Queensland
AGRICULTURAL JOURNAL

March–April 1979 Vol. 105 No. 2

DEPARTMENT OF PRIMARY INDUSTRIES

Director-General	E. O. Burns
Deputy Director-General	Dr. G. I. Alexander
Chief Advisory Officer (Administration)	N. F. Fox
Assistant Under secretary	
Assistant to Director-General	
Accountant	J. D. Reardon
Director, Information and Extension Training Branch	M. D. Littmann
Executive Officer, Central Administration	K. G. Trudgian
Chief Biometrician	C. P. Hamilton
Executive Officer, Research Stations Section	G. H. Allen
Executive Officer, Extension Services Section	J. Gibb
Director, Division of Plant Industry	B. L. Oxenham
Deputy Director	G. S. Purss
Director of Agriculture	Dr. J. K. Leslie
Director of Horticulture	N. S. Kruger
Director, Botany Branch	Dr. R. W. Johnson
Director, Entomology Branch	T. Passlow
Director, Plant Pathology Branch	Dr. R. C. Colbran
Director, Agricultural Chemistry Branch	T. J. Beckmann
Director, Division of Land Utilisation	A. Hegarty
Deputy Director	H. W. Pauli
Director, Development Planning Branch	W. F. Y. Mawson
Director of Soil Conservation	H. S. Pink
Director, Division of Animal Industry	
Deputy Director (Research)	J. W. Ryley
Deputy Director (Field Services)	B. A. Woolcock
Director of Veterinary Services	S. G. Knott
Director, Biochemistry Branch	C. W. R. McCray
Director of Husbandry Research	L. Laws
Director of Pathology (A.R.I.)	W. T. K. Hall
Director of Sheep Husbandry	Dr. P. S. Hopkins
Director, Beef Cattle Husbandry Branch	M. R. E. Durand
Director, Slaughtering and Meat Inspection Branch	B. Parkinson
Director, Pig and Poultry Branch	F. N. J. Milne
Director, Division of Dairying	W. D. Mitchell
Deputy Director	
Director of Research	A. J. Gillies
Director of Field Services	G. G. Crittall
Director, Dairy Cattle Husbandry Branch	I. H. G. Rayner
Director of Marketing	D. P. Lapidge
Deputy Director	D. R. J. Densley
Director of Economic Services	R. B. Bygott
Director of Marketing Services	W. Kidston
Director of Agricultural Standards	W. V. Mungomery

COVER: Silky oak *(Grevillea robusta)* is a native tree that was discovered and named by Allan Cunningham in 1827.

See 'The Grevilleas of South-eastern Queensland' in this issue.

Photograph by M. W. Hodge.

QUEENSLAND AGRICULTURAL JOURNAL

Vol. 105 No. 2 March–April 1979

Editor—P. R. Lee

Contents

The *Queensland Agricultural Journal* is published every second month by the Department of Primary Industries, William Street, Brisbane, Queensland, 4000. Telephone 224 0414.

71679—4

New pastures for the

by J. K. Teitzel and C. H. Middleton, Agriculture Branch.

NATIVE pastures in the wet tropical coast have very low carrying capacities and poor cattle fattening abilities. Consequently, it has become necessary to introduce better plants from overseas.

South Johnstone Research Station has been the centre of pasture plant introduction and evaluation for the Australian wet tropics since the late 1930s. Over 1 000 introductions have been made with some 44% occurring after 1965.

Beef production is the major enterprise and pasture evaluation studies have placed emphasis on the maintainence of rapid and economic fat cattle turn-off and pasture stability.

Currently recommended commercial pastures

Grass/legume pastures form the basis of commercial beef production enterprises in the Australian wet tropics. Certain grass-only pastures which receive nitrogen fertilizer dressings of at least 200 kg nitrogen per ha per year (grass/bag nitrogen pastures) give higher levels of production but are much less attractive financially.

Inherent soil fertility and drainage are major determinants in the choice of pasture mixtures and this is reflected in the list of currently recommended grass/legume mixtures shown in table 1. It must be stressed that desirable levels of phosphorus and trace elements must be maintained in the soil if these pastures are to give satisfactory production. An adequate

Riversdale guinea grass/puero.

nitrogen input is critical and nitrogen fixation by legumes is particularly sensitive to both over and under-supply of trace elements. A thorough knowledge of soil mineral nutritional status is therefore essential.

One of the biggest problems with these grass/legume pastures is their highly uneven seasonal production. Growth is vigorous during the wet season (more than 150 kg dry matter per ha per day) but gradually declines to very low levels (less than 50 kg per day) during the cooler dry season.

Normal practice is to base property stocking rates on the pastures' ability to carry animals through the cool, dry season. This, however, results in inefficient utilization of the feed grown in summer.

To help overcome this problem, we recommend that each property should combine the winter productivity and carrying capacity of grass/bag nitrogen pastures with the economy of grass/legume pastures. A suggested ratio is 25% of grass/bag nitrogen and 75% grass/legume. The grass/bag nitrogen pasture should be located on the heavier, deeper soils which will be better supplied with moisture during the cool, dry season.

Species recommended for the grass/bag nitrogen pastures are Basilisk signal grass (*Brachiaria decumbens*) and para grass (*B. mutica*). Pangola (*Digitaria decumbens*) was once popular but, because of recent pest and disease problems (rust and aphids principally), it can no longer be recommended.

Riversdale guinea grass/centro.

TABLE 1

CURRENTLY RECOMMENDED GRASS/LEGUME MIXTURES FOR VARIOUS SITUATIONS IN THE WET TROPICS

Situation	Grass–legume mixture*
Well-drained fertile soils	Guinea-centro-puero
Well-drained soils of moderate fertility ..	Guinea-centro-puero-stylo
Well-drained soils of low fertility	Guinea-puero-stylo, or signal grass-puero-stylo
Moderately-drained soils	Hamil-centro-puero-stylo
Poorly-drained soils	Para-centro-puero-stylo

*Guinea =*Panicum maximum* cultivar Riversdale or common.
Hamil =*Panicum maximum* cultivar Hamil.
Para =*Brachiaria mutica*.
Centro =*Centrosema pubescens* cultivar Belalto or common.
Puero =*Pueraria phaseoloides*.
Stylo =*Stylosanthes guianensis* cultivars Schofield, Cook or Endeavour.

Alternative pastures

Certain other pastures are known to be more productive than the recommended pastures under certain conditions. Good examples are some elephant grass (*Pennisetum purpureum*) cultivars when grown on deep, friable, fertile soils. However, their restricted environmental range and problems related to establishment and management have resulted in the general attitude that the marginal increase in productivity does not compensate for the added costs and troubles.

There is an even larger number of commercially available cultivars which, although quite useful, have nevertheless been shown by grazing trial comparisons and commercial experience to be significantly less productive than the recommended pastures. Some of the more important examples include guinea grass cultivars Coloniao and Embu, *Setaria anceps* cultivars Nandi and Kazungula, *Brachiaria ruziziensis* cultivar Kennedy, *Melinis minutiflora* (molasses grass), *Glycine wightii* cultivar Tinaroo, *Vigna luteola* cultivar Dalrymple, and *Macroptilium atropurpureum* cultivar Siratro.

More than 1 000 introductions were screened out early in the evaluation phase at South Johnstone because of some clearly evident trait. Included among these were species (for example, some *Brachiaria* spp. and *Cynodon* spp.) which are used extensively in other countries. Others, such as *Leucaena* got to an early stage of evaluation under grazing but persistence or establishment problems suggested that further testing be given low priority.

New pasture plants

Problems associated with the highly uneven seasonal production of the recommended pasture types were described earlier. Table 1 indicates that selection of some of the recommended pastures was dependent on their relative adaptability to inherent soil infertility and poor drainage. There is still room for considerable improvement in all three characteristics. It would also be helpful to have a legume which would persist with the vigorous prostrate grasses under grazing, and pastures which are less sensitive to grazing mismanagement.

- PASTURES WITH A LESS SEASONAL GROWTH CURVE

Sensitivity of the legume to low temperature is the single most important production limitation. Progress was thought to have been made with the commercial release of Belalto centro, Cook and Endeavour stylos, and Makueni guinea. All had shown superior cool season growth to their equivalent, commercially available cultivars in small plot experiments. However, with the exception of Belalto centro, none of these cultivars has shown this superiority under grazing.

Current animal production levels achieved from Makueni pastures have been less than those from Riversdale. Makueni pastures also appear to be more difficult to establish and more prone to weed invasion. These observations must be cushioned by the fact that we have had a series of warm winters. Makueni could well be better suited to cooler areas.

ABOVE. Hamil guinea grass/stylo. Hamil is a replacement for Riversdale in moderate to poorly-drained areas.

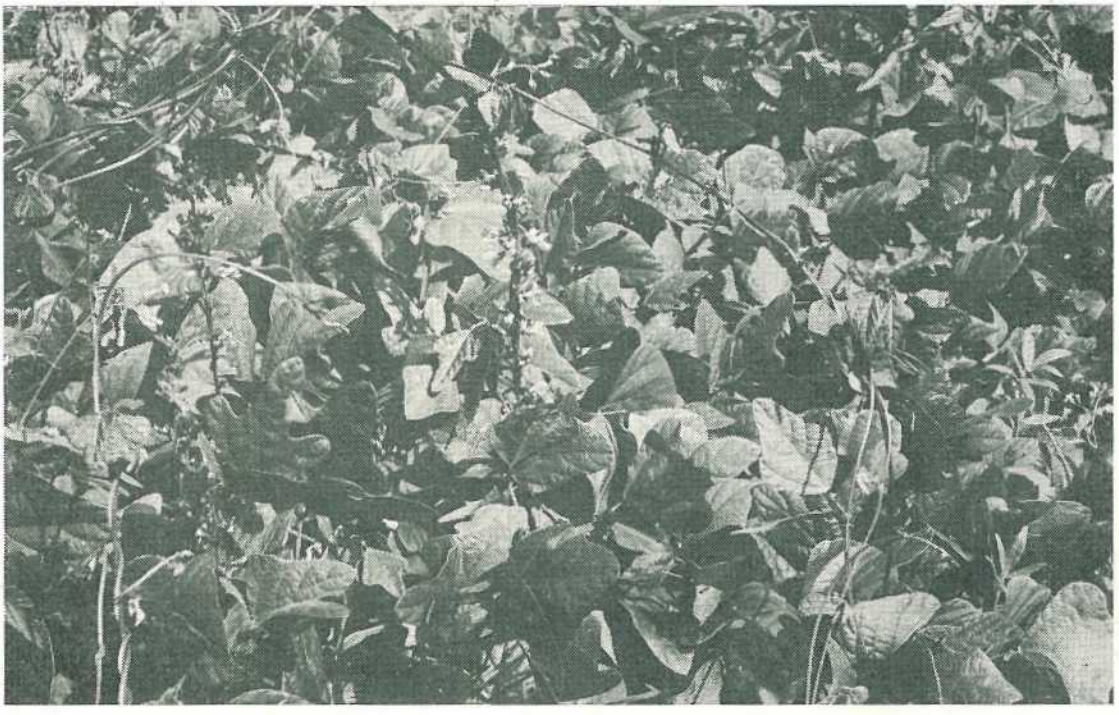
BELOW. Setaria splendida—*a grass showing promise but still under test.*

With Cook and Endeavour stylos, the correction of mineral deficiencies and the resultant higher stocking rates have placed them at a competitive disadvantage with both grasses and twining, stolon-rooting legumes (centro, puero). We now regard the three stylo cultivars as only pioneering legumes on naturally infertile soils.

Comparative evaluation of Belalto centro under grazing has not been finalized. Current experiments under simulated commercial systems suggest a superiority to common centro in association with guinea grass at high stocking rates. This is now being reflected in better animal performance. Also, Belalto continues to remain less susceptible to pests and diseases (*Cercospora* leaf spot and red spider) than common centro. Unfortunately, the current economic depression in the beef industry has given little incentive for its seed production and wider usage.

• PASTURES FOR POORLY-DRAINED SITUATIONS

The legumes currently recommended for these situations are at best only poorly-adapted and have some difficulty in forming a stable association with para grass. Limited long term production has only been achieved by restricting grazing to the dry season. A number of *Vigna luteola* lines have been examined in the past and several *V. gracilis* lines are currently under study. However, a more intensive search for replacement cultivars will most likely be required.



Calopogonium coeruleum—*a new legume with some very desirable attributes.*

• LEGUMES WHICH WILL PERSIST WITH VIGOROUS PROSTRATE GRASSES

Difficulty has been experienced in finding legumes which will associate effectively under grazing with the vigorous mat-forming grasses such as pangola and Basilisk signal grass which are currently popular with a large section of the farming community. Schofield, Endeavour and Cook stylos have persisted with both these grasses on sandy mineral deficient situations, but they are relatively unproductive pastures.

It was therefore surprising to find, a number of years ago, that the legume hetero (*Desmodium heterophyllum*) had established itself unaided in a heavily-grazed pangola pasture at South Johnstone. Re-testing of the plant showed that it would form stable and productive (more than 750 kg liveweight per ha per year) pastures with mat-forming grasses in a number of situations. It does, however, have formidable seed production problems and is strain-specific for root-nodule bacteria. This results in establishment problems. Only small areas have been planted commercially.

A number of stoloniferous *Desmodium* lines (for example, *D. canum, D. scorpiurus, D. ovalifolium, D. adscendens*) have been evaluated. Although they possess better seed production habits, none has performed as well as hetero in association with stoloniferous grasses under grazing.

• STOLONIFEROUS GRASSES FOR BUFFER PASTURES

Pure grass pastures of prostrate, mat-forming growth habit have generally been more resilient under heavy grazing or mismanagement than tufted grass/legumes. Such grasses have two important roles to play in the wet tropics of Australia. Firstly, as outlined earlier, they can be used as grass/bag nitrogen pastures to improve winter production. Secondly, they can be used during other stress periods to relieve

the pressure from grass/legume pastures which are more sensitive to grazing management. For example, heavy defoliation or trampling of grass/legume pastures during prolonged wet periods can lead to legume decline and weed invasion.

With the demise of pangola there is a need to find a back-up to basilisk signal grass. Over the last few years, a range of grasses (principally within the genera *Digitaria, Brachiaria* and *Cynodon*) has been examined. Although several introductions have demonstrated much better pest and disease tolerance than pangola, none has approached basilisk signal in yield, yield distribution and responsiveness to winter-applied nitrogen. For the purpose of a buffer pasture for heavy grazing during the wet season, a grass such as *Brachiaria humidicola* or *B. dictyoneura* could be useful despite a marked inferiority to basilisk signal in winter productivity.

- SPECIES WHICH WILL PERSIST UNDER LOWER FERTILIZER INPUT

All the above recommended pastures require the application of about 300 kg superphosphate per hectare every 2 years and re-application of necessary trace elements every 4 to 5 years if they are to maintain a competitive advantage over weeds and regrowth. It may be worth re-testing some of the shrub legumes (for example, *Leucaena, Desmodium*) which may retain a competitive advantage with a lower fertilizer input.

- NEW CULTIVARS WITH GREATER ALL ROUND SUPERIORITY

Over the years, some 20 grasses and legumes have been released principally for use in the wet tropics of Australia. Some of these (common guinea, common centro, Schofield stylo, para grass and Hamil grass) have been in use for over 30 years and are still widely recommended (see table 1). Of the others, some have succumbed to pests and diseases (for example, pangola, *Vigna luteola*) while the supposed superiority of others (for example, Coloniao and Embu guinea, Cook and Endeavour stylo, *Brachiaria ruziziensis*) has not been reflected in increased animal productivity. This has been due mainly to the unexpectedly large production increases from existing pastures resulting from improved fertilizer and management technologies.

While attainment of the ideal pasture plant may well be impossible, considerable scope still exists for improved new plants. *Setaria splendida* and *Calopogonium coeruleum* possess some desirable characteristics and are currently being tested under grazing. New breeder's lines of hybrid *Centrosema* spp. and *Digitaria* spp. are in the preliminary evaluation phase while the evaluation of other hybrids (*Macroptilium atropurpureum* (Siratro) and *Setaria* spp.) is planned. There are also species such as *Hemarthria altissima* which have created interest in other countries, but which have received little attention in Australia.

Council of Agriculture composition changed

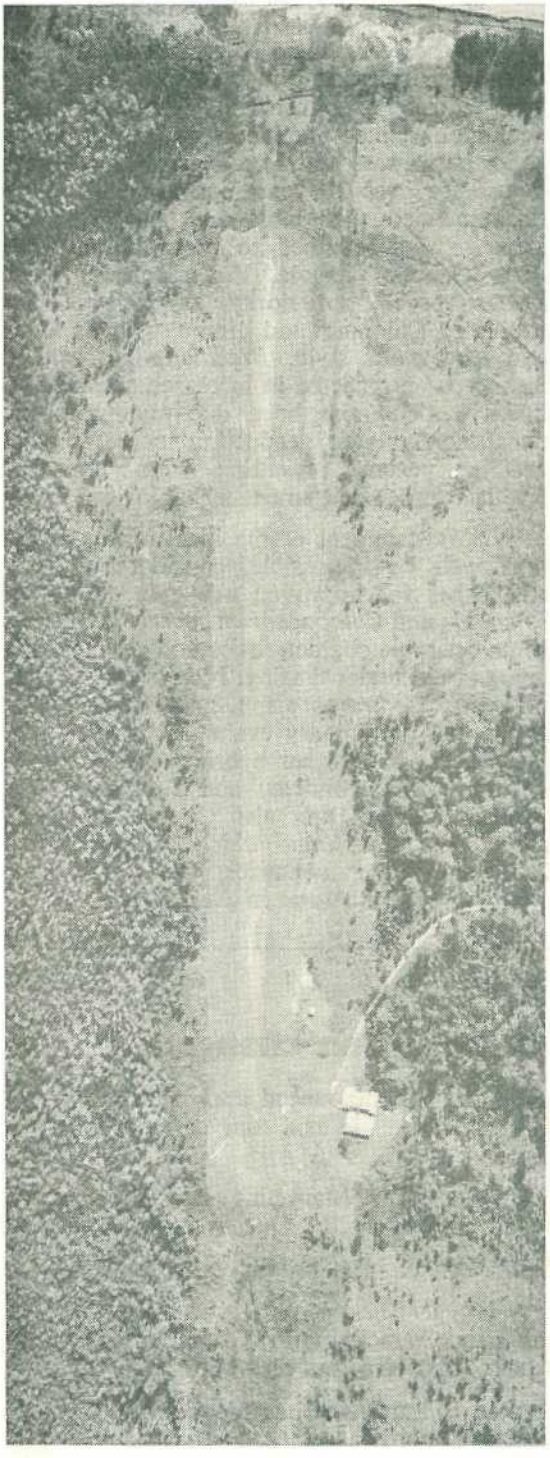
THE Minister for Primary Industries, Mr V. B. Sullivan, has announced approval for changes in the composition of the Queensland Council of Agriculture. He said four organizations had been deleted and two added.

The Broom Millet Marketing Board and Northern Pig Marketing Board no longer functioned and the Brisbane Milk Board had been superseded by the Queensland Milk Board.

The Queensland Commercial Fishermen's State Council was no longer covered by the Department of Primary Industries' legislation.

Other than the Queensland Milk Board, the new Council member organization is the Queensland Commercial Pig Producers' State Council. This also is a newly-formed body.

The Minister said that the Council now represented 14 marketing boards, the State Councils of three producer organizations and the Milk and Wheat Boards.



Check your farm airstrip

by A. J. Ernst, Beef Cattle Husbandry Branch.

THIS article is directed at the many non-pilot country people who take advantage of the benefits of using light aircraft.

These advantages include increases in farm efficiency, mobility and improved medical, delivery and religious services.

The increases in farm efficiency may come from speedier delivery of urgently needed machinery spares or veterinary attention for valuable stock, faster and easier checking of remote watering points, the location of stock to be mustered, earlier detection of flood damage and the position of bushfires to name a few.

Further evidence of the usefulness of aircraft can be seen by the large number of private landing strips on all sorts of rural properties throughout Queensland.

However, many non-pilot property owners and managers do not know the requirements for safe aerial operations and the detailed specifications of their airstrips. A pilot flying to your property, may ask you any or all of the following questions about the location of your property and the location and condition of your airstrip. This is even more likely to happen if it is his first visit to the area. The information allows the pilot to assess the suitability of your airstrip to the operational requirements of his aircraft.

The questions are:

- Where is your property in relation to a major landmark (for example, a river, mountain, road, railway or a property you know is marked on the aviation maps)? Better still, do you know the map co-ordinates of your property?

LEFT. A well-marked landing area.

- Where is the air strip in relation to the homestead or buildings?
- In what direction does the strip run?
- What is the approximate length and width of the airstrip in metres?
- What type of surface. Gravel, grass (long or short), hard or soft?
- Which way if any does the strip slope?
- What sort of condition is the surface in? For example, are there any pot holes, etc?

As a general guide to the suitability of the surface for light aircraft operation, you should be able to drive a heavily sprung vehicle over the surface at 50 kmph (30 mph) in reasonable comfort.

- Is it an all weather strip?
- How high is it above sea level?
- Will there be livestock grazing in the paddock or will they have been removed?
- How high are the trees at either end of the strip and how far are they from the end of the landing area?
- Are there any power or telephone lines near by?
- Is there a windmill, dam, windsock or other device close by which will enable the pilot to easily determine the wind direction.

As well as all of these questions, the Department of Transport lays down regulations regarding the suitability of areas for use as airstrips for aircraft engaged in private, aerial or charter operations during daylight hours.

Briefly, these regulations according to the Department of Transport's Visual Flight Guide are:

Width and approach areas

The strip width and the dimensions of approach and take-off areas at both ends of the strip shall not be less, and the approach and take-off gradients at both ends of the strip shall not be steeper, than those shown in figure 1 (not to scale).

There shall be on obstructions (including wires) on or over the landing area, which includes the hachured area and, no obstructions (including wires) above the approach and take-off gradients.

Length

The strip shall not be less than the length specified in the aircraft's flight manual or approved performance charts as being necessary for take-off or landing as appropriate, under the conditions pertaining.

An aircraft for which there is no approved flight manual or performance chart may be operated with the strip lengths in the following table in accordance with the Department of Transport's categorization table, provided that it is not fitted with any special function, external equipment or is not engaged in agricultural operations.

