Yeppoon', 12 Maple Street, Yeppoon	CL, CB, BM		
Sichter, J. S. & E. A., 'The Loch Brahman Stud', Alligator Creek, via Mackay	BM		
Smith, F. H. & E., 'Sommerville Brahman Stud', 'Brahmeadows', M.S. 1883, Rockhampton	BM		
Soppa, M., 'Riverside', Ogmoo	BM		
Sparke, R. L., 'El Rocco', c/- P.O. Box 77, Moura.....	BM		
Sparke, R. L., 'Wirranda', Moura.....	MG		
Stanbroke Past Co., 'Waverley', St. Lawrence.....	BM		
Swan Hill Pastoral Co., 'Swan Hill', Blackall	SG		
Sykes, B., 'Glen-App', Milman.....	BM		
Sykes, B. & R. N., 'Oxborough', P.O. Box 718, Rockhampton	BM		
Sykes, B. & R. N., 'Amaroo', P.O. Box 718, Rockhampton	BM		
Tarana Past Co., 'Tarana', Gracemere.....	M		
Tennant & Geddes, 'Doonside', Rossmoya, via Rockhampton.....	BF, BS		

Townsville Division

Ayr Research Station, P.O. Box 15, Ayr... M

Cairns Division

Cardillo, J., 'Oena', Springs Road, Mareeba	DM
Davidson, M. T. A. & R. J., 'Waterloo Brahman Stud', P.O. Box 207, Mossman ..	BM
Kairi Research Station, P.O. Box 27, Kairi	M
King Ranch Development Co. P/L., Tully River Station, Euramo.....	SG
Rasmussen, E. J., 'Euluma Stud', c/- P.O. Box 80, Mossman	DM

INDEX

AF	— Afrikaander
AG	— Angus
AFS	— Australian Friesian Sahiwal
AIS	— Australian Illawarra Shorthorn
AMZ	— Australian Milking Zebu
AY	— Ayrshire
BR	— Belmont Red
BF	— Braford
BM	— Brahman
BS	— Brangus
CB	— Charbray
CL	— Charolais
CH	— Chianina
COM	— Commercial
DM	— Droughtmaster
FS	— Friesian
GW	— Galloway
GS	— Guernsey

HF	— Hereford
JS	— Jersey
LM	— Limousin
M	— Mixed
MG	— Murray Grey
PH	— Poll Hereford
PS	— Poll Shorthorn
RP	— Red Poll
SW	— Sahiwal
SG	— Santa Gertrudis
SH	— Shorthorn
SM	— Simmental
MA	— Marchigina
DV	— Devon
PD	— Poll Devon
RS	— Red Sindhi
PZ	— Pinzgauer
RN	— Romagnola

'Watery' pork cuts returns

by C. B. Davis, Veterinary Public Health Branch

Pale soft exudative (P.S.E.), or 'watery' pork, as it is better known in the trade, is a serious condition which is costing the ham and bacon processing industry a lot of money.

P.S.E. pork has been occurring in bacon factories for quite some time. Its incidence appears to have increased during the last 6 to 10 years.

The muscles most frequently affected are the leg, loin or eye muscle, and the fillet. These are the most expensive portions of the carcass. When affected, these cuts are only suitable for manufacturing purposes. This reduces returns to the manufacturer and ultimately to the producer.

It is most important to understand how this condition occurs. It is considered to be caused by stress affecting pigs before slaughter.

Scientific evidence shows that certain pigs are more susceptible than others, therefore P.S.E. is in part a breeding problem. Specific breeds of pigs are more prone to this condition and individual pigs from these breeds may show a higher susceptibility.

These pigs are also usually more prone to stress, deaths on the way to the meatworks and unexplained deaths at the meatworks before slaughter.

If susceptible pigs reach the meatworks alive, they are much more liable to P.S.E. muscles after slaughter.

P.S.E. may affect all or part of a muscle. This is most pronounced in the eye muscle of a middle bacon. Middle rashers may show dark and light areas in the eye. The affected muscle has a fish-like texture and is much paler in colour. It may ooze watery fluid. When P.S.E. meat is cooked, the affected portion has an inferior texture and tends to be dry. Pale, watery muscle loses much more moisture during cooking than normal meat. P.S.E. cooked hams have a greater amount of jelly and the pale, watery muscle is drier and has a poorer texture.

Pork affected with P.S.E. is of little use to a processor apart from its possible use in manufacturing smallgoods. Even for this use, it is not really successful as it binds fat and water poorly and produces a poor texture. P.S.E. is very noticeable in the cured product. Hams and bacon noticeably affected are not offered for, or withdrawn from sale. This causes financial loss because of the high cost of processing.

To lower the incidence of P.S.E., the whole industry including producers, carriers and meatworks need to recognize the problem and work together to lessen it.

Producers could help by:

- Breeding stress resistant pigs.
- Avoiding undue stress factors such as high temperatures.
- Avoiding overcrowding.
- Avoiding mixing pigs at loading that is, with other unfamiliar pigs.

Carriers could help by:

- Travelling pigs during the cooler parts of the day.
- Covering the top of the truck with hessian. Canvas or plastic may cause overheating. If no cover is used, sunburn can occur. Remember, if the driver is hot, and feels like a cold beer, the pigs probably feel two or three times as bad.
- Allowing pigs to leave the truck with a minimum of stress at the meatworks. Remember, travelled pigs have probably been put under more stress in the preceding few hours than they have since they were born.

The processor could help by:

- Making sure that unloading facilities are adequate.
- Ensuring holding yards are clean and dry and an adequate supply of fresh water is available.
- Handling pigs as efficiently as possible.



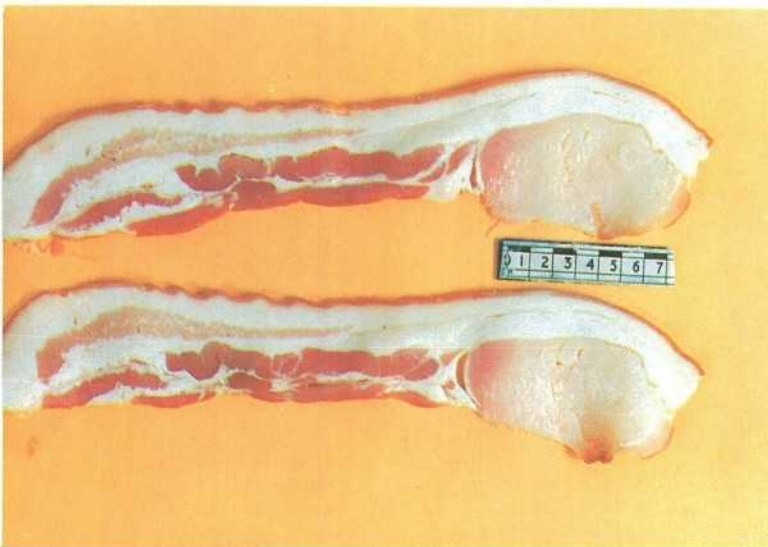
'Watery' pork cuts returns



A cut of P.S.E. pork showing the pale colour, fish-like texture, and excessive 'drip'.



The same cut as above compared with normal pork.



P.S.E. eye muscle in bacon rashers.