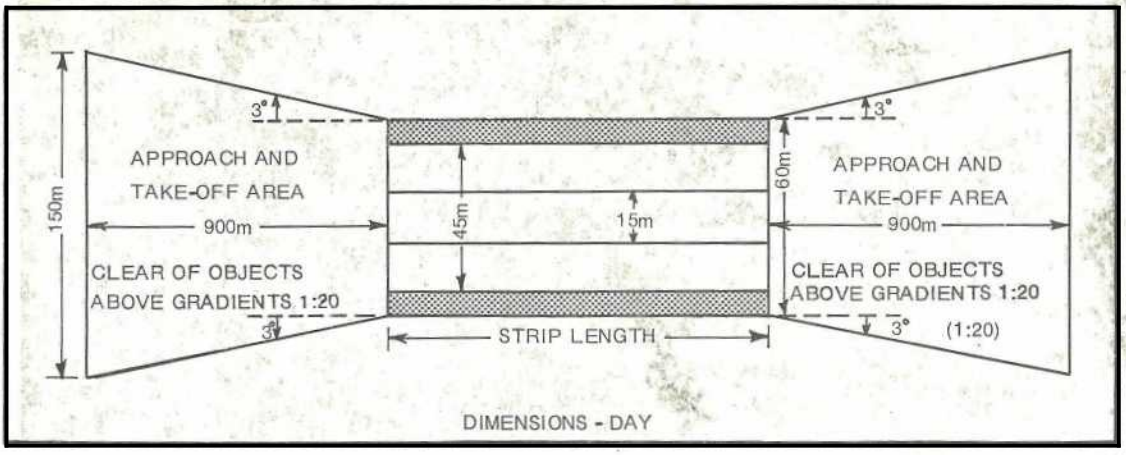
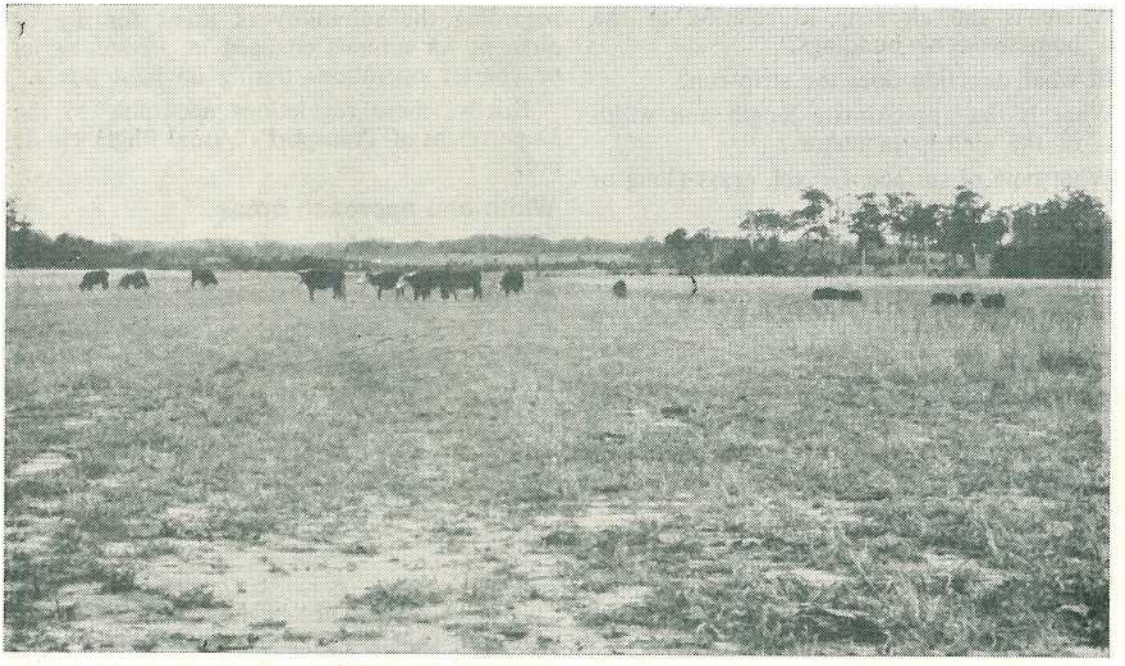


Figure 1.



Cattle near the airstrip are a hazard.

Trees too close to the airstrip can cause wind eddies.

Aircraft category	Required strip length
Category 1	1 050 m (3 500 ft.) plus an increase at the rate of 90 m (300 ft.) for every 300 m (1 000 ft.) the strip is above sea level
Category 2	750 m (2 500 ft.) plus an increase at the rate of 60 m (200 ft.) for every 300 m (1 000 ft.) the strip is above sea level
Category 3	600 m (2 000 ft.) plus an increase at the rate of 60 m (200 ft.) for every 300 m (1 000 ft.) the strip is above sea level
Category 4	450 m (1 500 ft.) plus an increase at the rate of 45 m (150 ft.) for every 300 m (1 000 ft.) the strip is above sea level

The popular single-engined Cessna, Piper and Beechcraft aircraft all fit into category 3. It is not possible due to the wide range of options available to give examples for the other categories. Nor is it possible to give a recommended length as various other factors vary the length required by a particular aircraft.

How does your airstrip measure up?

If you have any doubts or queries about the length, position or suitability of your airstrip, you should contact the Department of Transport.

For those considering building or modifying an air strip here are a few guidelines. As well as the factors listed, you should also consider the direction of early morning and late afternoon sun.

There are three main considerations in selecting the site for an airstrip. These are:

- Terrain
- Prevailing wind
- Accessibility of the site

The flattest area may be too wet after rainy periods, a gently sloping area is usually better for your-round operations. Do not select an area which will align an aircraft's take-off path with any large obstacle (for example, power lines, water towers, windmills, radio and T.V. towers etc.) One-way operations are unacceptable except for aerial agricultural operations (crop dusting or spraying not aerial mustering), so there must be suitable approach and take-off areas at each end of the proposed runway.

The maximum allowable longitudinal grade between strip ends shall be 1:50 but longitudinal grades up to 1:35 on any part of the strip may be permitted if the change of grade is gradual. The maximum allowable transverse grade shall be 1:40 over the central 45 m of the strip and 1:8 over the remainder of the strip.

The central 15 m (see figure 1) of the strip over its length shall be smooth, 15 m on each side of the central 15 m shall be in such condition that an aircraft running over it following a swing on take-off or landing would not suffer damage.

The portion of the strip enclosing the runway and run-off area should be marked with large, white gable markers about 3 m long and made of frangible materials, flush rectangular markers of a similar size or large, white cones. They should be spaced at not more than 180 m intervals along each edge, with 4 across each end. Two markers should be used at corners. An adequate and commonly used substitute on properties is old motor car tyres painted white.

Fences which cross the approach or departure ends should be conspicuously marked with white discs 60 cm in diameter along the central 30 m.

Obstacles such as poles or other hard to see objects close to an approach should have their tops conspicuously painted (white or white/red bands).

Some points to keep at hand and an example:

Name	"Multimodal" Homestead
Position	20° 30′S, 144° 00′E
Runway—Direction	05/23 ie. 050°/230° N.E./S.W.
—Length and width	1 000m × 30m
—Surface and condition	Grassed clay
—Markings	
Elevation	180 m (600 ft.)
Other significant information	—Obstruction to the east —Do not confuse with abandoned runway 3 nautical miles east.

Further details can be obtained by contacting the Regional Director, Department of Transport, Aviation House, Fortitude Valley, Q. 4006.

Acknowledgements

The author acknowledges with thanks the assistance provided by The Department of Transport and fellow pilots in compiling this article.

A warning on weed control

by K. W. Priestly, Standards Branch.

IF you use weedkillers, then beware!

You probably know that drift of weedkillers during spraying operations can cause damage to nearby susceptible plants; but, a hidden damage exists when certain formulations of weedkillers are used.

These are the ester formulations. They are volatile—that is, they vaporize easily. They form a vapour, or fumes, composed of very small particles of the weedkiller. Weeds sprayed with these formulations can give off fumes for several days after application. If these fumes blow across a susceptible crop, the damage can be just as severe as if the original spray had drifted on to it.

It is for this reason that the use of these ester formulations of weedkillers in the Shires of Pine Rivers, Caboolture, Landsborough, Maroochy and Noosa, and the city of Redcliffe, has been restricted to licensed commercial operators who hold a special permit issued by the Agricultural Chemicals Distribution Control Board.

Further information on these restrictions can be obtained from the Secretary of this Board, Standards Branch, Queensland Department of Primary Industries, Brisbane.

If an ester formulation of a weedkiller, such as 2,4-D, 2,4,5-T or a similar phenoxyacetic acid type is used where an amine formulation would do the same job, not only would the job be more expensive, but the risk of damaging nearby susceptible plants is increased.

Before spraying weedkillers, consider your neighbours. It is necessary to use an ester? Perhaps a low volatile formulation such as amine would do the job.

21 months of grazing stylos in the dry tropics

SEASONAL weight loss of cattle and light carrying capacities are the most serious drawbacks beef producers face in the dry tropics of north Queensland.

The introduction of *Bos indicus* blood has helped to increase beef production but native pastures will have to be improved before any large increases in production can be achieved.

Pasture legumes are the best hope for improving feed quality. For a pasture plant to be useful in this environment it must be cheap to establish, resistant to bush fires and have the ability to flourish on soils of low fertility. It must also improve animal production.

Townsville stylo (*Stylosanthes humilis*) has been very successful in increasing both stocking rates and beef production on some properties. However, this annual legume has serious limitations. It is a poor competitor with other plants and out-of-season rain lowers the quality of the dry feed. Over recent years, the growth of Townsville stylo has been markedly reduced by anthracnose.

Verano stylo (*S. hamata cv. verano*) a short term perennial stylo was released in August 1973. It is much less susceptible to anthracnose. Recently another perennial stylo, Seca (*S. scabra* cv. Seca), has been released and seed supplies are being increased. Seca is resistant to anthracnose and more strongly perennial than Verano.

In 1975, a 32 ha paddock at Mareeba was planted with a mixture of stylo seed to demonstrate that these species could be easily established, and to record the weight gains and losses of steers grazing the paddock.

by P. J. McKeague, Agriculture Branch and A. E. Holmes, Beef Cattle Husbandry Branch

The type of country is representative of large areas of Cape York Peninsula and the Gulf country.

Topography and soils

The area is flat to undulating with a low ridge on the western side of the paddock. Duplex soils with a silty-sand surface layer overlaying clay predominate over most of the paddock, and gravel outcrops occur on the ridge.

The soils have low fertility with phosphate levels being particularly low.

Vegetation

The paddock is open forest country. The main tree species are narrow-leaved ironbark (*Eucalyptus creba*), box (*E. leptophleba*), bloodwood (*E. polycarpa*), tea-tree (*Melaleuca* spp.), poplar gum (*E. alba*) and quinine (*Petalostigma* spp.).

The dominant natural grasses are kangaroo (*Themeda australis*), black spear (*Heteropogon contortus*), three-awn (*Aristida* spp), ribbon (*Chrysopogon fallax*) and blue (*Bothriochloa* spp. and *Dichanthium* spp.),

Pasture establishment

In October 1975 the paddock was burnt. In December, the seed was sown in strips using a spinner behind a tractor. About 8 kg of superphosphate was mixed with each kg of seed before spreading.

The superphosphate acted as a carrier in the seed spreading operation. It should also have had a beneficial effect on the establishment of the legumes.

The 32 ha paddock was sown with 80 kg of Verano and 40 kg of a mixture of Seca and some unreleased perennial stylos. The mixture was mainly Seca but the other unreleased stylos were added to assess their establishment.

The strips cover about 25% of the total paddock area. Within the strips, the seeding rate was about 15 kg per ha and the fertilizer rate 120 kg per ha of superphosphate.

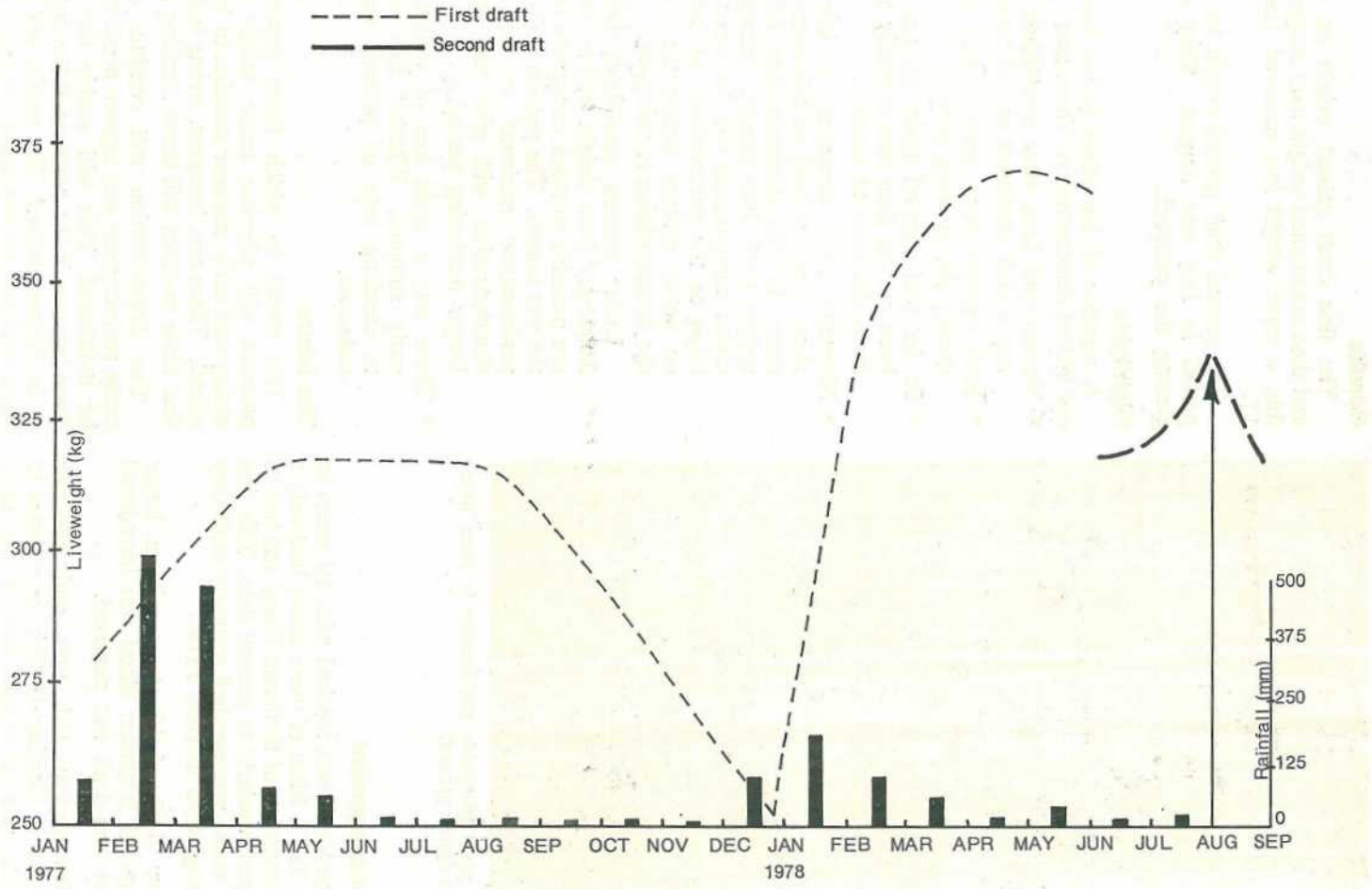
After sowing, good germinating rains fell. These were followed by more rain in early 1976. This resulted in a thick stand of legumes within the strips.

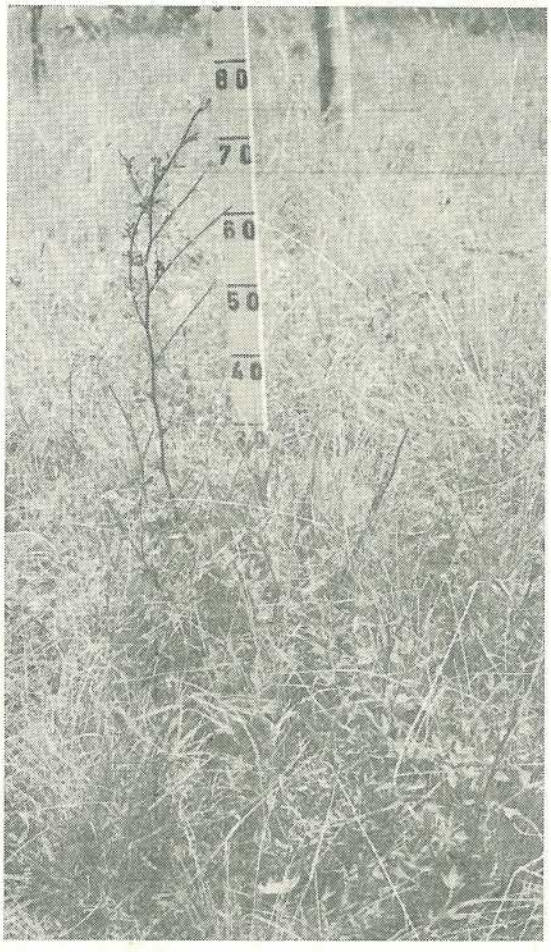
In 1976, it was intended to graze the paddock lightly. However, a number of horses broke in and the legumes received a heavy grazing. Consequently there was little or no seed set.

The legumes set seed in 1977 and there was seedling germination with the 1977-78 rains. However, with an excessively dry year in 1978, it is yet to be seen if these seedlings survive. It is hoped that with the right combination of seasons, the legumes will spread from the strips.

A view of the grazing paddock in April 1977. The broad-leaved plants in the grass are perennial stylos.

Figure 1


First draft
Second draft
Liveweight (kg)
375
350
325
300
275
250
Rainfall (mm)
500
375
250
125
0
JAN
1977
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
1978
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP



The tall plant alongside the marker is Seca which has been lightly grazed.

Cattle management

The paddock was stocked with 10 steers in January 1977. Most of those steers had only a small percentage of Brahman blood and had to be sprayed regularly to control ticks. This first draft of steers was weighed regularly until they were slaughtered in June 1978.

A new draft of 10 steers with a larger percentage of Brahman blood was introduced when the first draft was removed.

Supplementation with urea and salt was commenced in October 1978 in an attempt to reduce the rate of weight loss in the early summer period.

Results

The first draft gained weight up to May and then maintained weight until August. After this, a rapid weight loss occurred (see figure 1).

The second draft gained weight for a short period in July and August. They are still grazing the paddock.

Highlights

A number of important points have come out of this demonstration. These are:

- Verano and Seca were established without any timber treatment or soil preparation.
- Both legumes were readily eaten by stock during the growing period.
- So far beef turn-off from this pasture has been greater than that normally expected from this type of country.
- Normally, cattle commence to lose weight about April or May on this country. The steers in this demonstration held their weight until July-August. However, no direct comparisons can be made at this stage as the performance of beef cattle on native pasture during the period of the demonstration is unknown.

  Under present conditions, sale cattle frequently lose weight before the roads are passable to stock transports following the wet season. The pattern of liveweight performance achieved so far in this demonstration will give the grazier a longer marketing period.
- There was a rapid loss of weight in the early summer. Whether this was due to stocking rate or pasture quality is unknown.

The future

The extent to which these legume-based pastures will alleviate cattle weight loss in spring and early summer remains to be determined. There are, however, strong indications that these pastures will boost stocking rates.

The demonstration will continue so that cattle performance and legume persistence can be monitored. This will enable the role of these legumes in the pastures of the dry tropics to be further defined. The results will provide more evidence on the place for these legumes in the tropical grazing industry.

Tail tagging and bruising

Tagged and untagged cattle had the same level of bruising.

TRIALS conducted in Queensland show that tail tagging does not increase the amount of bruising on cattle sent for slaughter.

The introduction of tail tagging, as part of the Tuberculosis and Brucellosis Eradication Scheme, has been strongly criticised on the grounds that it caused an increase in bruising.

Tail tagging is most often carried out in the crush or in the truck following loading. In either case, some cattlemen feel that the extra handling inevitably increases bruising.

A series of trials was designed to test the amount of bruising caused by the handling associated with tail tagging. These trials involved either horned or hornless cattle, cows or steers and British or Brahman cross cattle. In three of the trials, cattle came from Departmental Research Stations and the others from commercial properties in various parts of the State.

Travel from the properties to meatworks was by road transport, road and rail or walking and then rail. The distances travelled varied from 160 km to over 1 800 km.

In each trial, the cattle were tagged in the crush rather than in the trucks. The untagged group were held in an adjoining yard. All the cattle were boxed together after tagging and travelled to meatworks in the normal way.

by R. C. Beasley, J. H. Bond and R. Tyler, Beef Cattle Husbandry Branch.

TABLE 1

Trial	Breed	kg bruised tissue trim per carcase	
		Tail tagged	Untagged
1†	Hereford	0·69	0·69
2	Hereford	0·96	0·90
3	Hereford X Santa Gertrudis ..	0·24	0·29
4	Hereford	0·05	0·09
5	Brahman X	0·85	0·74
6*	Brahman X	3·18	3·09
7*	Shorthorn	0·86	0·83

† Cows, all other trials with steers.

* Horned, all other trials with hornless animals.

Tail tagging does not increase bruising, but horns do.

In none of the trials were the tagged cattle significantly more bruised than the untagged cattle. The average bruising of the 248 tail tagged cattle was 1·1 kg while the 246 untagged cattle had an average of 1·0 kg of bruise trim. The results of the trials are shown in table 1.

It is not possible from these trials to infer that bruising does not occur when cattle are tail tagged. Rather, the trials show that cattle can be tagged without increasing the level of bruising.

Some of the animals which went down and were climbed over in the crush did not always show more bruising, while other quiet cattle were sometimes badly bruised. It would appear that some cattle are more prone to bruising than others and further work is required on this aspect.

Even where heavy bruising occurred in Trial 6, tail tagging did not lead to any further increase in bruising. The high levels of bruising in this trial were possibly caused by handling horned cattle in strange yards and shunting of rail wagons.

Poor yard construction and poor handling can cause bruising regardless of whether cattle are tagged or untagged. Care should always be taken with sale cattle to avoid any factors which may lead to an increase in bruising.

Acknowledgements

We wish to thank the management and staff of North Australian Pastoral Co., Ltd.; Stanbroke Pastoral Co.; Thomas Borthwick and Sons (Australasia) Ltd.; and F. J. Walker Pty. Ltd., Maryborough, for their assistance.

We also thank Messrs C. F. and J. B. Day, St. Lawrence, and L. and J. MacNeill, Condamine, for their help in conducting these trials.

Aquatic plants of Queensland part 2

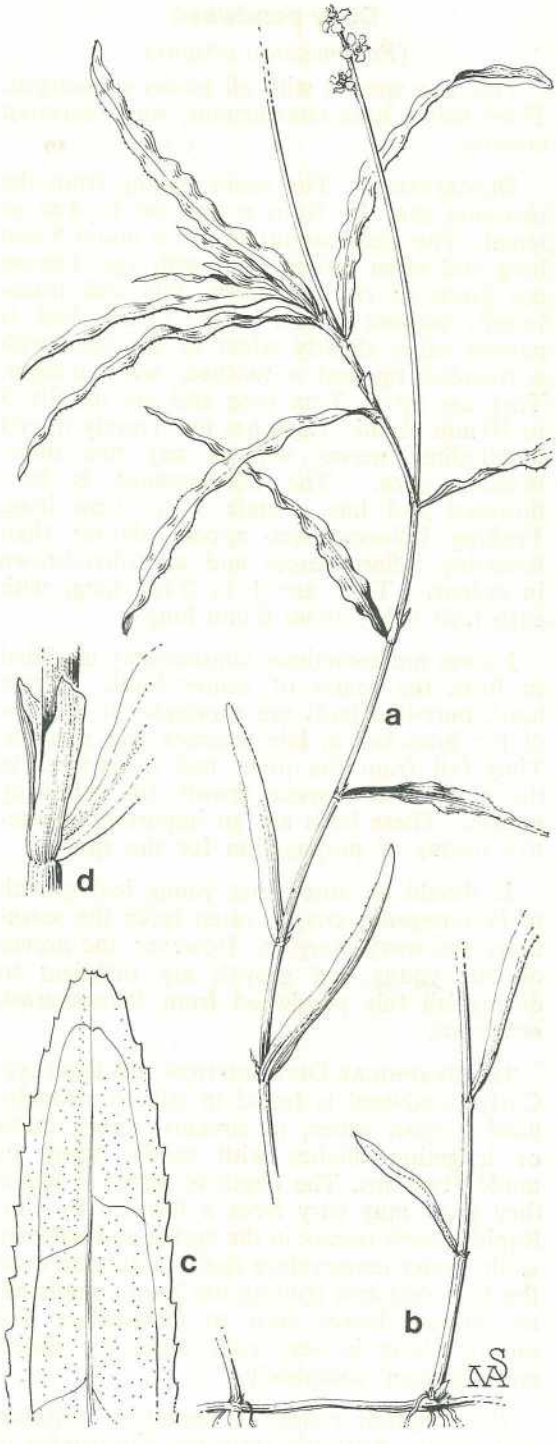
The pondweeds of Queensland

PONDWEEDS are rooted, submerged aquatics or rooted aquatics with surface-floating leaves as well as submerged leaves.

All belong to the genus *Potamogeton* which belongs to the family Potamogetonaceae. Four species of completely submerged pondweeds and two species of pondweeds with submerged and floating leaves are found in Queensland. All six species are native to Australia.

All the pondweeds are perennial with slender rhizomes and alternate leaves. All have a membranous sheath clasping the stem above the leaf axil, though sometimes it disintegrates with age. The inflorescences are spikes of a few to many flowers which are held above the water for fertilization and then drawn back underwater where the fruits mature. Flowers and fruits are produced from late spring to late autumn.

The pondweeds are considered an important source of food for waterfowl.



RIGHT. *Potamogeton crispus.* a—upper portion of stem with inflorescence x 1; b—lower portion of stem with rhizome x 1; c—leaf tip showing venation and toothed margin x 6; d—leaf base with stipular sheath x 4.

by T. D. Stanley, Botany Branch.

Curly pondweed

(*Potamogeton crispus*)

This is a species with all leaves submerged. These leaves have conspicuous, wavy, serrated margins.

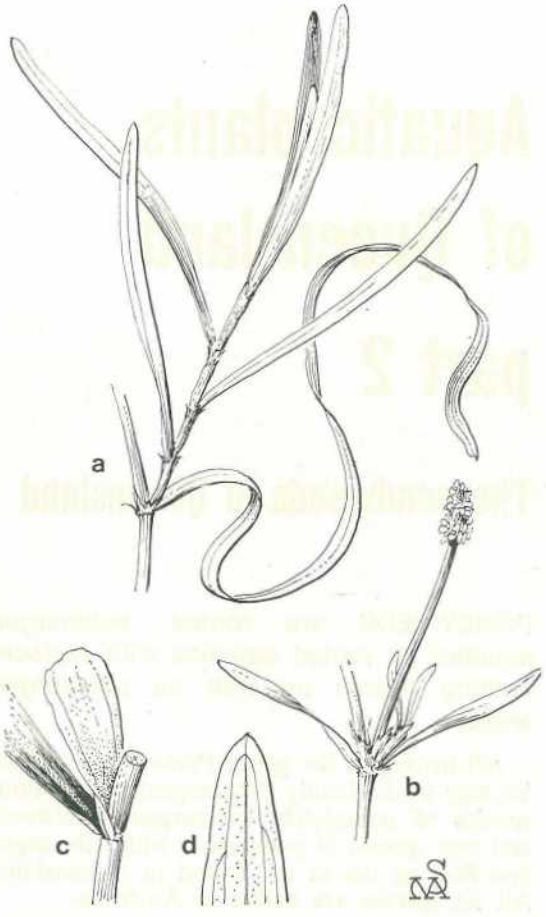
DESCRIPTION. The stems arising from the rhizomes may be from a few cm to 4 m in length. The membranous sheath is about 5 mm long and often disintegrates with age. Leaves are green to reddish-brown, thin and translucent, without a leaf stalk. Each leaf is narrow often slightly wider at the base with a rounded tip and a toothed, wavy margin. They are up to 7 cm long and are usually 5 to 10 mm broad. Each has five (rarely three) longitudinal nerves without any fine intermediate ones. The inflorescence is few-flowered and has a stalk 2 to 7 cm long. Fruiting inflorescences appear denser than flowering inflorescences and are olive-brown in colour. They are 1 to 2 cm long, with each fruit being about 6 mm long.

Leaves are sometimes considerably modified to form the scales of winter buds. These hard, burr-like buds are produced at the tips of the branches in late summer and autumn. They fall from the plant and overwinter in the mud to commence growth the following season. These buds are an important vegetative means of propagation for the species.

It should be noted that young leaf growth of *Potamogeton crispus* often lacks the serrations and wavy margins. However, the nerves of this young leaf growth are sufficient to distinguish this pondweed from *Potamogeton ochreatus*.

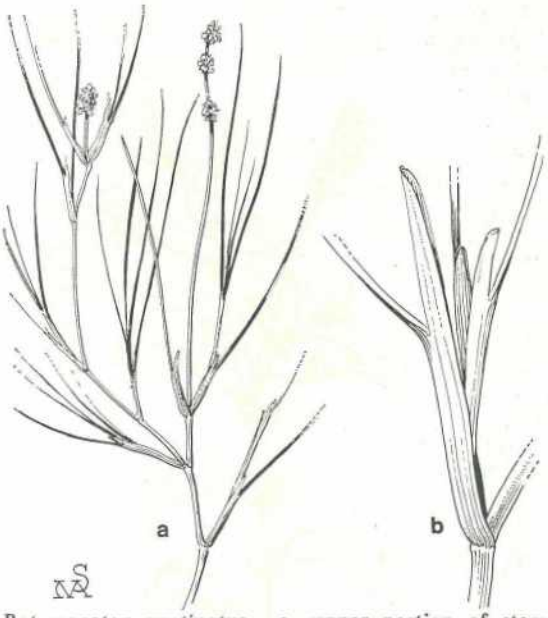
GEOGRAPHICAL DISTRIBUTION AND HABITAT. Curly pondweed is found in still to strongly-flowing fresh water, in streams, rivers, dams or irrigation ditches with sandy, stony or muddy bottoms. The depth of water in which they grow may vary from a few cm to 4 m. Rapid growth occurs in the spring and summer as the water temperature rises. In autumn once the flowering and fruiting has been completed, the mature leaves start to disintegrate and during winter in very cold water the shoots may die back completely.

Potamogeton crispus is found in northern and eastern Australia from the Kimberleys in Western Australia to Victoria. In Queensland, it is found as far west as the Warrego River near Cunnamulla and the Leichhardt River near Mt. Isa. It is also found in Europe, Asia, Africa, North America and the North Island of New Zealand.



Potamogeton ochreatus. a—upper portion of stem x 1; b—inflorescence x 1; c—leaf base with stipular sheath x 2; d—tip of leaf showing venation and smooth margin x 4.

IMPORTANCE. Dense growths of this species in irrigation and drainage channels may impede the flow of water and can be an annoyance to sailing boats and power craft. Curly pondweed is sometimes used as an aquarium plant. The species is considered to be an important source of food for waterfowl.



Potamogeton pectinatus. a—upper portion of stem with inflorescences x ⅓; b—leaf bases showing stipular sheath with ligule x 4.

Blunt pondweed

(*Potamogeton ochreatus*)

This species has all foliage submerged. It has long, narrow leaves with flat, non-serrated margins.

DESCRIPTION. The species is similar in appearance to *Potamogeton crispus* with a submerged rhizome and branched stems to about 4 m in length. Young plants have membranous axillary sheaths about 1·5 cm long. As the plant ages, the sheaths start to disintegrate and the fibres separate till eventually the whole resembles a small tuft of hairs. The leaves are long and narrow, green to brownish, translucent, and do not have a stalk. Each leaf has flat, non-serrated margins and three to five main longitudinal nerves with numerous fine intermediate ones. They are usually 2 to 10 cm long and 2 to 5 mm broad. The leaf tips are rounded or occasionally pointed. The flowering portion of the inflorescence is up to 2·5 cm long with flowers densely clustered, and borne on a stalk up to 7 cm long. Each fruit is about 3 mm long.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Blunt pondweed is found sporadically in still to strongly-flowing fresh or somewhat brackish water in rivers, streams and dams at depths from a few cm to 4 m. It is often found growing with other pondweeds but usually in deeper water than the other species. Rapid growth occurs in spring and summer as the water temperature rises. Usually, the plant has completed flowering and fruiting by midsummer and the shoots then begin to disintegrate.

In Queensland, blunt pondweed is found only in the Darling Downs and Moreton districts of southern Queensland. It is also found in New South Wales, Victoria, South Australia and south-western Western Australia as well as in New Zealand. This species is more common in southern States than in Queensland.

IMPORTANCE. Because of its sporadic distribution, this species is not considered to be of any economic importance in Queensland. In New South Wales, it has obstructed irrigation channels after periods of vigorous growth.

Fennel pondweed or sago pondweed

(*Potamogeton pectinatus*)

This species has long, narrow, submerged leaves.

DESCRIPTION. The stems arising from the rhizome are slender, up to 3 m long and are usually much branched. The membranous sheath at the base of the leaves is distinctive. Its lower portion is 0·5 to 2·5 cm long and encircles the stem, the upper portion continuing as a distinctive stem-clasping ligule. The leaf appears to arise on the back of this sheath at the base of the ligule. The leaf blade is green or brownish, very narrow, with entire margins and a pointed tip. It is usually 1·5 to 15 cm long and 0·5 to 2 mm broad. The flowering parts of the spike can be up to 5 cm long with groups of flowers scattered along its length. A long, slender, thread-like stalk 2 to 20 cm long carries the flowers above the water for pollination. The fruit are each about 2 to 4 mm long.

Underground tubers are sometimes formed by this species. These act as a means of vegetative reproduction.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. This species is found in still to swiftly-flowing fresh to brackish water at depths from a few cm to about 3 m. In still waters, it can form dense growths. Dense growths have also been reported from brackish bore-water drains. The species grows vigorously during the warm months.

In Queensland, this species grows in the south-eastern part of the State to as far west as Bollon. The Queensland Herbarium also has a single specimen of it from near Hughenden. This pondweed is probably widespread in the State but is fairly inconspicuous unless it occurs in dense growths. For this reason, it probably has not been collected in all areas where it does occur. In Australia, it is also found in New South Wales, Victoria, Tasmania, southern South Australia and south-western Western Australia. It is also found in Europe, Asia, Africa, North and South America and New Zealand.

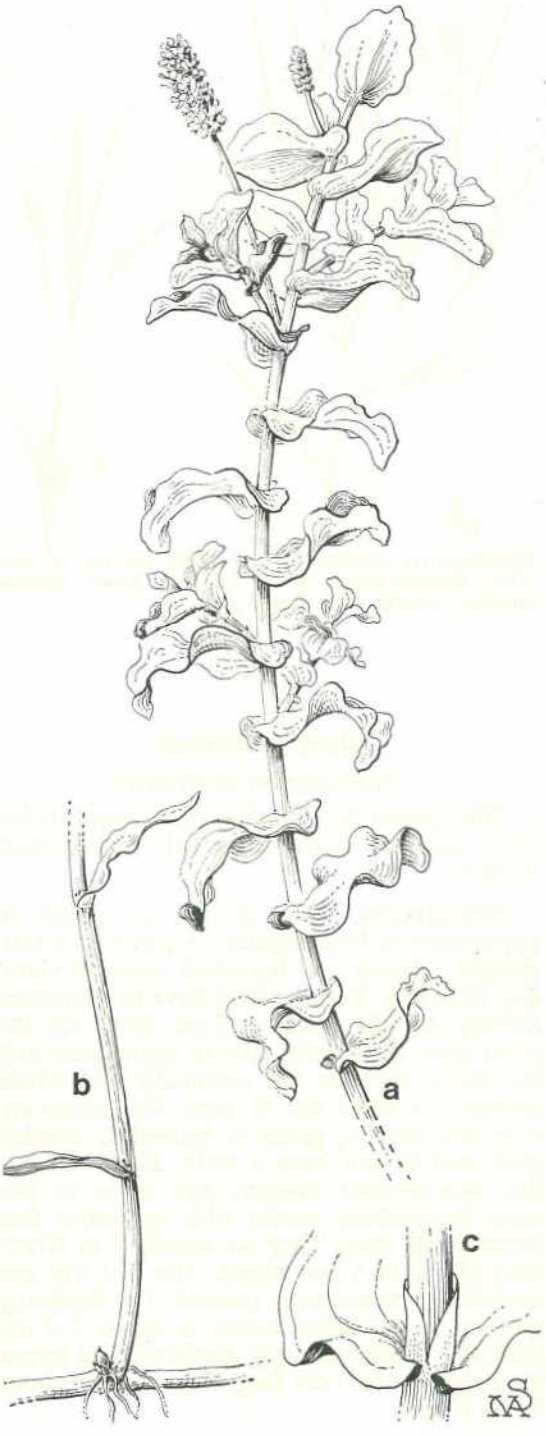
IMPORTANCE. Very dense growths may impede the flow of water in bore drains and be a nuisance in stock tanks. It is usually of little economic importance.

Clasped pondweed

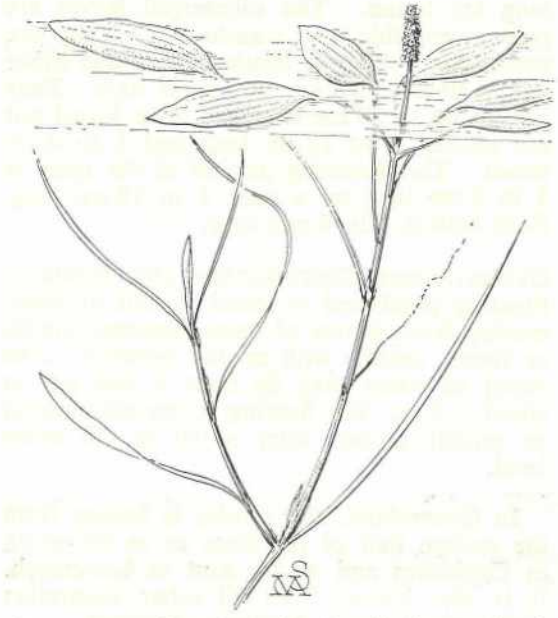
(*Potamogeton perfoliatus*)

This species has all leaves submerged. It has characteristic triangular leaves, the base of which clasps the stem.

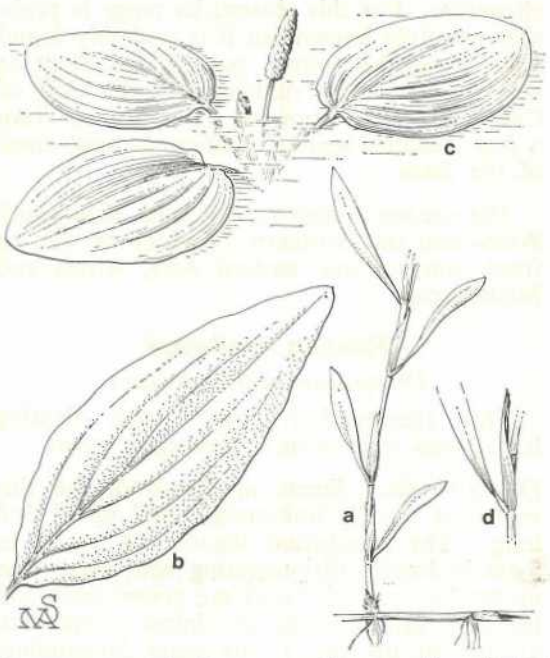
DESCRIPTION. Stems arising from the rhizomes are up to 3 m long. The membranous sheath is about 1 cm long but soon disintegrates. The triangular leaf blade is green to brownish and has a wavy margin and a broad, rounded base clasping the stem. Each leaf is usually 1 to 6 cm long and 1 to 3·5 cm broad. The flowering portion of the spike is usually 1 to 2 cm long with flowers densely clustered along it and borne on a stalk to about 7 cm long. Each fruit is about 3 mm long.



RIGHT. *Potamogeton perfoliatus*. a—upper portion of stem with inflorescence x 1; b—lower portion of stem with rhizome x 1; c—leaf base with stipular sheath x 3.



Potamogeton javanicus, showing floating and submerged leaves and inflorescence x $\frac{1}{3}$.



Potamogeton tricarinatus. a—lower portion of stem with lower submerged leaves and rhizome x $\frac{1}{4}$; b—upper submerged leaf x $\frac{1}{4}$; c—floating leaves and inflorescence x $\frac{1}{2}$; d—leaf base of submerged leaf with stipular sheath x $\frac{2}{3}$.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Clasped pondweed is found in slowly to strongly-flowing fresh waters (rarely still waters) of streams and rivers at depths up to 2·5 m. It can occur on sandy, stony or muddy bottoms. The species grows rapidly during warm months.

This species seems able to tolerate colder and more strongly-flowing water than the other species of pondweeds in Queensland.

It is found in south-eastern Queensland, east of the Great Dividing Range. The species is also found in New South Wales, Victoria and Tasmania as well as from Europe, North Africa, Asia and North America.

IMPORTANCE. It is not considered to have any real economic importance in Queensland.

Small floating pondweed

(*Potamogeton javanicus*)

This distinctive species has narrow-elliptic floating leaves and long, narrow, submerged leaves.

DESCRIPTION. Stems arising from the rhizome are usually less than 1 m long but can be up to 2 m in length. The upper floating leaf-blades are green or yellowish-green, narrow-elliptic with a pointed tip and 5 to 7 longitudinal nerves. The margins are without serrations. Each blade is 1·5 to 3·5 cm long and 0·5 to 1 cm broad on a stalk which is usually 1 to 8 cm long. The submerged leaves are green to brownish, translucent, linear-oblong and are usually 3 to 6 cm long and up to 2·5 mm broad. Flowering portions of the spikes can be up to 1·5 cm long with flowers densely clustered along it and born on a stalk to about 3 cm long. The fruits are 2 to 2·5 mm long.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. This species is found in still to fast-moving fresh water of rivers, streams, dams or irrigation ditches. It is sometimes seen in large quantities in new dams and weirs and in newly dug irrigation ditches. Once other species become established, this pondweed becomes inconspicuous and may be overlooked

altogether. For this reason, its range is probably not fully known but it is probably found right along the eastern part of the State as well as in streams running into the Gulf of Carpentaria. At present, it is known from a few localities scattered along the east coast of the State.

The species is also known from New South Wales and the Northern Territory as well as from southern and eastern Asia, Africa and Madagascar.

Floating Pondweed

(*Potamogeton tricarinatus*)

This species has large, waxy, floating leaves and translucent, submerged leaves.

DESCRIPTION. Stems arising from the rhizome are usually unbranched and up to 3 m long. The translucent sheath can be up to 5 cm in length, disintegrating with age. The upper floating leaf-blades are green, thick and leathery, broad-elliptic or almost round with a rounded tip and 11 or more longitudinal nerves. The margins lack serrations. Each blade can be 3 to 15 cm long and 1 to 7 cm broad but is usually 4 to 7 cm long and 2 to 4 cm broad on a leaf stalk to about 20 cm long. Occasionally, leaves less than 3 cm long are found. The submerged leaves are pale green, thin and translucent. They are much longer than the floating leaves and either lack a stalk or have a very short stalk. They can be up to 20 cm long and 9 cm broad but are usually 5 to 12 cm long and 1 to 4 cm broad. The flowering portion of the spike is 3 to 8 cm long on a stalk 4 to 18 cm long. Each fruit is 2 to 4 mm long.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Floating pondweed is found in still or slow-moving fresh waters of dams, swamps, creeks or rivers, usually with muddy bottoms. The depth of water may be from a few cm to about 2·5 m. The floating leaves may persist on muddy ground after a fall in the water level.

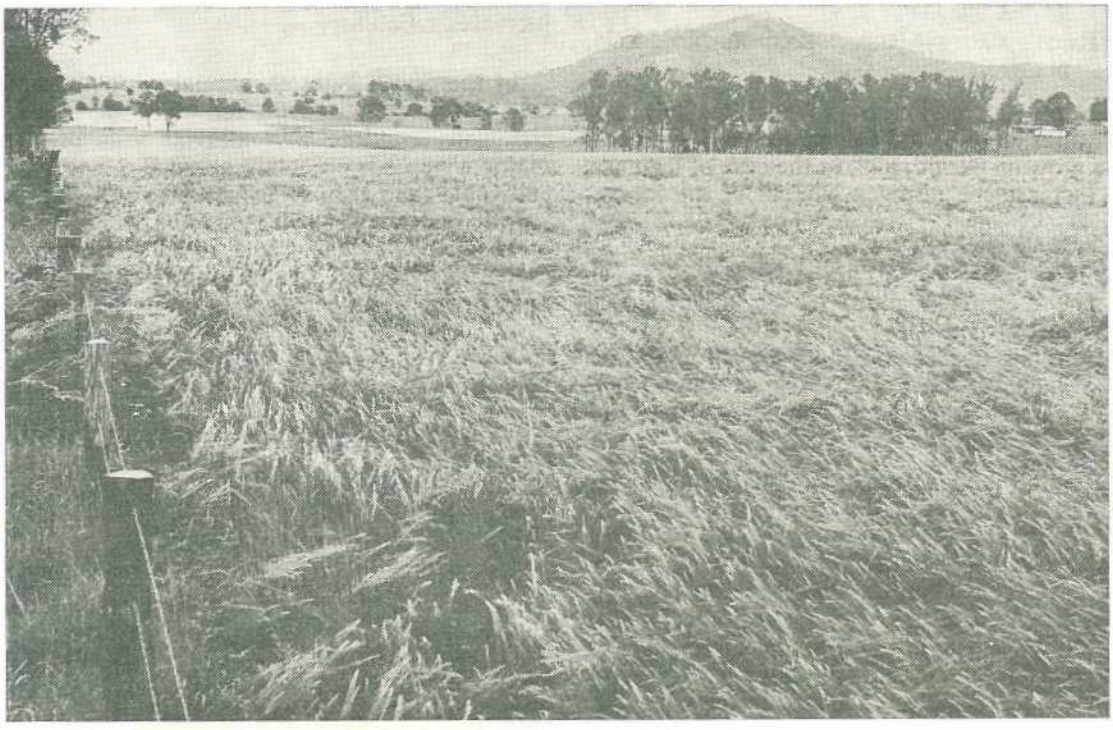
In Queensland, the species is known from the eastern half of the State to as far north as Cooktown and as far west as Longreach. It is also known from all other Australian states including the Northern Territory.

IMPORTANCE. In times of rapid growth, it can cause considerable obstruction to water flow in streams and small rivers. Rotting vegetation can foul the water. Dense growths can interfere with boating.

Key to the Species of Potamogeton in Queensland

1.	Plants with all leaves submerged	2
	Plants with upper leaves floating on the water surface and with the lower leaves submerged	5
2.	Lower part of axillary membranous sheath adnate to leaf, upper part free and forming a distinct ligule. Leaves mostly less than 2 mm wide	*Potamogeton pectinatus*
	Axillary membranous sheath almost completely free from leaf, not forming a ligule. Leaves mostly greater than 2 mm wide	3
3.	Leaves stem-clasping, more or less triangular	*Potamogeton perfoliatus*
	Leaves not stem-clasping, more or less strap-shaped	4
4.	Leaves with minutely toothed wavy margins; three to five nerved without fine intermediate nerves	*Potamogeton crispus*
	Leaves with entire margins; three to five nerved with numerous fine intermediate ones	*Potamogeton ochreatus*
5.	Floating leaves broadly elliptic to almost round, mostly greater than 3 cm long, the tip rounded	*Potamogeton tricarinatus*
	Floating leaves narrow-elliptic, mostly less than 3 cm long, the tip pointed	*Potamogeton javanicus*

Winter forage crops



for dairy cattle

by S. L. Stillman and K. F. Lowe, Agriculture Branch

ALTHOUGH native and improved pastures are the cheapest source of feed on South-east Queensland dairy farms, climatic limitations restrict their productive period.

Pasture quality and digestibility decline in autumn as flowering and maturation progress. As a result, pasture intake is reduced. This leads to poor animal performance.

To maintain high animal production during the winter-spring months, other sources of feed must be provided. Perennial temperate pastures are very useful during this period but they have their limitations. They require irrigation throughout the year, persistence is sometimes poor and yields are low in early winter. Annual winter forage crops are quick-growing and provide the most economical adjunct to temperate pastures.

Photograph above. This excellent crop of barley in the Imbil district received a light early grazing before being left to produce grain.

Winter forage crops can be classified broadly as:

- GRASSES—Oats, wheat, barley, ryegrass.
- LEGUMES—Lucerne, clovers, annual medics, field pea, vetch, lupin.
- ROOT CROPS—Rape, field turnip, kale, mangels.

Normally, they are grown separately but mixtures of types are sometimes used to extend the growing period, and, in the case of legumes, to increase the nitrogen content of the forage.

Area and climate

The recommendations in this article apply to coastal and sub-coastal areas from the Queensland border north to Maryborough. The area includes East and West Moreton, the Gold Coast hinterland, South Burnett and Wide Bay regions.

Rainfall is highest near the coast and ranges from 1 700 mm near Cooroy to 1 400 mm at Southport and 650 mm in the foothills of the Great Dividing Range. Two-thirds of this rain falls between October and March. Rainfall reliability decreases in subcoastal areas, especially in autumn and winter. Irrigation is required to maintain continuous cool season growth of temperate species throughout the area.

Choosing soils and sites

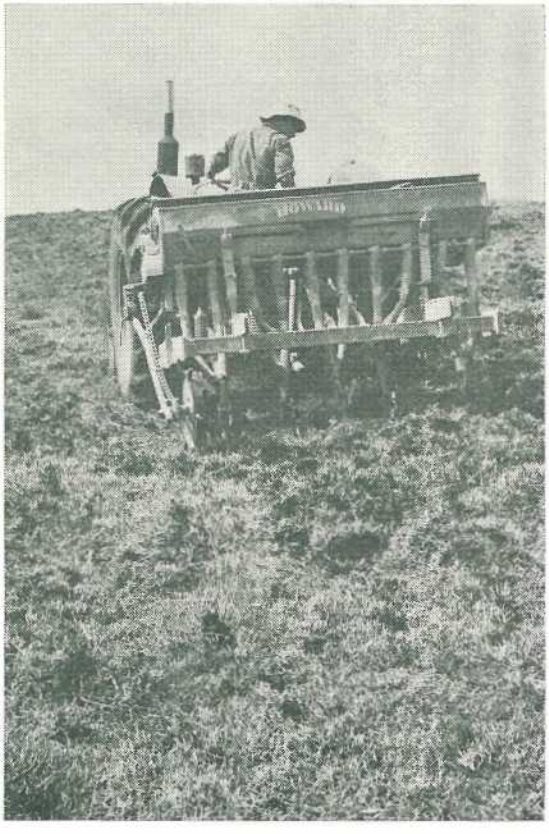
Winter forage crops can be grown on any well-drained and reasonably fertile soil if irrigation is available. On the other hand, rain-grown crops should be restricted to deep soils with good moisture retention capacity.

In the West Moreton region, most winter forage crops are grown on river flats where irrigation facilities are available. Opportunist rain-grown forage crops are planted on both the more fertile clay soils and the poorer forest soils. Summer fallowing is essential for storage of sub-soil moisture but even then reliable crop production is uncertain.

Many soils in the Gold Coast Hinterland are too infertile and rocky for winter forage crop production—only the lower slopes and river and creek flats are used.

The red basaltic plateau soils of Springbrook, Beechmont, Tamborine and Maleny are not well suited to annual winter forage crops as the soils dry out quickly. However, as these areas receive high rainfall, some crop growth can be expected, although irrigation greatly increases reliability.

In the South Burnett, annual winter forage cropping is practised on red soils, dark grey clay soils and the rich alluvial soils of the major watercourses. Only about 0·2% of the cultivable land can be irrigated so dairying is heavily dependent on rain-grown annual winter crops such as oats and barley. Soil moisture is therefore the major factor limiting winter crop and pasture production.



Forage crops can be sod-seeded into a grass sward. Follow-up irrigation is necessary for reliable establishment.

Heavy summer grass growth must be turned over early in the season to allow plant residues to decompose and to build up soil moisture reserves.

In the undulating to hilly areas of the Wide Bay region, crop growth is restricted by the poor moisture storage capacity of the shallow topsoils and only limited irrigation is available—mainly from farm dams. Only the creek flats and the clay loams found on the lower slopes are suitable for forage crops. The sandy loam alluvials of the Mary River are used extensively for annual forage crops and perennial pastures. Most of the area can be irrigated although flooding of lower terraces is a major limitation.

On the Coastal Lowlands high rates of fertilizer are required. Satisfactory rain-grown crops can be grown on the sandy loam ridges in 3 years out of 5. On the wet heath areas, poor drainage often restricts crop growth. Although drainage and low fertility can be improved, these cultural practices may not be economic under present conditions. Paddocks inundated by water for more than 1 day should be avoided, as winter cereals such as oats and barley may fail to germinate.

The heavy frosts experienced throughout the region from May to September have little effect on the growth of annual winter forages. Indeed, the frost susceptible sites are best used for annual winter forages and the frost-free sites for tropical pastures.

Establishment

Seedbed preparation

Seedbed preparation is governed by the amount and reliability of rainfall or irrigation, the type of pasture presently growing in the area, the type of forage to be sown, and its intended use. The intensity of land preparation will determine how well the crop will establish, the amount of early production obtained, and the competition from existing pasture species.

• FULL SEEDBED PREPARATION

Land preparation should aim at a moist, firm, weed-free seedbed. Early commencement is desirable to conserve moisture and allow breakdown of plant remains. The initial ploughing should break up the topsoil, bury all plant residues and leave the ground to fallow in a rough state. Subsequent tillage operations should be progressively shallower to reduce clod size, settle the soil and eliminate weeds. Normally two or three workings will suffice, but this will vary with soil type, soil moisture level and cultural history of the land. Prior to sowing, harrows should be used to break up clods and to destroy weeds.

The best method of sowing is with a seed drill or combine which gives accurate depth placement of seed. Seed should not be planted too deeply otherwise emergence is reduced. Small legume seeds such as annual medics and lucerne can be mixed with sand or sawdust to ensure even distribution. Alternatively, seed can be mixed with superphosphate and planted through the fertilizer box of the combine. To do this, legume seed must be lime pelleted otherwise the nitrogen-producing bacteria will be killed by the acidity of the fertilizer.

Seed may also be broadcast by hand or with a fertilizer spreader. Better distribution of small seeds will be obtained if a carrier (such as fertilizer, sand or sawdust) is used.

Inverted peg tooth harrows or chains dragged behind the planter will give sufficient coverage in well-prepared seedbeds. The use of a cultipacker or corrugated roller after sowing gives excellent results in consolidating the soil and improving the contact between seed and soil moisture. This is particularly important on the sandy loam soils along the coast and the sandy loam prairie alluvials of the Mary River. In soils which have a high clay content or which tend to form surface crusts, rolling should be avoided.

• OVERSOWING

Forage crops can be sown directly into existing pasture without full cultivation, thus reducing costs and disruption to grazing. Existing pastures of kikuyu, pangola grass, mat grass, Rhodes grass or paspalum should be heavily grazed or slashed before land preparation is commenced. Disc or tine equipment can be used depending on the pasture and the soil type. Sowing can be at the same time as the initial renovation or as a separate operation. Sowing in two directions is recommended to improve seed distribution.

Without follow-up irrigation, the establishment of annual winter forage crops has only one chance in three of being successful, even in the more favoured rainfall areas.

Rotary hoeing of the existing pasture after an initial ripping improves the seedbed and increases the chance of obtaining a good stand of winter forage species. This method is particularly recommended in areas with a dense kikuyu sward. Whether tine or disc cultivators or a rotary hoe is used, the density of the existing sward will determine the number of cultivations required to prepare a suitable seedbed. Planting rates must match the degree of soil disturbance, with increased seeding rates being applied on less intensively prepared seedbeds.

• SPECIAL TECHNIQUES

An improvement on the oversowing technique is to use a 'Rotoseeder', which basically is a seedbox mounted on a rotary hoe (see figure 1). It cultivates and drills in one operation, covering 6 to 8 hectares in 8 hours. In dense pastures two cultivations may be necessary. The first cultivation, at 10 cm depth, chops up the existing vegetation. The second at 5 to 7 cm depth, and some 4 to 6 weeks later, incorporates plant residues and kills weed seedlings as well as applying the seed and fertilizer.

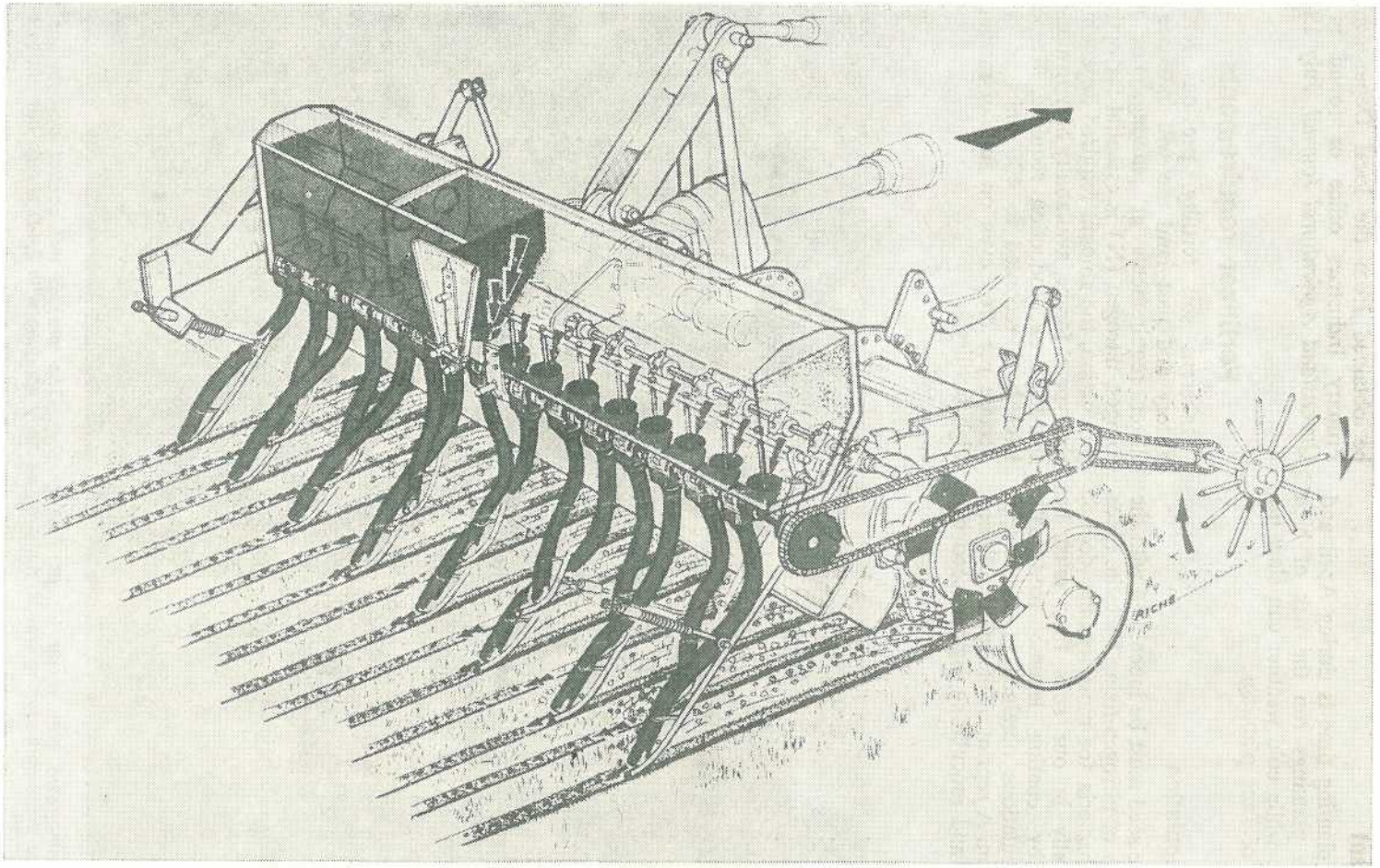


Figure 1. An exploded view of a rotoseeder showing the principle of operation. This type of machine is widely used overseas but has required extensive modification for Australian conditions. Diagram supplied by courtesy of Howard Rotovator Australia Pty., Ltd.

When to plant

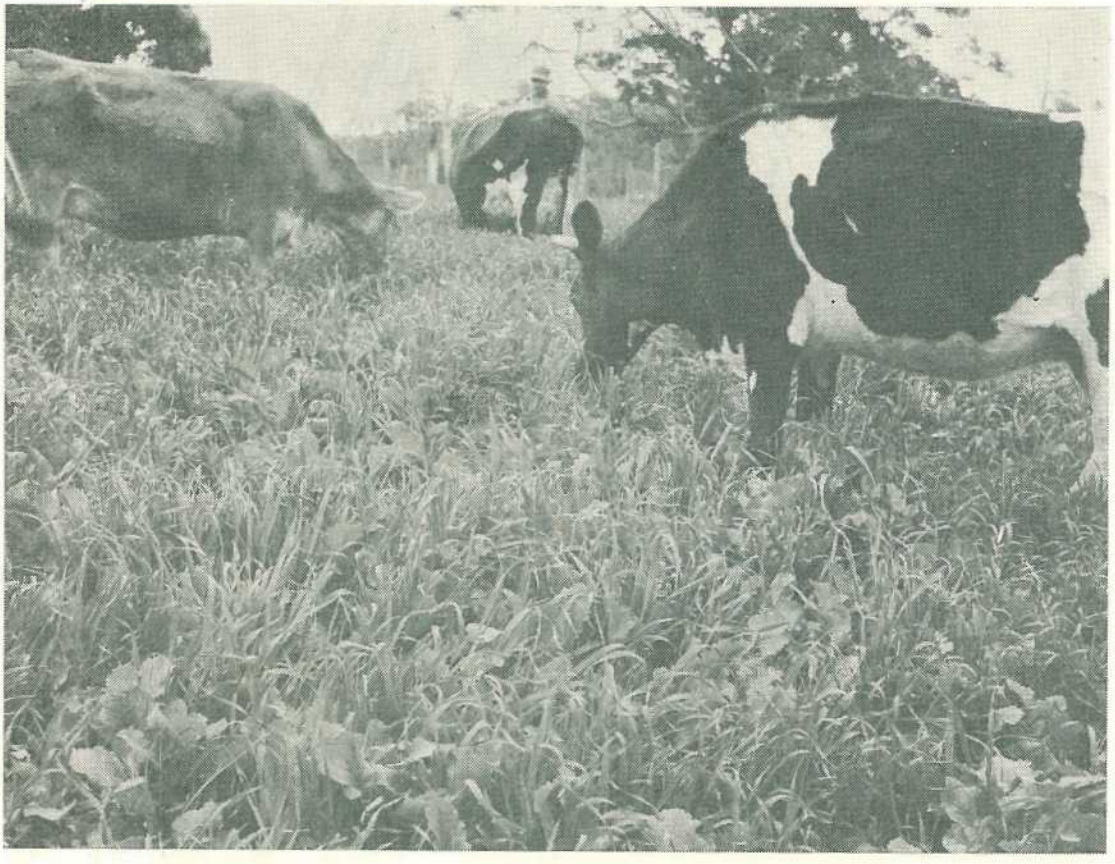
The best planting time is during April and May. March plantings run the risk of high temperatures while cold weather can slow the germination of June plantings.

Legume inoculation

All legume seed must be inoculated with the correct strain of nitrogen-fixing bacteria. Since the correct bacteria for most legumes do not occur naturally in our soils they must be introduced by coating legume seed with bacteria populations obtained in commercial peat inoculum. A reprint of the full description of pelleting and inoculating legume seed can be obtained from the local Department of Primary Industries office or found in the *Queensland Agricultural Journal,* July 1971.

Fertilizer requirements

Inherent soil fertility, previous fertilizer history and past land use will influence fertilizer requirements at planting. For grass forages, nitrogen (N) is essential for optimum production, the amount required depending on the type of forage, availability of irrigation, and the level of production required. Responses have been recorded to 400 units of N per hectare per crop even on soils of medium to high fertility.



A crop of rain-grown oats ready for its first grazing. The grazing will control the obvious weed infestation. For these milk tainting weeds, however, an early spraying with 2,4-D should have been carried out.

Generally, 75 to 100 kg N per hectare should be applied to irrigated oats or ryegrass at planting. After each grazing, a further 50 kg is required to maintain high growth rates. This could be doubled in July to overcome reduced growth during the cold midwinter period. Under rain-grown conditions, 50 to 75 kg N per hectare should be applied at planting. A further 50 kg could be applied following the second grazing but this and subsequent applications will depend on rainfall.

With high rates of nitrogen, other nutrients such as potassium and phosphorus may limit growth responses. These should be corrected to obtain maximum yields; levels in soils can be determined by soil samples. Adequate phosphorus is essential for optimum growth of leguminous crops and, on acid soils, molybdenum deficiency can also restrict production.

Description of crops

Grasses

- OATS (*Avena* spp.)

Oats is the main winter forage crop for rain-grown conditions, and for early feed under irrigation. If managed correctly, it provides palatable high quality feed from May to October. Oats is leafier and bulkier than most winter cereals, tolerates moderately dry weather, and makes good hay and silage. It is often included in temperate pasture mixtures to provide quick, early feed.

Rain-grown oats sown in March or April yields up to 5 tonnes per hectare of dry matter in an average season. From 2·5 to 3·5 tonnes per hectare of dry matter may be produced from May to August with the remainder coming from regrowth after August. Poorly-grown crops will only yield around 1·5 tonnes per hectare. Irrigated oats will yield 7 to 11 tonnes per hectare depending on fertilizer applications.

SAIA oats, introduced from Brazil in the early 1950s, has been the highest yielding and most popular variety. It is erect, narrow-leaved, and gives quick, early grazing and a long growing season. This variety was originally resistant to stem and crown rust but is now highly susceptible to virulent races of rust.

BENTLAND is an erect, broad-leaved mid-season variety which tolerates adverse moisture conditions. A high leaf to stem ratio makes it an excellent grazing variety, especially in autumn and early winter. Although initially resistant to rust, it has become very susceptible in recent years and for that reason is now losing favour.

MINHAFER is a broad-leaved, thick-stemmed midseason variety with a similar growth habit to Bentland. It is capable of high dry matter production, but is susceptible to overgrazing. It is the most popular variety in the Moreton and Wide Bay regions, mainly because it is moderately rust resistant.

GARRY grows slowly early in the season, yields well in midseason but late season growth is poor. It is only recommended when seed of other midseason varieties is unavailable.

CAMELLIA is an erect, broad-leaved, high yielding variety which is readily accepted by cattle and recovers well after grazing. It must be planted early because it is late maturing, but it is the highest yielding oats from September onwards. It has high protein levels, good rust resistance and a high leaf to stem ratio. Camellia is the most popular late season variety, particularly on the coast.

COOBA is another late-maturing variety with a relatively short productive period. Although its highest production also comes late in the season, it is normally outyielded by Camellia. It is moderately rust resistant and can be used as a substitute for Camellia.

ALGERIAN is a very slow-growing, late-maturing variety which requires early planting if it is to be well established before grazing. It tillers well, which leads to quick recovery after grazing. However, Algerian is less palatable and lower yielding than other varieties and is susceptible to crown rust, particularly along the coast.

STOUT is a relatively new variety that is reputed to possess good rust and lodging resistance. It is an erect type, slow to flower, and has similar forage yields to Minhafer. Seed supplies are available for the 1979 season.

• BARLEY (*Hordeum vulgare*)

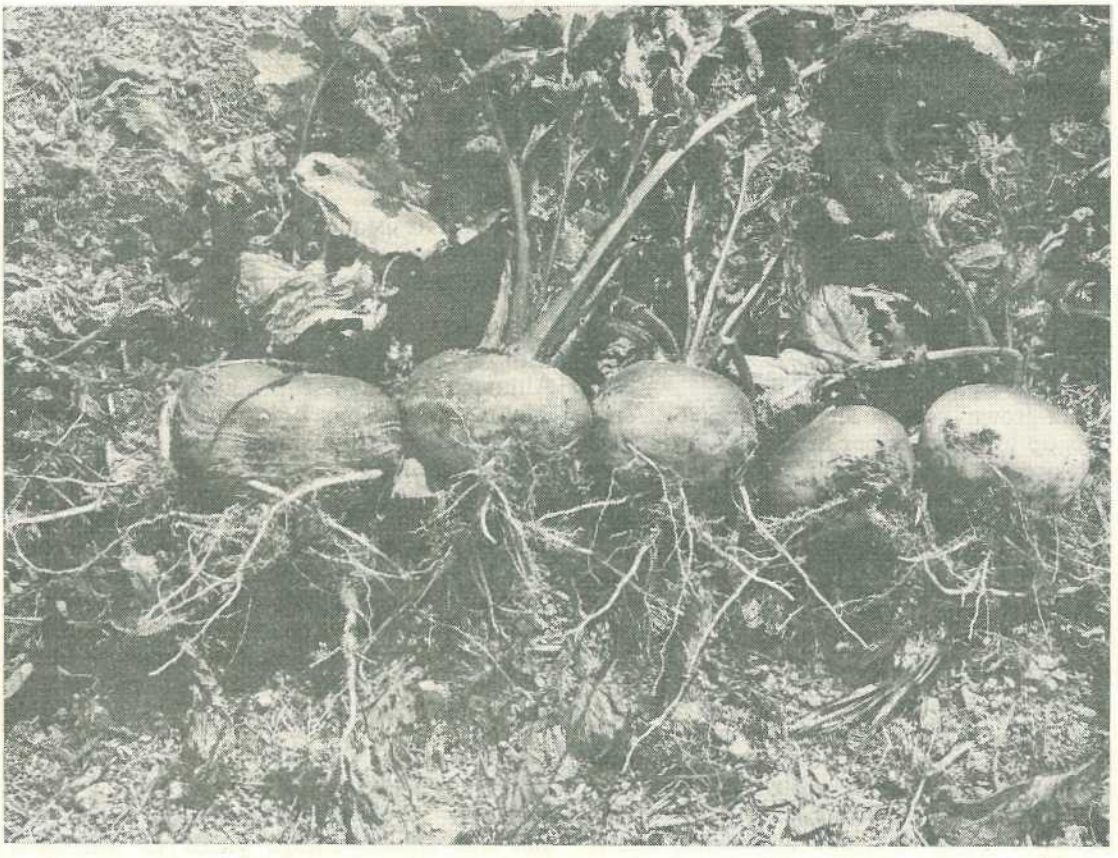
Barley is inferior to oats for grazing. Most barley sowings are normally intended for harvesting grain, the area planted solely for grazing being extremely small. Many varieties are low yielders of forage, with poor leaf to stem ratio, and commence flowering early. Cattle generally will not eat barley as readily as oats in this condition. Rain-grown barley yields up to 3·5 tonnes per hectare of dry matter but in wet years up to 4·8 tonnes have been recorded. Approximately 80% of this yield is produced by the end of August.

CLIPPER (bred at the Waite Agricultural Research Institute in South Australia) is a malting barley which can be used for grazing. It is erect, narrow-leaved, and outyields all other varieties. It is moderately resistant to lodging but is susceptible to powdery mildew.

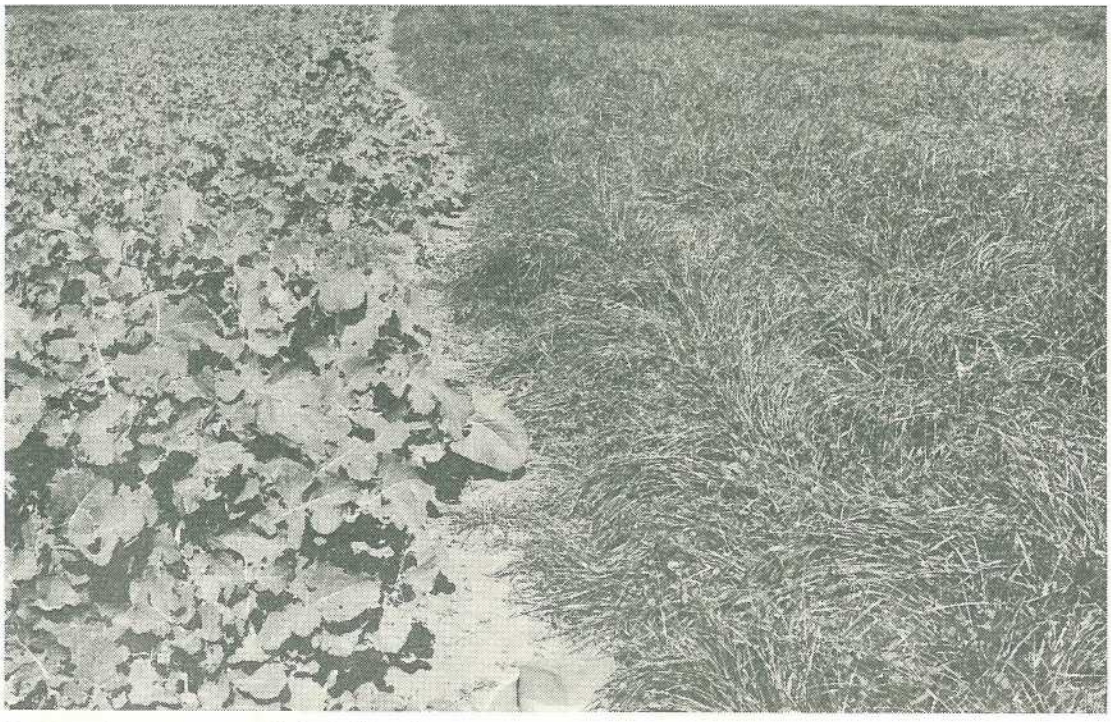
BLACK barley is a broad-leaved, erect variety that grows slowly at first but recovers well after grazing. It is a useful forage type despite its susceptibility to powdery mildew.

CAPE is a late-maturing, broad-leaved variety which is moderately susceptible to rust and powdery mildew. It germinates quickly but lacks vigour and is not recommended in coastal regions.

PRIOR is low-yielding, narrow-leaved, slow-growing and prone to rust. It is not recommended as a forage.



Field turnips provide excellent grazing from tops and bulbs. However, this crop will taint milk and is prone to severe damage by aphids.



Rape and ryegrass are high-yielding forage crops. Rape tolerates dry conditions but taints milk. Ryegrass must be irrigated for best performance.

• WHEAT (*Triticum vulgare*)

Wheat is rarely sown for grazing, being inferior to oats and barley. It goes to seed rapidly if not grazed regularly, and, once in seed, is poorly accepted by stock. Overall yield can be as high as barley in good years but the proportion of leaf is very low. The main grazing varieties are: HOPPS, FESTIGUAY and TIMGALEN.

• RYEGRASS (*Lolium* spp.)

Ryegrasses are excellent winter forages as they are leafy, highly palatable and respond well to nitrogen fertilizer. When irrigated they produce more dry matter than oats and have a longer growing season. Growth rates are lower than oats in autumn and early winter, but much higher in spring. Ryegrass makes good hay which retains its leaf well and contains high levels of protein. Ryegrass cultivars can be grouped as annuals or perennials. In Queensland, however, the perennials rarely persist longer than 2 years.

KANGAROO VALLEY (*Lolium perenne*) is the highest yielding and most reliable cultivar, producing as much feed as the annuals in winter, and considerably more in spring. Its peak growing period is September to November. Up to 15·6 tonnes per hectare of dry matter can be expected under irrigation with average production varying from 7 to 12 tonnes per hectare depending on moisture and the amount of nitrogen fertilizer applied. Seeding does not greatly reduce digestibility.

Kangaroo Valley will persist strongly into the second year if summer grass competition is reduced. It is the most heat-tolerant and rust-resistant of the ryegrass cultivars, and makes quick growth after rain or irrigation.

VICTORIAN PERENNIAL (*L. perenne*) is a selection of perennial ryegrass developed in Victoria which grows more slowly in autumn than Kangaroo Valley. Dry matter production varies from 5 to 14 tonnes per hectare.

71679—6

Vetches provide good quality grazing and are easily sod-seeded into grass swards.

GRASSLANDS MANAWA (*Lolium perenne* x *L. multiflorum*) originally called Short Rotation or H1 ryegrass—is a vigorous hybrid capable of high spring yields. Yields are slightly lower than from Kangaroo Valley but are produced earlier in the winter. It is intermediate between Kangaroo Valley and Grasslands Tama in rust resistance and is generally treated as an annual.

GRASSLANDS ARIKI (*L. perenne* x *L. perenne* x *L. multiflorum*) is a cross between perennial ryegrass and Grasslands Manawa. It is less productive than Kangaroo Valley especially in the autumn. Dry matter production varies from 7 to 15 tonnes per hectare and it is moderately resistant to rust.

WIMMERA (*Lolium rigidum*) is a fast-growing annual making most growth from April to September. Yield varies from 5 to 13 tonnes per hectare, production being influenced by rust, climate and soil type. It will yield twice as much as most other ryegrasses from the first two grazings, although production is still lower than from oats at this stage. It is fairly susceptible to rust and must be grazed frequently to reduce damage. Under Queensland conditions, Wimmera may flower, set seed and complete its life cycle in August. Regeneration in the following year is poor.

GRASSLANDS PAROA (*L. multiflorum*) previously called ITALIAN, establishes rapidly but has only fair rust resistance and persists poorly. Dry matter production ranges from 6 to 13 tonnes per hectare with winter and spring production being similar to Grasslands Manawa.

A well-grown crop of field pea. This crop only gives one grazing.

GRASSLANDS TAMA (*L. multiflorum*), bred in New Zealand, is a broad-leaved, thick-stemmed cultivar of Italian. Dry matter production varies from 6 to 12 tonnes per hectare. It provides very lush feed with a high moisture content but in South-east Queensland it is very susceptible to rust.

Legumes

- LUCERNE (*Medicago sativa*)

Although not adapted to coastal areas, lucerne is grown widely throughout the sub-coastal parts of the region for grazing or hay. Under rain-grown conditions, it provides more winter feed than other temperate legumes. Lucerne is best suited to well-drained, fertile alluvial soils. Stands will last from 2 to 6 years, persistence being affected by disease, insect damage, nematode build-up, frequency of flooding, fertilizer usage and the ingress of weeds and grasses.

Thousand Headed kale has a high proportion of palatable leaf to stem but is very susceptible to aphids.

HUNTER RIVER is the best adapted cultivar but recently insect damage (spotted alfalfa and blue-green lucerne aphids) has reduced its usefulness. It is still the most widely used cultivar, but requires regular spraying to control insect populations.

SIRO PERUVIAN and AFRICAN, although having improved winter and spring yields, are more susceptible to disease and offer no more insect resistance than Hunter River. CUF 101, an American lucerne bred for resistance to blue-green and spotted alfalfa aphids, is currently being evaluated under local conditions.

• BERSEEM CLOVER (*Trifolium alexandrinum*)

Also known as Egyptian clover, this is grown as a short-term winter forage on the fertile alluvials of the Beaudesert and Lockyer districts. It has a high winter growth rate and an erect habit similar to lucerne which makes it suitable for cutting or grazing. It is not suited to acid soils.

• ANNUAL MEDICS (*Medicago* spp.)

These can be grown alone as an annual winter forage crop or in mixtures with oats or ryegrass. Their use is restricted to the West Moreton and South Burnett regions as they are not suited to acid soils. Under rain-grown conditions, medics require early winter rain for establishment. Burr medic (*M. polymorpha*) is naturalized on the neutral to alkaline scrub soils of the region and when rainfall conditions are suitable, will dominate native pastures. However, production is extremely variable, good winter grazing being available in 1 year out of every 4.

Under irrigation, medic production is more reliable and in mixtures with oats or ryegrass it can produce 6 to 12 tonnes per hectare of dry matter. When sown with oats a long season of production is possible. The oats provides feed until the end of winter whereas medics reach peak production in spring, and produce seed in October or November. SNAIL medic (*M. scutellata*) and JEMALONG barrel medic (*M. truncatula*) are the best under local conditions. Snail medic is moderately resistant to blue-green aphid damage. Other medic varieties are extremely susceptible and would need to be sprayed to obtain good dry matter yields.

• LUPINS (*Lupinus* spp.)

The lupin originated in the Mediterranean region and was used for centuries as a source of high protein grain and green manure. Experimental sowings in New South Wales and South-east Queensland have produced 4 to 12 tonnes per hectare of dry matter depending on variety, growing conditions and time of planting. Lupins have shown some potential in South-east Queensland as a standover spring forage. They do not take the place of oats or ryegrass as only one grazing can be obtained; several plantings at regular intervals must be used to ensure a continuity of feed. Seed must be treated with the correct inoculant for effective production.

Lupins will grow on sandy loam or gravelly soils of slight to moderate acidity but are intolerant of potassium deficiency. They are easily sod-seeded into existing pastures and heavy sowing rates should be used.

Lupins are highly susceptible to brown leaf spot (*Pleiochaeta setosa*), moderately susceptible to bean yellow mosaic virus and susceptible to native budworm (*Heliothis* sp.). Root and crown rots (*Sclerotium rolfsii*), (*Pythium* sp.) and fusarium wilt may reduce forage yields in coastal areas. Lupins are slow to nodulate and are highly specific as to the correct inoculant.

The most important varieties are *L. angustifolius* cultivars UNICROP, UNIHARVEST and UNIWHITE (sometimes referred to as narrow-leaved lupin) and *L. luteus* cultivar WEIKO III (commonly called yellow lupin).

• VETCHES (*Vicia sativa*)

Vetches are only used to a small extent in the South Burnett. They will grow on a wide range of soils from light sandy types to moderately heavy clays. Yields of dry matter average 3 to 4 tonnes per hectare in winter and spring. They can be easily sod-seeded into paspalum, kikuyu or mat grass pastures. When sown in late March, grazing can commence in late June or early July. Where dairy cattle are allowed half their daily food intake from vetch, grazing can be made to extend until the end of October. Seed is generally expensive with the GOLDEN TARES cultivar the most widely used because it is the most palatable. Inoculate seed with commercial inoculant 'F' before planting.

TABLE 1

ANNUAL WINTER FORAGE CROP PLANTING GUIDE

Crop	Main Use	Sowing Time	Sowing Method	Sowing Rate (kg/ha)		Period of Growth (mths.)	Remarks
				Rain-grown	Irrigated		
Oats, wheat Barley	Grazing, hay, silage	March–May	Broadcast/ drilled	45–67	80–100	3–5	Oats sown mainly for grazing.
Ryegrass	Grazing, hay, silage	March–May	Broadcast/ drilled	NR	20–40	7–9	Must be irrigated; lower seeding rate is used for well prepared seedbeds. Requires 300–400 units of nitrogen per hectare.
Berseem clover ..	Grazing	April–June	Broadcast/ drilled	NR	8–12	4–6	Do not use on acid soils.
Medics	Grazing	April–June	Broadcast/ drilled	2–4	4–6	4–6	Do not use on acid soils.
Lucerne	Grazing, hay silage	April–June	Broadcast/ drilled	7–14	10–14	8–10	Requires well drained fertile soils.
Field pea	Green manure grazing	March–May	Preferably drilled	70	100	3–4	22 kg/ha sown with oats.
Vetch	Green manure grazing	March–May	Broadcast	50	70	3–5	15 kg/ha sown with oats, susceptible to disease.
Lupin	Grazing, grain	March–May	Preferably drilled	80	80–100	5	30 kg/ha sown with oats. Sow only alkaloid-free varieties.
Rape	Grazing	March–May	Broadcast/ drilled	4	NR	2–4	Susceptible to aphid attack. Taints milk.
Turnip	Grazing	March–May	Broadcast/ drilled	2–4	NR	4–5	May be sown with oats, susceptible to aphids, taints milk.
Kale/mangels ..	Grazing	March–May	Broadcast/ drilled	2–4	NR	4	May be sown with oats, susceptible to aphids, taints milk.

NR–Not recommended

• FIELD PEA (*Pisum arvense*)

Field pea is leafy with succulent stems but is not readily accepted by cattle. It is intolerant of acid soils and prefers clay loams to sandy soils. The large seed should be drilled rather than broadcast and covered to a depth of 5 cm. The most common variety is DUN. Field pea can be sown on its own or with oats. Its major drawback is that it only provides one grazing.

Root and related crops

• RAPE (*Brassica napus*)

Rape is a high-yielding, drought-tolerant member of the cabbage family. It recovers slowly after grazing, particularly late in the season. Stock find it unpalatable until they become accustomed to it. To overcome this problem, stock are not allowed any other feed sources apart from dry roughage. Rape readily taints milk and should only be fed to dry stock.

In wet years, it has yielded up to 7 tonnes per hectare of dry matter but 3 to 4 tonnes per hectare is more likely. Rape is used to a limited extent in the South Burnett. The main cultivars are DWARF ESSEX, GIANT KANGAROO and APHIS RESISTANT (which is not resistant to our races of aphis).

• TURNIPS (*Brassica rapa*), KALE (*Brassica oleracea*), MANGELS (*Beta vulgaris*)

These are similar crops to rape. They will taint milk and are susceptible to severe aphid damage. If grazed too early, the small roots can choke stock. Wet weather will rot the roots. The advantages of these crops are the low seed costs, high yields of tops and roots, and their ability to condition stock. Commonly sown varieties are MAMMOTH PURPLE TOP turnip, THOUSAND HEADED kale and LONG RED mangel.

Grazing management

Grazing of winter cereals and ryegrass should commence when these crops are 20 to 30 cm high, by which time secondary roots should have developed. Young plants may be uprooted if grazed too early, particularly where the soil is soft after rain or irrigation. Quick-maturing varieties of oats produce a large amount of foliage quickly. Grazing must aim at maintaining a favourable leaf to stem ratio. Severe defoliation will cause considerable tiller death, slowing the recovery after grazing. The slow-maturing varieties can be stocked at a constant level thus making management easier. Oats should be grazed at 4 to 6-weekly intervals for maxiumm production and quality. Grazing below 8 cm is detrimental, reducing both the number and vigour of the remaining tillers.

To obtain maximum production, annual ryegrass should be grazed every 3 weeks, after an initial 6 to 8 week establishment period. There should be 3 to 6 cm of growth remaining after grazing; leaving more or less will reduce regrowth.

In the case of field turnips, kale, mangels and rape, the roots must be big enough before grazing to prevent animals from choking. As a general guide, grazing can commence when leaves are 15 to 30 cm long.

Legumes such as vetches, lupins and field pea should be grazed just before full flowering. Cattle often will not accept these at the first grazing but generally acquire a taste for them. There is no hard and fast rule for grazing legumes such as lucerne and medics. Generally, however, the best combination of yield and quality is obtained from 4-weekly grazings. Combinations of legumes and winter cereals can use a similar grazing frequency.

Strip grazing enables the best utilization of feed and when combined with a back fence ensures that regrowth is unrestricted. Regular spreading of manure will help to keep areas of rank growth to a minimum.

Weed control

Annual weeds can be a problem in many forage crops. If the weeds are not too dense, mowing or slashing will probably give sufficient control to allow the forage crop to become well established. It should aim to reduce weed bulk, doing as little damage as possible to the crop.

If weed infestation is severe, overall spraying of legumes (except lupins) with 3 litres 40% 2,4-DB as the potassium salt per hectare or grass forage species with 1 litre of 2,4-D amine per hectare will control broadleaved weeds such as wild turnip (*Brassica tournefortii*) and wild mustard (*Sisymbrium* spp.).

Control is most effective when weed seedlings are small. The 2,4-DB should be applied when legumes are at the first to eighth trifoliate leaf stage. It is a slow-acting herbicide and the weeds may take up to 2 weeks to die. No herbicides are registered for use on lupins in Queensland.

Most weed infestations occur during the seedling stage. Weed problems in later stages usually indicate lack of vigour of the crop or declining populations. Fertility and grazing management should aim to maintain a vigorous crop while at the same time maximizing animal utilization.

Animal health problems

Bloat

Grazing cattle on lush pastures particularly young, rapidly-growing legumes in the pre-bloom stage is the biggest single cause of bloat. Young cereal crops and even lush ryegrass can also cause bloat. The problem is most acute on irrigated white clover based pastures. The economic losses from bloat can be considerable unless preventive measures are undertaken. Methods of prevention are:

(a) Use antifoaming agents such as vegetable and mineral oils and tallow, administered in the drinking water, in bail feed once a day, as a drench, or sprayed on to crops. Many newer detergents are now being used successfully at an average dosage of 5 to 10 gms per head in the bail feed twice daily.

(b) Feed dry roughage before allowing animals access to lush growth.

(c) Allow ready access to dry pasture.

(d) Strip graze, allowing cattle access to only a small area of crop at a time. The cattle are then forced to eat the whole plant, rather than selectively grazing the succulent, bloat-producing parts.

(e) Mow crops and allow to wilt before offering them to cattle.

(f) Delay grazing until plants mature and flower.

Of these, (a) to (d) are the most acceptable bloat control measures.

Nitrate poisoning

Nitrate poisoning can occur where high rates of nitrogen are used on oats, ryegrass or rape. High levels of nitrate can accumulate in these crops, especially after extended periods of moisture stress, under overcast conditions, or if nutrient deficiencies other than nitrogen are restricting growth. Wilted plants are most dangerous. To minimize the risk, hungry cattle should not be allowed acess to these crops.

Lupinosis poisoning

Lupinosis poisoning may occur if livestock graze dry lupin stubble. The disease is apparently caused by a toxin produced by fungi growing on the stubble, and is quite different from alkaloid poisoning associated with bitter varieties.

Conclusions

Grass forage crops grown under irrigation with nitrogen fertilizer are the highest and most reliable producers of winter forage. However, this material must be efficiently untilized as production costs are high. The overall economics of dairying (the cost of production and returns from product) must be considered when using this high input system. Where nett return is small, other sources of feed must then be considered.

Leguminous forages are cheaper to produce because they do not require nitrogen fertilizer. However, without irrigation they are less reliable than grass forages and cannot withstand high stocking rates. If land is not limiting, larger plantings can overcome this problem.

The wisest approach is a combination of both types, which will not only make feed cheaper, but will allow overlapping of feed supply. In good seasons, winter forages can also be conserved for later use.

Under rain-grown situations, the choice is less attractive. Winter cereals can provide adequate feed if seasons are good. The cost of even small amounts of nitrogen fertilizer must be weighed against possible production increases. Autumn-saved summer pastures, lucerne, autumn-grown feeds such as lablab bean (*Lablab purpureus*) and summer crop residues can all be used to supplement winter-growing forages.

Setaria—an important pasture grass

by P. E. Luck, Agriculture Branch.

SETARIA (*Setaria anceps*) is one of the most important grasses used in sown pastures in coastal areas of Queensland and Northern New South Wales.

Yet only 20 years ago this species was virtually unknown in Australia.

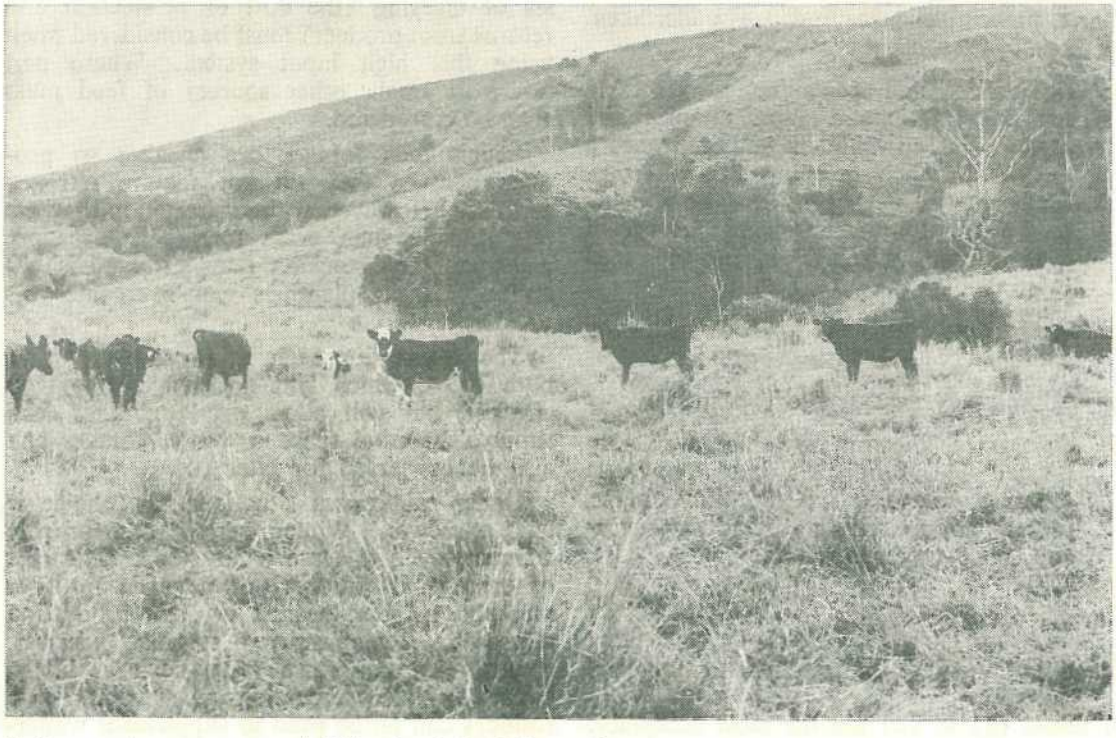
The setaria complex originated in Africa, where it is both widespread and dominant over large areas. It is most common in the southern half of that continent.

The strains at present used in Australia have the botanical name of *Setaria anceps*. There are a number of other strains and species of setaria, some of which may form the basis of further commercial releases.

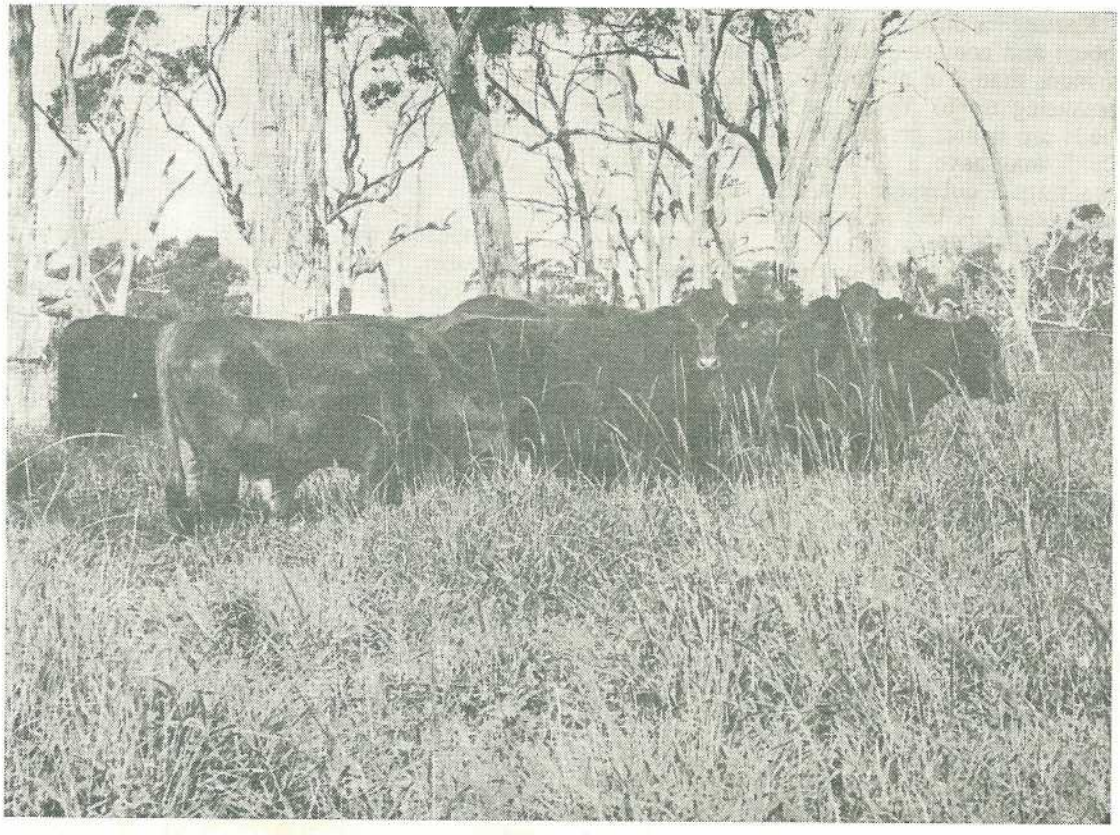
Description

The members of the setaria complex are tufted perennials, with or without rhizomes (underground creeping stems), and very variable both within and between species. The seed-head is a cylindrical spike up to 45 cm or more long.

S. anceps is tall and tufted, without fibre at the base and without elongated rhizomes. Young shoots are fan-shaped and strongly compressed at the base. Sheaths of basal leaves are broad and sharply keeled, and leaves are generally broad.



Heifers grazing a pure sward of Nandi setaria at Eumundi.



Steers grazing a Kazungula setaria dominant pasture on a wallum ridge at Coolum. Greenleaf desmodium is the main companion legume.

Cultivars

There are three commercial cultivars, Nandi, Kazungula and Narok.

Nandi

Nandi originated from a naturally occurring type in the Nandi highland district of Kenya. In trials at the Kitale Grasslands Research Station in Kenya it performed well but was rather variable. A selection programme resulted in the commercial release of an improved leafy, vigorous and late-flowering form. Introductions of commercial seed from Kitale in 1961 and 1964 form the basis of the Australian cultivar.

Nandi is a tussocky perennial with very short rhizomes and erect stems up to 1·5 m high at flowering. It forms broad, slightly spreading tufts which may become a complete sward under grazing.

The spike-like seed-head is of variable length up to 25 cm, usually orange-brown or brown tinged with green. Seedlings are yellowish-green, flat at the base and with a purple blotch on the basal leaf sheath.

Kazungula

Kazungula is an ecotype native to Zambia, and developed in South Africa for grazing and hay production. The seed grown in Australia originated from material introduced by the New South Wales Department of Agriculture from Pretoria in 1949. Grown originally at the Grafton Agricultural Research Station, the seed was subsequently multiplied for commercial use by Mr J. Redrup of Terranova Tropical Pastures Pty. Ltd. in 1962.

Kazungula differs from Nandi in being more robust and coarser. Plants may attain a height of more than 2 m at flowering with seed-heads measuring up to 38 cm in length. The seed-heads are lighter green in colour than those of Nandi and have a greater tendency to bend. The purple coloration on the sheaths of the basal leaves is less pronounced and the nodes on the stems are a paler red. The leaves are more of a blue-green colour. Kazungula will not cross pollinate with Nandi.

Narok

Narok is a selection from an introduction from the Aberdares region of Kenya (altitude 2 190 m). It was one of several introductions resulting from a plant collecting expedition made in 1963 by Dr R. J. Jones of C.S.I.R.O. Dr Jones sought plants with some degree of frost tolerance and also vigour. A subsequent selection programme to upgrade winter production and frost tolerance was carried out by Dr J. B. Hacker of C.S.I.R.O. The result was the release by the Queensland Herbage Plant Liaison Committee of the cultivar Narok in 1969.

Narok is more robust than Nandi but not as coarse as Kazungula, from which it may be distinguished by its greener colour. At flowering, Narok is up to 1·8 m or more in height with rust-coloured seed-heads up to 38 cm long. Vegetative tillers are broader than those of Nandi, and some plants lack the red pigmentation at the base common to Nandi and Kazungula. Narok can cross pollinate with Kazungula but not with Nandi.

Setaria splendida

Another species, *Setaria splendida* has been sown on a small scale in North Queensland. This species, an introduction from East Africa, has not been officially released for commercial use. It is similar to the *S. anceps* cultivars but is considerably larger—it is taller, the leaves are longer and wider, and the internodes are thicker. It is more vigorous than the commercial cultivars and is known as 'giant setaria' in North Queensland. It is extremely palatable compared with most other grasses and there is no problem of uneaten, coarse, stemmy material as occurs with Kazungula.

The main drawback is that it sets very little viable seed, but it is readily established vegetatively. Because of its vigorous habit, there are likely to be problems of legume compatibility.

Frost tolerance

Compared with most other summer-growing grasses, Nandi and Kazungula setaria have some frost tolerance. Light frosts do little damage but heavy frosts will completely kill the top growth and some plants may actually die. However, surviving plants will regrow quickly with favourable soil moisture and temperature conditions.

Erect seed-heads of Narok setaria at the flowering stage.

Narok is the most frost tolerant. Negligible leaf damage occurs at temperatures of −2·8°C to −3·3°C, but heavier frosting results in leaf kill. Little growth is made in winter but recovery in spring can be rapid.

Climatic and soil requirements

Apart from their widespread geographical distribution, species of setaria are found naturally in a wide range of situations from poor sandy and granite soils to heavy black clays, and under waterlogged or even swampy conditions. The altitude range is also wide. In East and Central Africa, setaria occurs from sea level in coastal forest glades to moorlands and forest edges at up to 3 000 m altitude, but is most common in the 600 to 2 400 m range. The setaria complex appears to be adapted to wet conditions, with most associations occurring above a rainfall of 750 mm with no prolonged dry season.

In East Africa, *S. anceps* is frequently found in low-lying areas with a high water table, on stream banks and forest edges. It does not appear to be common on alkaline soils or on very acid soils, the majority of collections being made at a soil pH of 5·5 to 6·5.

In Australia, setaria is adapted to similar subtropical and tropical conditions as experienced in Africa. It is commonly planted in coastal and subcoastal areas extending from Northern N.S.W. to North Queensland. Kazungula being the most drought tolerant cultivar is planted in areas down to 750 mm rainfall, whereas Nandi and Narok are generally confined to areas with 1 000 mm or more rainfall. They are sown on a wide range of soils with from poor to good drainage and generally in the pH range of 5·0 to 7·0. Kazungula is also the most flood tolerant cultivar.

Soil fertility

While setaria can persist at fairly low levels of fertility, it requires at least medium fertility for productive growth. The main nutrient deficiencies are usually nitrogen, phosphorus and potassium.

A wide range of legumes may be grown with setaria and in this way much of its nitrogen requirement can be met. However, it is usually capable of responding to much higher levels of nitrogen than can be supplied by legumes. Phosphorus and potassium are essential for both legumes and grasses. Setaria is an exceptionally heavy feeder of potassium and can induce potassium deficiency in legumes on soils which are not normally regarded as deficient in this element.

Growth rhythm

Seasonal growth is obviously determined by temperature and rainfall. The rate of growth can also be markedly influenced by soil fertility status. The growth rhythm of all three commercial cultivars is similar.

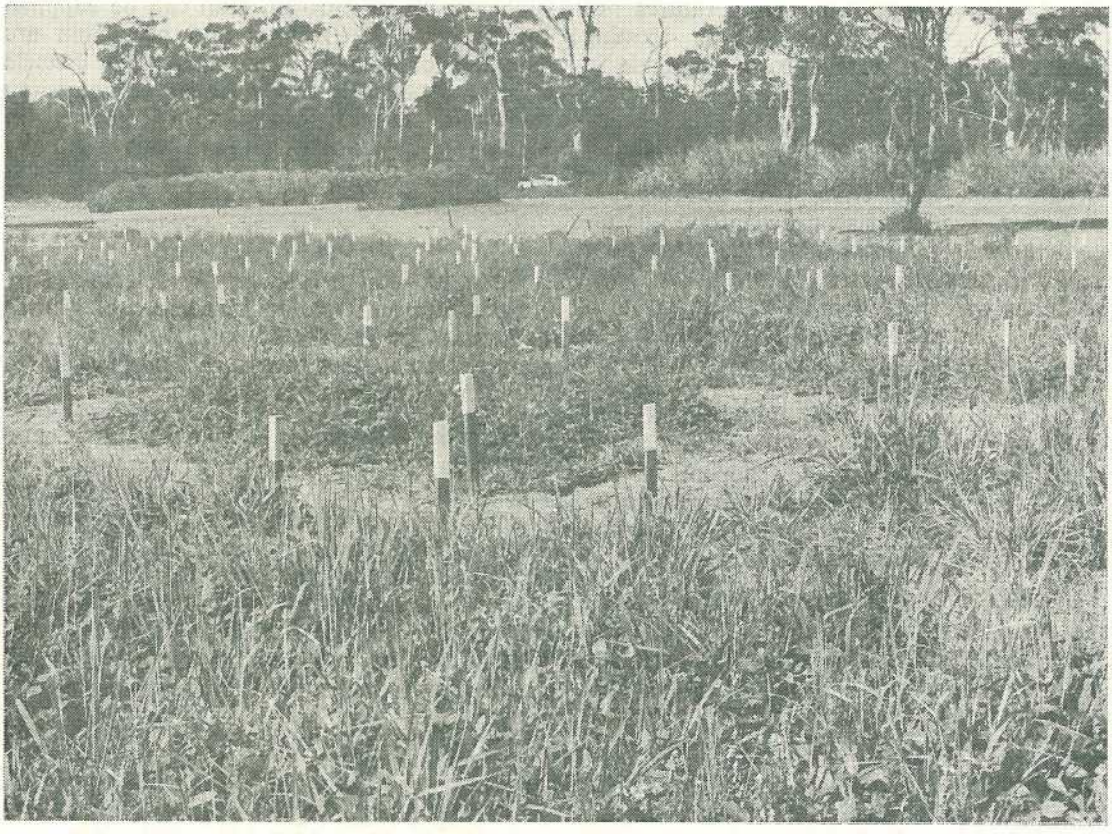
Growth commences early in spring and continues at low autumn temperatures. If frosts are not too severe, all cultivars are capable of a small amount of winter growth. Early spring growth of Kazungula is slightly less than that of Nandi or Narok, but it has a marked peak of summer growth when yield is greater than that of Nandi or Narok. Kazungula flowers up to a month later in spring and has a more concentrated flowering period.

The yield potential of all cultivars is high; total annual dry matter yields under ideal growing conditions can be of the order of 10 000 kg per ha. The yield of Nandi would generally be 10 to 20% below that of Kazungula or Narok. However, the extra summer growth may be of no advantage, as it is usually coarse and stemmy, and relatively unacceptable to animals. Because Narok puts up fewer seed-heads this problem is less noticeable than in Kazungula, and a longer period of nutritious feed is the result.

Seed production

Setaria is almost entirely cross-pollinating and isolation is necessary for seed production. This is particularly important with cultivars Kazungula and Narok which will cross readily.

The 'seed' of setaria consists of the caryopsis and enclosing lemma, palea and glumes. It is frequently difficult to ascertain whether a 'seed' contains a caryopsis. Germination is generally fairly low (30 to 40%) and drops rapidly unless stored in cool, dry conditions.



Experimental plot at Coolum Research Station comparing Narok and Nandi setaria grown with various desmodiums.

The usual method of seed harvesting is direct heading with a combine harvester. Using this method, yields seldom exceed 40 to 60 kg per ha per harvest. Two harvests per year can be obtained, one in early to mid-summer and the other in autumn. Hand or machine cutting of the seed stalks followed by sweating for several days before threshing can result in greatly increased yields (up to 100%). The drawback is that it is a very labour-intensive method.

To achieve even these moderate yields, the crop has to be well grown. This requires heavy dressings of nitrogen fertilizer (100 to 150 kg N per ha per harvest). Kazungula produces the highest seed yield and Narok the lowest. In established stands of Narok, yields as low as 20 kg per ha are common.

The problem appears to be two-fold. All strains flower and seed over a protracted period of at least a month, which makes it difficult to choose a period of peak ripeness. Before the younger seed matures, earlier ripened seed falls from the spike. The other drawback, particularly with Narok, is that a large number of tillers fail to produce a seed-head.

Establishment

Setaria can be established vegetatively from rooted tillers (stems) but is usually established from seed. Compared with other grasses, setaria establishes relatively slowly from seed. This is sometimes an advantage as there is less competition for the establishment of a companion legume. Nandi establishes more slowly than the other cultivars.

An actively-growing mixture of Nandi setaria, Greenleaf and Silverleaf desmodiums, and Tinaroo and Clarence glycines at Eerwahvale.

A well-prepared, firm, moist seedbed gives best results. While the seed may sometimes be successfully sown on the surface, a light soil covering is recommended where possible. The ideal sowing depth will vary depending on soil type and moisture conditions. However, sowing deeper than 2 cm may result in seedlings failing to emerge. The recommended sowing rate depends on the quality of seed. Given reasonable quality seed, the rate is 1 to 2 kg per ha. Kazungula can be sown at a lower rate than Nandi or Narok (nearer to 1 kg than 2 kg per ha).

When planting vegetatively, care is necessary to ensure that the planting material is not completely buried. Unlike some other vegetatively propagated grasses (for example, sugar cane), setaria fails to establish unless part of the tiller remains above ground.

The best planting time is from October to February. When sowing with temperate species such as white clover, late autumn or very early spring sowings are sometimes employed. However, 'cool-season' establishment is much slower and somewhat poorer overall.

Very early grazing should be avoided as young plants are pulled out by the roots, especially when the soil is moist. However, a fairly light grazing when the pasture is several months old can be beneficial. This opens up the sward and allows light to reach the young legume plants.

The correction of known nutrient deficiencies is essential for good establishment. Phosphate in particular is an important nutrient for rapid establishment.

Fertilizing for production

While setaria is not as demanding of high fertility as kikuyu grass, it requires a reasonable level. The fertilizer required will vary from one area to another depending on soil fertility, but the general fertilizer recommendations for phosphorus, potassium and trace elements for establishment and maintenance of other grass-legume pastures will be applicable. The trace element molybdenum is often required by the companion legume.

Pure grass swards

The general fertilizer recommendations are similar to setaria-legume swards, except that molybdenum is not required. However, nitrogen fertilizer is essential in the absence of a legume.

Setaria is most responsive to nitrogen (N) and, for large dry matter yields, high application rates are required. Satisfactory yield responses are obtainable with up to 400 kg N per ha per year. Because nitrogen is expensive, very high rates are rarely used. Rather, nitrogen is applied at rates up to 90 kg N per ha (2 bags urea or 2½ bags of ammonium nitrate), applied twice yearly.

The main period of feed shortage is winter—spring. Nitrogen applied in autumn and late winter or early spring may result in a significant grass boost for these critical periods. Grass-legume pastures will provide sufficient high quality summer and early autumn feed.

Grass-legume compatibility

The cultivars are grown with a range of legumes, including Greenleaf and Silverleaf desmodiums (*Desmodium intortum* and *D. uncinatum*), Siratro (*Macroptilium atropurpurenum*), glycine cultivars (*Glycine wightii*) and lotononis (*Lotononis bainesii*). The choice of legume is governed mainly by its suitability for a particular site and the management to which it is likely to be subjected. As a general rule, most legumes are likely to be more compatible with Nandi or Narok than with Kazungula. When Kazungula grows rank and coarse and becomes relatively unacceptable to cattle, the companion legume is likely to suffer extreme competition for light, moisture and nutrients. Lotononis is very sensitive to competition for light and should only be included in mixtures which will be closely grazed.

Mixtures of setaria cultivars should be avoided. For example, in a mixture of Nandi and Kazungula the more palatable and less vigorous Nandi will eventually disappear. The same principle applies to mixtures of setaria and other grasses.

Management and utilization

The setaria cultivars are tolerant of a wide range of management practices. They perform well under both continuous and rotational grazing. Management should be geared towards survival and growth of companion legumes and optimum utilization of the grass.

Both overgrazing and undergrazing reduce pasture productivity. Overgrazing results in reduced pasture growth. Tropical legumes are particularly susceptible to close, frequent grazing. This results in weakening and eventual loss of the legume. Because of the reduced nitrogen supply, the grass subsequently weakens.

Undergrazing causes the grass to become rank, coarse and unpalatable. This can result in detrimental shading of companion legumes. Coarse grass is not only poorly accepted by cattle but has a much lower nutritive value. As a result, animal performance suffers.

As in most management practices, there is a happy medium. This invariably involves some compromise between heavy, frequent grazing—younger, leafier, more digestible grass, and light, infrequent grazing—more growth, coarse, less digestible grass.

An adapted setaria—legume mixture will allow some flexibility between these extremes of grazing management. A good contrast is the management of a Kazungula pasture compared with a Narok pasture. Because of the former's strong summer growth and heavy seeding, it is almost impossible to prevent under-utilization in mid summer. On the other hand, Narok (particularly at the moderate soil nitrogen levels occurring in a legume pasture) while bulking up in the summer does not produce a large number of coarse seed stalks. Even

rank growth is much more acceptable to cattle. With Kazungula, much of the rank summer growth is merely trampled.

While setaria does not make much winter growth, there is usually a fair to large amount of summer growth accumulated by late autumn. As both grass and companion legumes are fairly dormant at this time, continuous heavy grazing is not detrimental to the sward. In fact it can be beneficial by removing old growth, thereby encouraging fresh growth in the spring.

Nutritive value

Setaria compares favourably with other subtropical and tropical grass species in digestibility and protein levels. As with other species, the levels are relatively high in young growth and decline markedly with age. Digestibilities of dry matter as high as 70% have been recorded, a level rarely attained by other tropical grasses. However, with setaria of 6 to 8 weeks' regrowth the digestibility is 50 to 55%. Of the commercial cultivars, Narok has a slightly higher digestibility.

Protein (nitrogen) content depends on soil nitrogen status and age of regrowth. Crude protein levels range from 15% in young growth down to 5% in mature stems. The faster the regrowth, the more rapidly the protein content falls. The reason is that the nitrogen taken up by the plant is being progressively diluted within the increasing bulk of plant. This probably explains why Nandi tends to have a higher protein content at the same age compared with Narok and especially Kazungula. Regrowth of Nandi under comparable conditions is likely to have a lower dry matter yield.

Nandi and Narok have a relatively low sodium content compared with Kazungula. Where cattle are continuously grazed on such a low sodium pasture, salt supplementation may be necessary—especially where the stock water is also low in sodium. A normal level of plant phosphorus in an adequately fertilized stand is 0·25% on a dry matter basis. Under very high levels of soil phosphorus, the level may exceed 0·3%. If phosphorus levels are low, phosphate supplements may need to be fed, particularly with high-producing dairy cows.

Stock problems

All strains of setaria contain oxalate. Kazungula has the highest level, which can reach 7% of the dry matter. Normally, however, it is around 4%. Narok is intermediate in oxalate content (3 to 4%), while Nandi is lowest at around 3%. *Setaria splendida* has an oxalate content comparable to that of Kazungula.

Horses may suffer from ill-thrift, lameness and swelling of the head bones ('big-head' disease) if they are on a sole diet of grasses high in oxalate. Setaria and buffel grass (*Cenchrus ciliaris*) are the main culprits but green panic (*Panicum maximum* var. *trichoglume* cv. Petrie) and kikuyu (*Pennisetum clandestinum*) have also been incriminated. Native grasses are very low in oxalate. It seems that oxalic acid combines with calcium, making the latter unavailable to the animal.

To prevent the disease, horses should not graze improved pastures of the abovementioned species for longer than 4 to 6 weeks, especially during periods of lush growth. They should be rotated between the improved pastures and native pastures, or grazed on native pastures all the time. Feeding of a calcium supplement such as ground limestone or lucerne hay can help to prevent or control the disease.

The problem of big-head disease is covered in detail in an article by J. C. Walthall in the *Queensland Agricultural Journal*, July–August 1977.

High levels of oxalate in setaria can also be toxic to cattle, by causing a sudden drop in the level of blood calcium (acute hypocalcaemia) resulting in coma followed by death.

However, oxalate poisoning of cattle is fairly rare. It is unlikely to occur with Nandi. With other cultivars, problems could occur when their oxalate levels are extremely high, coupled with the sudden introduction of cattle unaccustomed to oxalate. Oxalate concentration is highest in the leaf blade and young, leafy growth about 3 to 5 weeks old is suspect. Heavy fertilization with nitrogen and potassium can lead to increased oxalate in the plant tissue, and the content is highest at night.

Most cases of poisoning have occurred with hungry cattle admitted to lush setaria. They have received a high intake over a short period. Cattle should be introduced to lush setaria gradually. Once accustomed to setaria they can handle a high intake of oxalate. Initial short periods of access can be gradually increased to continuous grazing. If in doubt, two or three less valuable animals should be tried rather than risking a large number of valuable cattle.

Pests and diseases

Army worms, locusts etc., are pests common to all grasses in the subtropics and tropics. However, there are no serious pests peculiar to setaria.

The only important disease in Australia is the leaf spot fungal disease caused by *Pyricularia grisea*. Under hot, humid conditions, this disease can seriously retard growth in ungrazed stands. It attacks both Nandi and Narok but Kazungula is rarely attacked.

In Kenya, the bunt fungus *Tilletia echinosperma* can devastate seed crops. The disease has not been reported elsewhere and it is unlikely to become a problem in Australia as it can only spread from one open flower to another.

Lambs... why do they die?

THIS article is designed to help graziers determine the causes of lamb deaths. It gives a step-by-step method for examining dead lambs.

The method

Step 1

Examine the carcass thoroughly. Look for blood on the skin and for other signs of predation. (Predation wounds can vary from a small bite which is difficult to see to the extreme where the lamb is reduced to a piece of blood-stained skin).

If blood is present on the skin, the lamb was killed by a predator. If there is an open wound with no blood on the skin, the lamb was scavenged after death.

A swollen head is a sign of a difficult birth and a subsequent early death.

Look for after-birth on both sides of the carcass. If after-birth is still adhering to most of the carcass or to the underside of it then the lamb was still-born or died very shortly after birth.

Look at the feet. When lambs are born, the feet have a soft, pale yellow pad. These pads will be present on still-born lambs. The pads disappear once the lamb starts walking. After a day, the feet are hard, show signs of wear, and are usually darker in colour (see plate 3).

---

by A. S. LeFeuvre and D. J. Jordan,
Sheep and Wool Branch

Step 2

With a sharp knife, skin the left side—laying back the shoulder and hind leg. Flay back the skin to the backbone from the head to the tail. Cut the ribs at the brisket. Trim back the diaphragm and flank. Snap the ribs back over the spine as in plate 2.

Step 3

Starting at the head, look for bruising or areas of bleeding under the skin or on the flesh. These indicate injury.

Lambs with swollen heads will also have watery fluids in the tissues under the skin. These indicate a difficult birth.

Look in the chest cavity then look at the heart and lungs. In lambs that have not breathed, the lungs are small and are very dark purplish-red in colour. A portion of this lung will not float in water. In lambs that have breathed, the lungs look inflated, and a piece will float in water.

Step 4

Look at the heart and kidneys together. In still-born lambs or in healthy lambs that have been killed by a predator, a considerable quantity of white or pinkish fat will be covering these organs (see plates 1 and 2). In lambs that have or would have died of starvation there is very little fat, and this fat is of a plum-red colour (see plates 4, 5 and 6).

ABOVE. Plate 1. A normal lamb—note the heart and kidney.

RIGHT. Plate 2. A normal lamb—note the white fat on the heart and kidney and the large fourth stomach.

Plate 3. The feet of a non-walker, a walker and a non-walker.

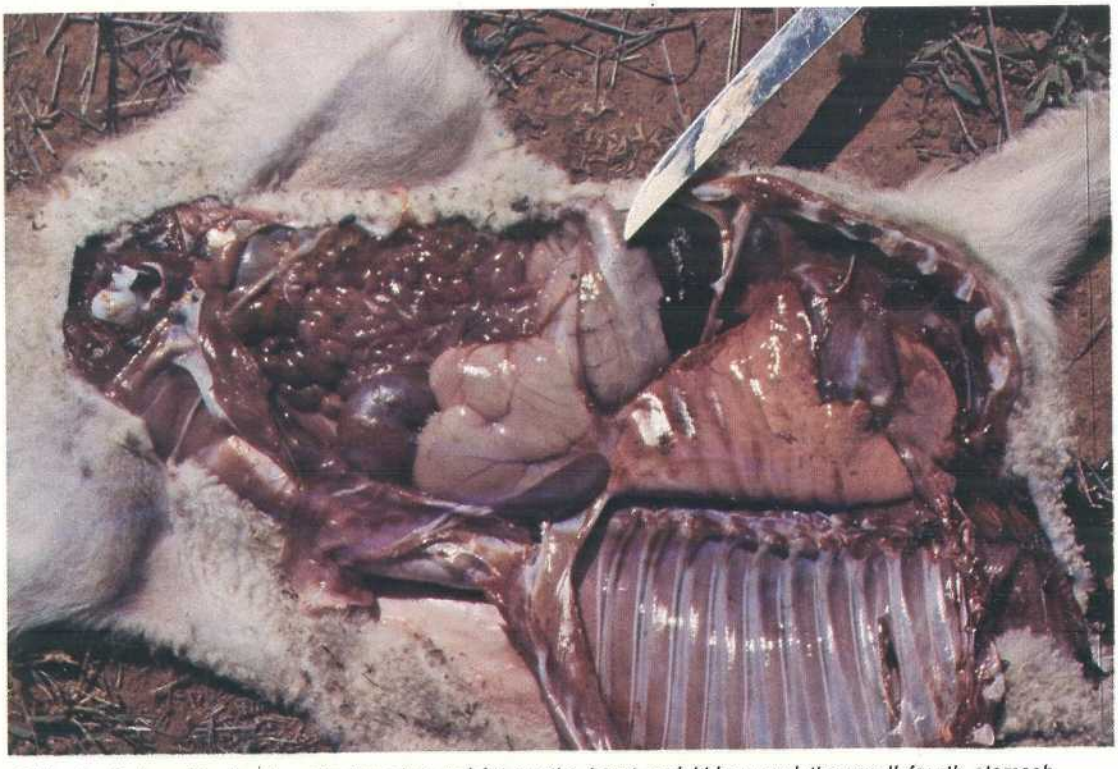


Plate 4. A starvation lamb—note the plum-red fat on the heart and kidney and the small fourth stomach.

Plate 5. A starvation lamb—note the plum-red fat on the heart.

Plate 6. A starvation lamb—note the plum-red fat on the kidney.

Step 5

Open the fourth stomach (abomasum). If it is empty the lamb died of starvation. If it contains milk or curds in any quantity, the lamb has suckled recently and is unlikely to have died from natural causes.

The liver should look and feel normal.

Features of common causes of death

Still-born or died during a difficult birth

- Pads on the feet not worn.
- Head swollen, to a greater or lesser degree.
- After-birth usually adhering to parts of the carcass.
- Bruising around the head, with watery fluid in the tissues of the head and neck.
- Dark, un-inflated lungs.
- Considerable quantities of white or pinkish fat around the heart or kidneys.
- No milk in the fourth stomach. (Some lambs may have taken a few breaths before they died during a difficult birth).

Starvation

- Feet worn.
- Lungs inflated.
- Plum-red fat on heart and kidneys.
- Very little or, more usually, no milk in the fourth stomach.

Predation of the live lamb

- Worn feet.
- Lungs inflated.
- Blood-stained skin with teeth or claw marks. (This may require a very close examination).

If plum-red fat is present on heart and kidneys, the lamb would probably have died of starvation anyway. If the fat is white and in considerable quantities, the lamb was healthy and normal until the time it was killed.

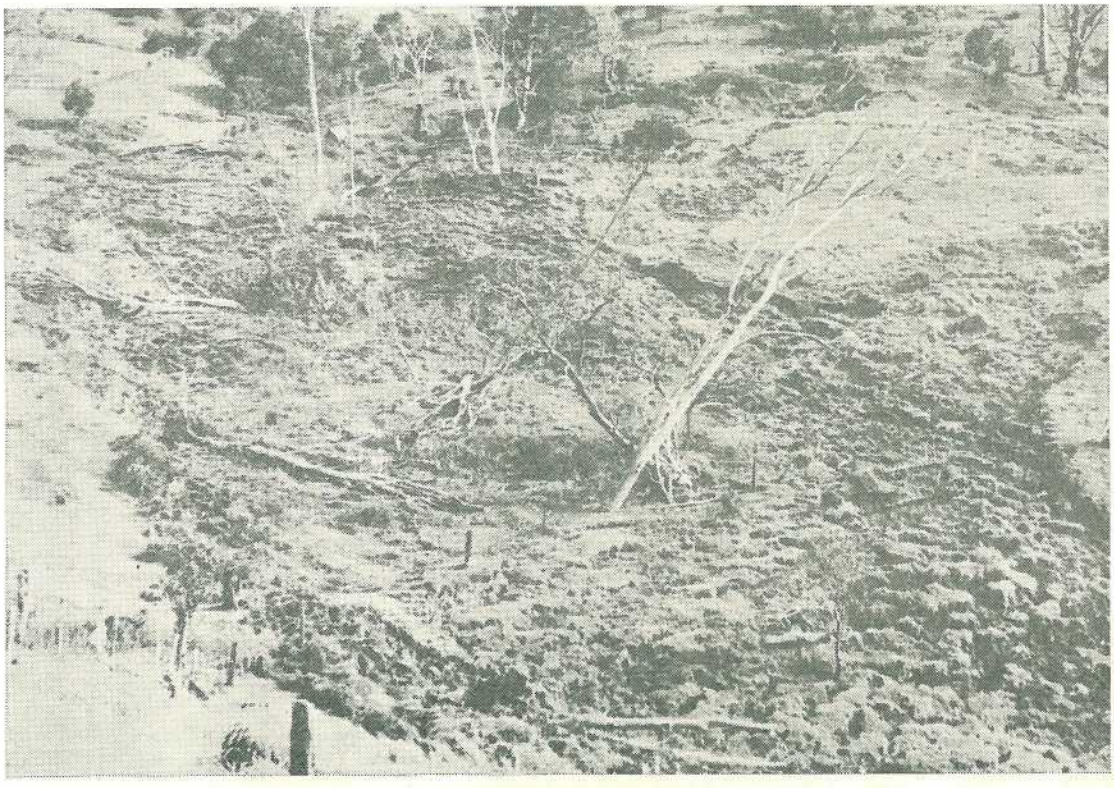
Scavenged carcass

A scavenged carcass will not have a blood-stained skin.

The preceding descriptions are those of normal deaths.

If your lambs are dying and do not have these symptoms, or you have a very large number of lambs dying that fit these descriptions, we suggest that you contact your nearest sheep and wool adviser or veterinary practitioner.

Landslip



on the Maleny Plateau

by R. Kelsey, Soil Conservation Branch and J. East, University of Queensland.

ONLY the more spectacular landslips, such as those endangering or damaging buildings, receive public attention, but damage to rural land can be equally devastating. Landslip is far more widespread on the Maleny Plateau than is commonly realized.

The Maleny Plateau forms the southernmost portion of the Blackall Range, extending from Mapleton in the north to Maleny in the south. Deep, stable krasnozemic soils characterize the undulating plateau top. In contrast, the shallow, brown clay soils of the plateau margins contain numerous landslips often of considerable size. The average annual rainfall is high (1 996 mm at Maleny), and this precipitation is often of high intensity.

Above. Part of a massive earth flow on the Maleny Plateau.

Land use in the area has traditionally been dairying. Since the latter part of the last century, clearing of the natural forest vegetation has progressed continually to enable timber getting and expansion of the dairying industry. Pineapples, small crops and tree crops complement the dairying.

In recent times, tourism and residential expansion, particularly along the plateau margins, have become of increasing importance. Development of the area has been accompanied by greatly accelerated landslip activity.

Causes of landslip

Landslips (also termed mass movements) occur when the intensity of shearing stresses becomes greater than the shear strength of the rock and soil materials. This situation may arise when storm run-off enters a sloping soil and through flow is impeded by an impermeable barrier such as bedrock or a clay-rich soil horizon; the pore pressures consequently developed result in decreased soil cohesion and increased soil mass, with ultimate failure of the slope.

On the Maleny Plateau, other characteristics of the soils and the topography, in addition to the presence of an impermeable layer, enhance the area's susceptibility to landslip erosion. These include the presence of swelling clay minerals, modification of the natural vegetation, the presence of exchangeable cations such as sodium, and the angle of slope of the terrain.

Role of vegetation

Land use, particularly clearing of the natural forest vegetation, is undoubtedly the most important factor influencing landslip activity on the plateau. It should be noted, however, that mass movements have played an important role through geological time in the development of the plateau. Clearing of the forest vegetation has dramatically increased the frequency of these natural processes.

Slump movement under kikuyu pasture.

Natural protection—codominant community of Eucalyptus grandis *(flooded gum) and* Tristania conferta *(brush box).*

Forest vegetation protects slopes against landslip activity by the following means:

- Tree roots (particularly deep rooted species such as the eucalypts) increase the shearing resistance of the solum thereby resisting movement.
- Deep tree roots are more effective in lowering the water table than pasture grasses, hence preventing excessive pore water pressures in the solum.
- Forest soils have a higher organic content which tends to bind the clay particles and prevent dispersion.
- Forest soils are not subject to the extreme ranges in temperature, moisture content and volumetric changes that pasture soils experience; this prevents breakdown of soil structures through soil 'cracking'.
- The holes and depressions remaining after the roots decay allow for the rapid intake of water into the subsoil, thereby increasing instability.

The extensive clearing of forest on the Maleny Plateau has probably resulted in all of the above contributing to the greatly increased landslip activity.

Soil properties

Certain properties of the brown clay soils along the plateau margins make them particularly prone to landslip erosion, especially once the natural forest vegetation has been cleared.

Land slump at Baroon Pocket on kikuyu that was once highly productive. Kudzu (Pueraria lobata) *has been planted to stabilize the area.*

GEOLOGY. Some rock types and the soils derived from them are more prone to instability than others. Basalt, the dominant rock type on the Maleny Plateau, has long been recognized as yielding soils of high erosion susceptibility. The underlying sandstones and the derived soils are also prone to landslips although to a lesser degree. Other areas where instability has been encountered in basalts include the Toowoomba escarpment, the Buderim Plateau and the Lamington Plateau.

CLAY MINERALOGY. The presence of large quantities of swelling clay minerals (for example, montmorillonite) causes the soils to crack on drying and to swell on wetting. The swelling is accompanied by a marked decrease in strength. In addition, the cracks formed in the dry clay soils allow for rapid intake of storm run-off, further increasing the possibility of landslip.

EXCHANGEABLE CATIONS. The presence of sodium cations in some soils on the Maleny Plateau tends to accentuate the loss of strength that accompanies hydration of the swelling clays. The cations are derived from sodium-rich minerals (zeolites) in the original basalt rock. The presence of the cations greatly reduces the stability of a slope.

Slope angle

It can be said generally that the steeper the terrain in any given soil type, the greater its susceptibility to landslip activity. However, this is not always so. On the Maleny Plateau, some of the largest movements have occurred on the more gentle slopes. This seemingly anomalous situation arises from the fact that these slopes are often the sites of seepage, resulting from the contact of the permeable basaltic soils and the underlying and relatively impermeable sandstones.

Climatic factor

It is likely that all the recent landslips on the plateau have been triggered by the intake into the slope of an unusually large quantity of storm run-off.

Although accelerated landslip activity has been occurring from the time of European settlement, the appearance of many slips indicates that they have occurred over the past few years. This sudden increase in landslip activity can be attributed to the abnormally large quantities of rain that have fallen in the area over recent years.

The years 1971, 1972, 1973 and 1974 all registered totals above the annual average (see figure 1). The high intensity of some of this rain is exemplified by single storm events in which up to half the average annual rain fell over a period of just a few days (for example, 10-12 February 1972, 856 mm, being 43% of average annual rainfall). High intensity rainfall such as this was an important factor in triggering many of these recent slips.

Social and economic considerations

The economic and social implications of slip activity of the plateau have been compiled from various sources: farmers, Department of Primary Industries officers and university researchers. They include the following—

- Damage to buildings, dwellings and roads

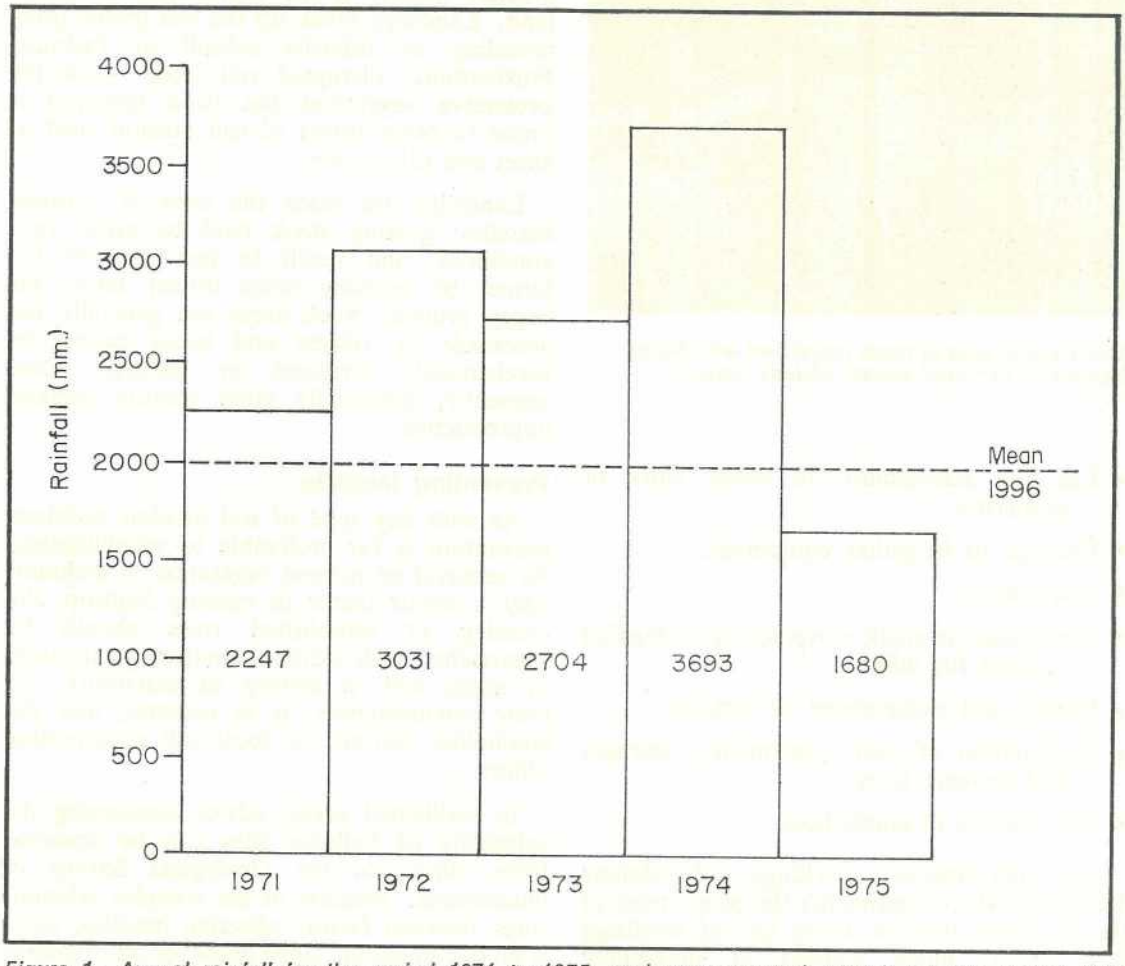


Figure 1. Annual rainfall for the period 1971 to 1975, and mean annual rainfall for the period 1916 to 1975, for Maleny (Source: Commonwealth Bureau of Meteorology).

Large slump type of mass movement with beast trapped in seasonal marsh, Maleny Plateau.

- Loss of accessibility to some parts of properties
- Damage to irrigation equipment.
- Stock losses
- Time losses in stock movement and cleaning of cows for milking
- Repair and replacement of fencing
- Degradation of water catchments, storages and drainage lines
- Degradation of arable land

Although damage to dwellings on the Maleny Plateau nowhere approaches the proportions of the Buderim situation where loss of dwellings has caused much distress, a potentially hazardous situation is developing with the subdivision and sale of housing allotments along the plateau's eastern escarpment. It is here, along the plateau margins, that landslip activity is concentrated.

Over the past 2 years, repairs to the Palmwoods-Montville Road and to the Maleny-Landsborough Road, necessitated through landslip damage have cost hundreds of thousands of dollars.

Similarly, the inability to maintain a road through landslip has caused at least one farmer to discontinue dairying, while another has been forced to handle his milk in cans across a slip which has severed his access road.

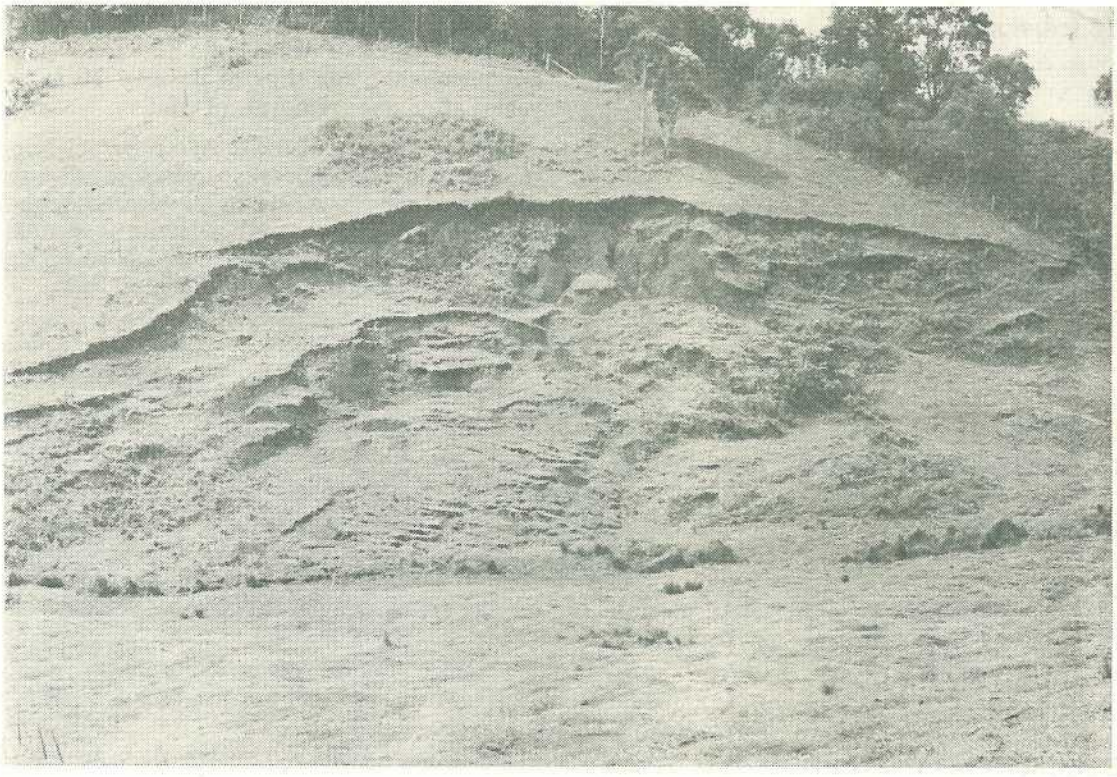
From the soil conservationist's viewpoint, the greatest tragedy is the degradation of arable land. Landslips break up the soil profile often revealing an infertile subsoil or bedrock. Furthermore, disrupted soil from which the protective vegetation has been removed is prone to other forms of soil erosion such as sheet and rill erosion.

Landslips are often the sites of seasonal marshes; grazing stock tend to avoid such conditions, and result in lost time to the farmer by resisting being driven across the boggy ground. Such areas are generally not accessible by vehicle and hence cannot be mechanically fertilized or slashed. Consequently, potentially good pasture remains unproductive.

Preventing landslip

As with any type of soil erosion problem, prevention is far preferable to rehabilitation. As removal of natural vegetation is undoubtedly a major factor in causing landslip, the clearing of established trees should be approached with extreme caution, particularly in areas with a history of instability. In these circumstances, it is essential that the landholder consult the local soil conservation officer.

In residential areas, advice concerning the suitability of building sites can be obtained from offices of the Geological Survey of Queensland. Because of the complex relationships between factors affecting landslip, there is no one minimum slope angle for all situations and above which there should be no clearing.



A slump in the Montville area.

Mr K. Hughes (Soil Conservation, D.P.I.) has identified the margins of basaltic plateau (for example, Toowoomba escarpment, Maleny Plateau, Buderim and parts of the Lamington Plateau) as areas particularly prone to landslip, recommending that no clearing be carried out on slopes greater than 15%.

In landslip-prone areas which have already been cleared, reafforestation is generally the most practical and economic corrective measure. Ideally, locally adapted, deep rooted, fast growing trees should be planted. A close-planted, 2-metre square system will compensate for losses which could be high. However, the replacement of a substitute tree cover is unlikely to be effective within one generation. Fruit and nut trees are unlikely to tolerate root disturbance in such areas.

As excessive water intake into a slope is the most common trigger of landslip, it is of fundamental importance that obstructions should not be allowed to retard storm run-off. Ponding of water in either natural depressions or man-made structures (such as dams and septic systems) on slip prone slopes should be avoided. Such water should be drained and, in the case of dams, relocated. Similarly, diversion or contour banks will increase water infiltration into the soil thereby increasing the risk of slip. Any 'across the slope' drains will need to be sealed.

Springs, seeps and wet spots should be regarded with suspicion. If the water is required for stock use, it should be piped to a safe watering point. Stock must not be allowed to trample a wet area. This can lead to sealing of the soil surface, thereby holding back the water and creating a hydraulic head—ultimately leading to slope failure.

Conclusion

The widespread development of landslip on the Maleny Plateau and other affected areas is a major tragedy, but the worst may be yet to come.

It may take 20 to 30 years for tree trunks and roots to rot away. Not only will they no longer be of assistance in anchoring the soil and in removal of water by transpiration, but the remaining holes can provide a means for mass entry of water into the soil. It is not uncommon for slips to develop 20 to 30 years after the removal of timber.

The short-term benefits of timber clearing should not outweigh the long-term disaster that can follow. Areas to be cleared should be carefully chosen and selectively cleared. Large trees offer the greatest safeguard. They should be retained if at all possible.

Glossary

BASALT	A dense, black, fine-grained rock of volcanic origin.
CATION	A positively-charged atom or group of atoms.
CRACKING CLAY SOILS	Shrinkable clay soils which exhibit numerous small cracks during a dry season or period.
DISPERSION	The separation of clay particles either by physical means (working a very dry or very wet soil) or by chemical means (the addition of sodium cations) or by a combination of both. Dispersion of a clay is accompanied by a decrease in permeability.
FAILURE SURFACE	The surface along which failure of a slope takes place. Common failure surfaces in landslips are the bedrock surface or a clay-rich soil horizon.
SOLUM	The A and B soil horizons, or the A horizon alone when no B horizon is present.
TEXTURAL PROPERTIES	The relative amounts of sand, silt and clay size particles in a soil.

Plant study in Central Australia

THE first major study of the plants of Central Australia for more than 100 years is being carried out by a team of botanists from five mainland States.

It will lead to the publication of a handbook to the flora of Central Australia.

The project was in the hands of about 50 botanists. These were from Queensland, New South Wales, South Australia, Western Australia and the Northern Territory.

The project began early in 1977 under the guidance of the Australian Systematic Botany Society.

The handbook would cover about 2 000 plant species that grew in arid central Australia. The part of Queensland involved was the far west, which received an annual rainfall of below 300 mm.

The handbook would contain short descriptions of the various plants, together with illustrations and keys to aid in their identification. It would also give the distribution of the plants and their common names as well as comments on their special features or properties.

The book is expected to be published in 1981, in time for the International Botanical Congress in Sydney.

Wheat varieties for Queensland—1979

EIGHT wheat varieties are recommended in Queensland by the Department of Primary Industries for 1979, based on agronomic, disease resistance and quality characteristics.

The varieties are listed below in order of maturity, and their main features described. Note that it is advisable to grow a number of varieties to reduce risk.

A list is also given of the recommended varieties for the various districts and the suggested planting periods. These recommendations may require modification for particular areas and topography: your Shire Agricultural Extension Officer will provide further information.

The varieties Cook, Kite and Shortim are recommended for irrigation.

Gatcher. Very quick maturity, suited to main season and late planting, particularly in Zone 2. Straw rather tall and susceptible to lodging. Medium yield potential, but yield may be low on heavier soils of the inner Darling Downs. Awned heads. Difenzoquat (Avenge) should be applied only between the 2½ and 4-leaf stage of the crop, or crop damage may occur with this variety. Resistant to stem rust but susceptible to leaf rust. In some seasons, may develop dark pigmentation on ear and stem (genetic black chaff). PH grain quality but medium to low protein. Released by University of Sydney in 1969.

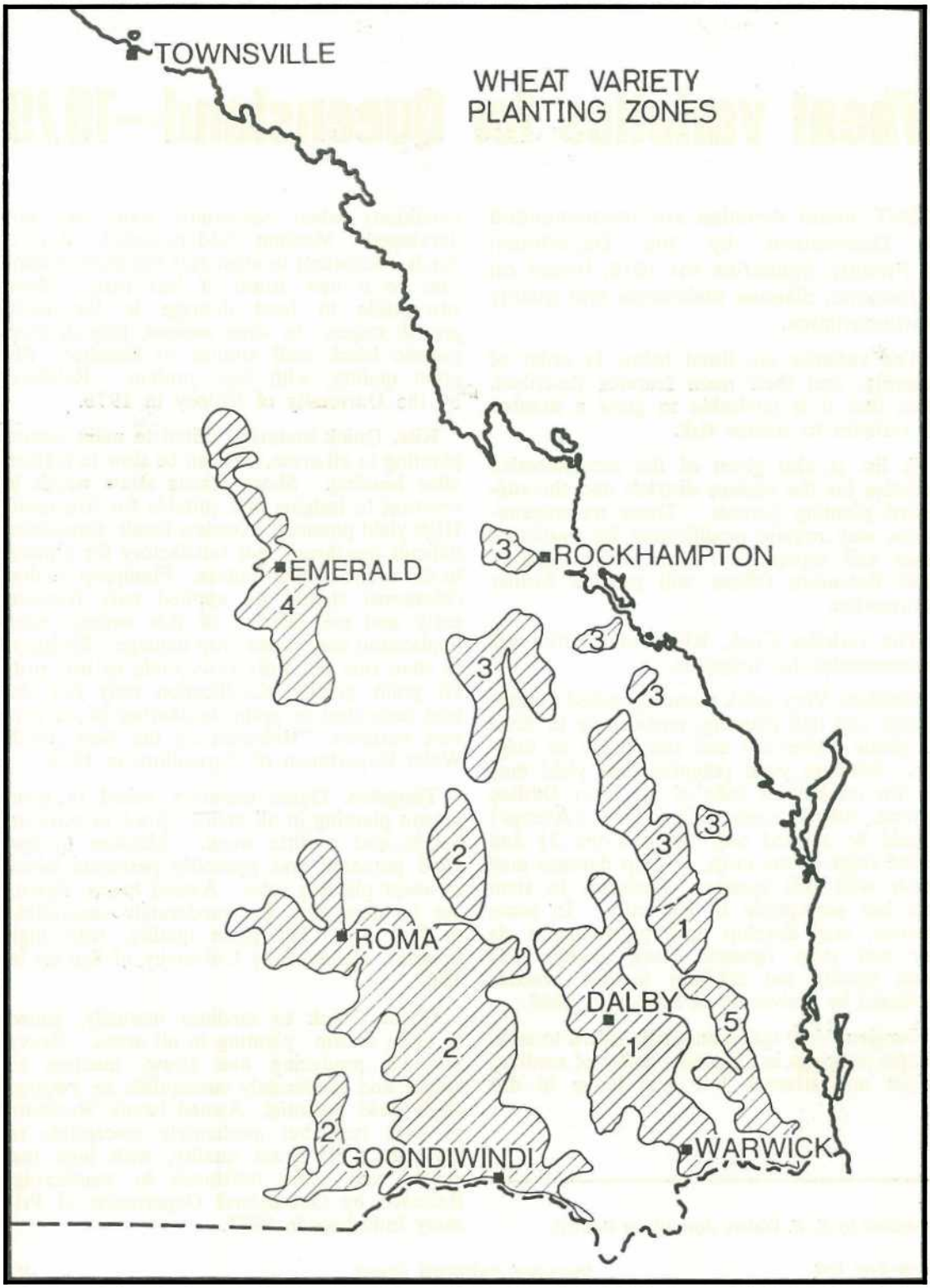
Songlen. Very quick maturity, suited to main season plantings in all areas. Straw of medium height and strength but may lodge in dry conditions when secondary roots are not developed. Medium yield potential. Awned heads. Resistant to stem rust but now susceptible to a new strain of leaf rust. More susceptible to frost damage in the early growth stages. In some seasons, may develop genetic black staff similar to Gatcher. PH grain quality, with high protein. Released by the University of Sydney in 1976.

Kite. Quick maturity, suited to main season planting in all areas, but can be slow to mature after heading. Short, strong straw which is resistant to lodging and suitable for irrigation. High yield potential. Awnless heads, sometimes difficult the thresh, but satisfactory for grazing in the event of crop failure. Flamprop methyl (Mataven) should be applied only between early and mid-tillering of this variety; later application may cause crop damage. Resistant to stem rust but fully susceptible to leaf rust. Hl grain quality classification only but the best resistance to grain weathering of all current varieties. Released by the New South Wales Department of Agriculture in 1974.

Timgalen. Quick maturity, suited to main season planting in all areas. Straw of medium height and a little weak. Medium to low yield potential and generally performs better at lower planting rates. Awned heads. Resistant to stem rust, but moderately susceptible to leaf rust. PH grain quality, with high protein. Released by University of Sydney in 1967.

Cook. Quick to medium maturity, suited to main season planting in all areas. Heavy tillering, producing fine straw, medium in height and moderately susceptible to lodging. High yield potential. Awned heads. Resistant to stem rust, but moderately susceptible to leaf rust. PH grain quality, with high test weight and some resistance to weathering. Released by Queensland Department of Primary Industries in 1977.

compiled by S. R. Walsh, Agriculture Branch.


TOWNSVILLE
WHEAT VARIETY
PLANTING ZONES
EMERALD
ROCKHAMPTON
ROMA
DALBY
GOONDIWINDI
WARWICK
1
2
3
4
5

Oxley. Medium maturity in central Queensland and western areas, where it is recommended for early planting. In colder areas it becomes quicker maturing and is recommended for main season planting. Late planting should be avoided in all districts. Heavy tillering, with medium straw height and good strength. High yield potential. Awned heads. Susceptible to the most common strain of stem rust and planting should be restricted, especially in wetter, rust-liable areas. In zones 1, 3 and 5 growers are recommended not to plant more than 10% of their area to Oxley owing to the risk of stem rust. Field resistance to leaf rust. PH grain quality. Released by Queensland Department of Primary Industries in 1974.

Timson. Maturity similar to Oxley. Straw of medium height and strength. Low yield potential. Awned heads. Resistant to stem rust but now susceptible to a new strain of leaf rust. Grain quality H1 only but high in protein. Released by University of Sydney in 1976.

Shortim. Slow maturity, suited to early and main season planting. Heavy tillering. Very short straw, hence unsuitable for low rainfall areas and rough ground. Medium to high yield potential. Awned heads. Resistant to stem rust, but moderately susceptible to leaf rust. PH grain quality, with medium-high protein. Released by University of Sydney in 1977.

DISTRICT GUIDE TO RECOMMENDED WHEAT VARIETIES AND PLANTING PERIODS

(Varieties in each planting period are in order of preference)

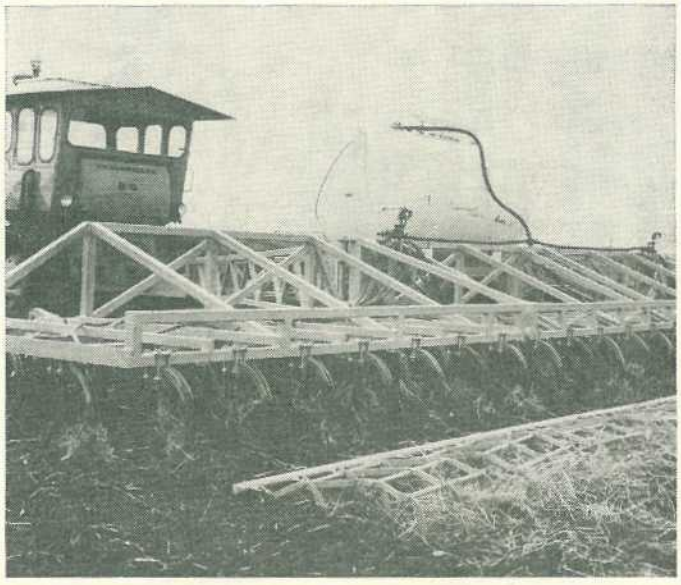
NOTE: To be used in conjunction with the text

Zone	——	Varieties	Planting Period (approx. wks.)			
			APRIL	MAY	JUNE	JULY
			1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
1	Darling Downs and Sth. Burnett	Shortim		XX	XXXX	
		Oxley, Timson		X	XXXX	
		Cook, Kite, Timgalen			XXXX	XX
		Songlen, Gatcher			XXX	XXXX
2	Western and Sth. Western Downs and Maranoa	Oxley, Timson, Shortim ..	X	XXXX	X	
		Cook, Kite, Timgalen		XX	XXXX	
		Gatcher, Songlen			XXXX	XX
3	Dawson–Callide, Burnett and Cent. Coastal	Oxley, Timson, Shortim ..	XX	XX		
		Cook, Kite, Timgalen		XXX	XX	
		Gatcher, Songlen		X	XXXX	
4	Central Highlands	Oxley, Timson, Shortim ..	XXX	XX		
		Cook, Kite, Timgalen		XXXX	XX	
		Gatcher, Songlen		XX	XXXX	
5	Sub-coastal South-east Qld. ..	Shortim, Oxley, Timson ..		XXXX		
		Cook, Kite, Timgalen		XX	XX	
		Songlen, Gatcher		X	XXXX	

WHEAT VARIETY CHARACTERISTICS, QUEENSLAND 1979

VARIETY	AGRONOMY						DISEASE		QUALITY			
	Maturity	Yield potential	Height	Awns (beard) present	Resistance to lodging	Early grazing suitability	Resistance to stem rust	Resistance to leaf rust	Classification	Test weight	Resistance to weathering	Protein %
GATCHER	v. quick	medium	tall	yes	poor	no	high	v. low	PH	medium	nil	low
SONGLEN	v. quick	medium	medium	yes	medium	no	v. high	medium	PH	medium	nil	high
COOK	quick	high	medium	yes	medium	no	v. high	low	PH	high	small	medium
KITE	quick	high	short	no	v. good	no	v. high	v. low	H1	medium	medium	medium
TIMGALEN ..	quick	medium	medium	yes	poor	no	v. high	low	PH	medium	nil	high
OXLEY	medium	high	medium	yes	good	light	v. low	high	PH	medium	nil	medium
TIMSON	medium	low	medium	yes	medium	light	v. high	medium	H1	medium	nil	high
SHORTIM	slow	medium	v. short	yes	v. good	light	v. high	medium	PH	medium	nil	medium

Anhydrous ammonia . . . play it safe



Photograph above. This 11·5 metre cultivator/applicator of Mr A. Gwynne, Jondaryan, is capable of covering 5·6 hectares in an hour.

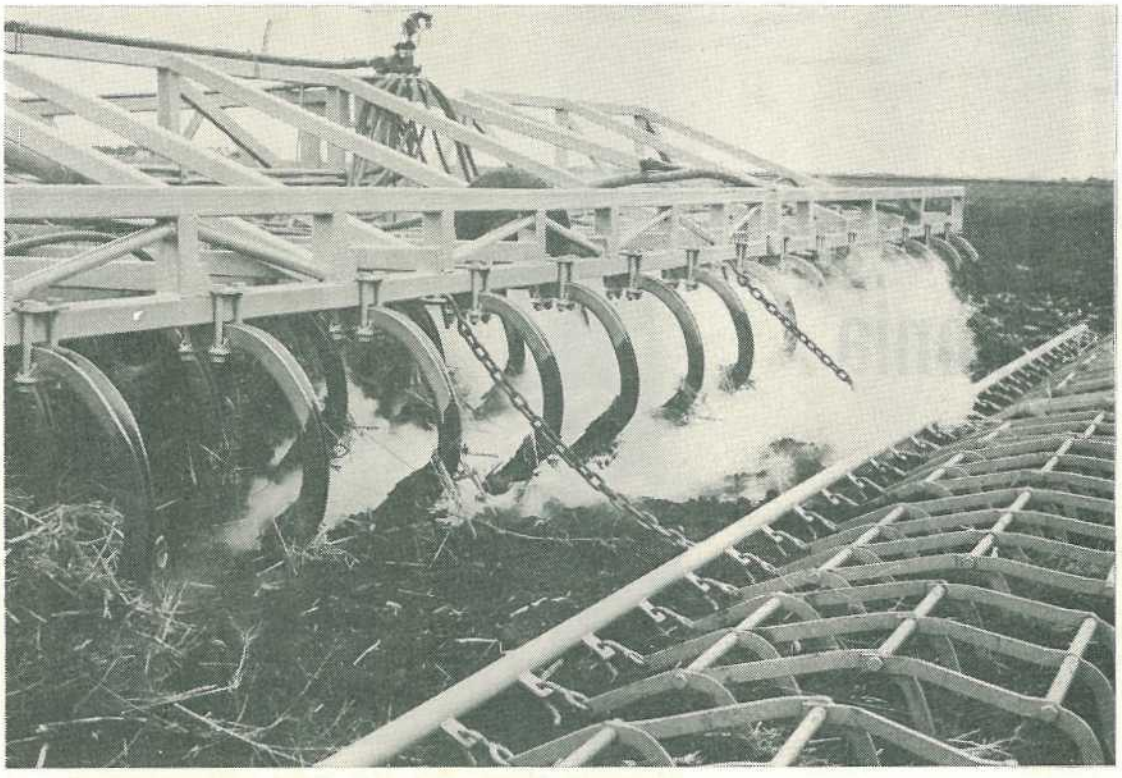
WHEN a nitrogen fertilizer is 40% cheaper than urea, its success is almost guaranteed.

The use of anhydrous ammonia as an agricultural fertilizer on the Darling Downs has increased from 5 600 tonnes in 1972 to 15 000 tonnes in 1976. Consequently, the safety aspects of handling anhydrous ammonia need to be emphasized as the fertilizer is potentially hazardous.

What is anhydrous ammonia?

Anhydrous ammonia (containing 82% N) is the most concentrated form of nitrogen fertilizer available. It is marketed as a liquified gas (under pressure) and is ideally suited to broad-acre farming areas near distribution centres such as the Darling Downs. Anhydrous ammonia is manufactured by combining nitrogen from the atmosphere and hydrogen from natural gas or petroleum by-products. The resultant gas is compressed into a liquid for storage and distribution purposes.

by D. J. Holman, Agriculture Branch.



Be sure to close off the anhydrous ammonia flow before lifting the tines out of the ground, otherwise escaping gas could cause injury.

While held under pressure in liquified form, the fertilizer is perfectly safe. However, if incorrectly applied to the soil, or in the case of mishandling of equipment or failure of equipment, the liquid ammonia may escape into the atmosphere as a very dangerous gas.

This gas will kill if it is inhaled in sufficent quantities.

Anyone handling anhydrous ammonia is dealing with a liquid under very high pressure—about 985 kPa. Because of the severe cooling effect of the anhydrous ammonia when it is allowed to expand to atmospheric pressure, it can cause severe freeze burns on the skin. In addition, the mucous membranes (particularly the eyes) can be injured very severely if the gas is allowed to contact them.

Accordingly, anhydrous ammonia must be handled carefully. It is essential that all equipment used to handle anhydrous ammonia is in satisfactory condition.

Behaviour of the gas in the soil

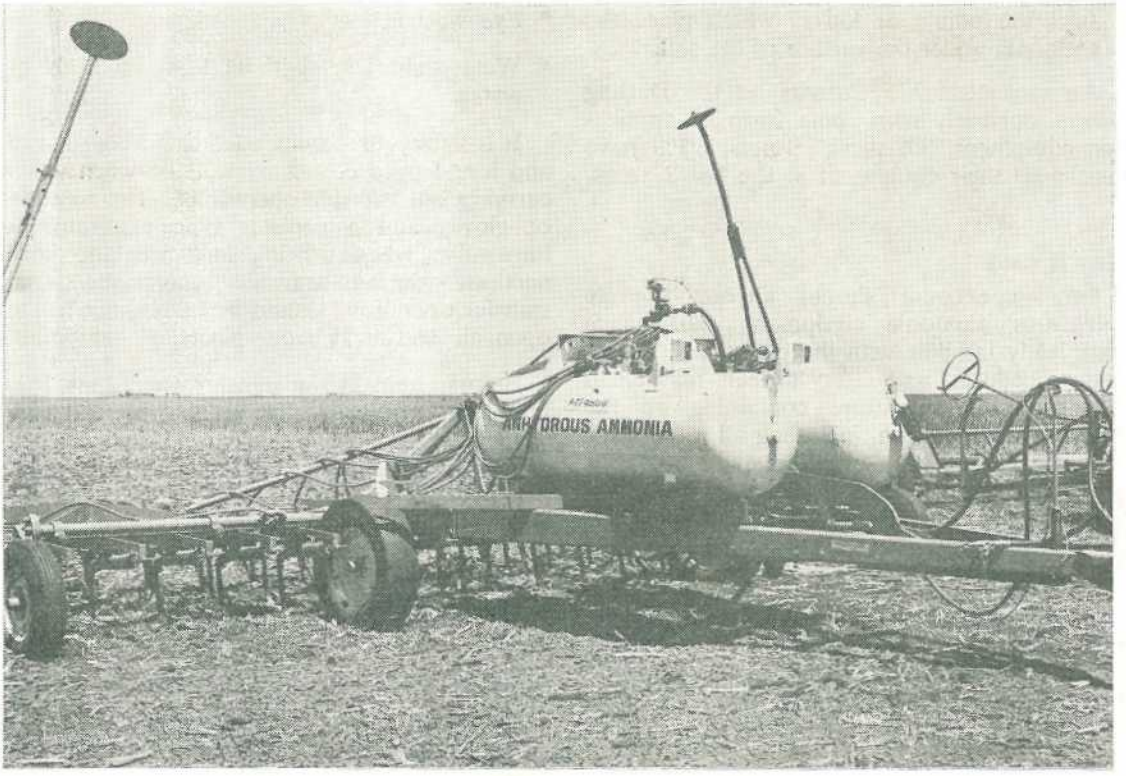
When anhydrous ammonia is injected into the soil, there are three possible reactions.

These are:

- The ammonium ion is attracted to and locks on to the clay particles.
- The ammonium ion combines with the soil organic matter.
- Ammonia dissolves in the soil moisture.

On the Darling Downs where the soils have an extremely high clay content (60% to 80%), the first reaction generally occurs.

When ammonia is released from a pressure vessel into the atmosphere, the sudden expansion causes quick cooling of the gas with a consequent condensation of atmospheric moisture. Escaping gas appears as a white cloud which is merely this condensed moisture.



This is another type of cultivator/applicator used on the Darling Downs.

Applications at depths of less than 10 cm without loss of ammonia are possible, provided the soil has a good clay content and is sufficiently friable to close in and retain the ammonia following the passage of the injection tine. Under ideal soil conditions, anhydrous ammonia can be successfully applied when the soil is dry.

Anhydrous ammonia equipment

Ammonia is usually compressed into a liquid and then stored in large pressure vessels—either long cylinders or large spheres. From these large pressure vessels, it is transferred to other smaller pressure vessels mounted on trailers (nurse tanks) in which it is transported to the point of usage. A smaller pressure vessel (application tank) mounted either on the tractor or on a trailing implement is used to apply it to the soil. This is filled with anhydrous ammonia from the nurse tank.

All pressure vessels constructed to contain anhydrous ammonia must comply with specifications laid down by the Queensland Division of Occupational Safety, and must pass tests both during and after manufacture. They must also be inspected regularly by Machinery Inspectors of the Division to ensure that they remain in a satisfactory condition. Other equipment such as hoses and connections must also withstand rigorous tests to ensure the safety of operating personnel.

Certain basic equipment is necessary for anhydrous ammonia application on farms. Different combinations of equipment are available for special circumstances. Basic equipment includes:

- Anhydrous ammonia applicator tank.
- A metering device to control the output.
- Hoses to convey ammonia to the injection point.

- Injection points or knives which place the ammonia under the surface of the soil.

An estimated 225 farmers on the Darling Downs currently own some form of application equipment. Of these farmers, 80% have purchased their equipment in the last 2 years.

Play it safe

On no account should anyone operate anhydrous ammonia equipment until he is completely familiar with the properties, operating procedures, and safety aspects relating to this product. Literature containing all the necessary information, including all safety procedures for handling anhydrous ammonia, is available through the local distributor of Consolidated Fertilizers Ltd. and must be studied thoroughly before attempting to handle the fertilizer.

Anhydrous ammonia at normal temperatures and pressure is a gas with a very pungent, irritating odour. The boiling point of liquid ammonia is —33°C at atmosphere pressure. This means that the liquid does not give off vapour at temperatures below —33°C. These conditions can exist after a hose has been vented to atmosphere. Therefore, treat all hoses as if they still contain very cold liquid ammonia. Only iron and steel fittings should be used as ammonia reacts with copper, zinc and any alloy containing them.

Ammonia is very soluble in water. This makes water the best first aid in the event of contamination of skin or clothing. Use copious quantities of water to dissolve and remove ammonia contamination. Liquid ammonia in contact with the skin or mucous membranes causes a freeze burn. A secondary alkali burn occurs if the ammonia is not removed immediately with large quantities of water.

Safety equipment and precautions

The following safety equipment should be attached to each nurse and applicator tank:

- Gloves.
- Goggles.
- Gas respirator and spare canister.
- Eye washer.
- Water containers with at least 25 litres of water.

It is strongly recommended that long-sleeved and long-legged cotton overalls be worn when carrying out transfer operations. The wearing of gloves and a canister type respirator is imperative when making and breaking connections during transfer operations. All transfer operations should be carried out in the open air and away from places of habitation.

Before commencing transfer operations, it is important to ensure that no unprotected personnel are standing close to or down-wind of any likely discharge. When moving or connecting hose end valves, always grasp by the body or hose itself, never the hand wheel. Grasping the hand wheel or hose end valve when moving hoses has resulted in a number of serious accidents.

Procedure following an accident

Following an accident involving injury to a person or damage to equipment, the following procedures should be adopted.

Injury to person (work fast)

- Where liquid ammonia has contacted skin or mucous membranes wash thoroughly with water. Continue to apply water to the contaminated area while seeking medical assistance.
- Inform a medical practitioner that the patient has been burnt with ammonia.
- Under no circumstances must salves or ointments be applied to a burn area for at least 24 hours.
- If a person is overcome by ammonia fumes and stops breathing, get him to fresh air and give artificial respiration.
- Advise the nearest Consolidated Fertilizers Ltd. depot of the details of the accident as soon as possible after applying first aid. This is important as the Company will investigate to assess the need for changes in procedures and/or equipment design.

Damage to equipment

Advise the nearest Company depot of the circumstances involving the damage to equipment so that immediate action can be taken to repair the damage or to modify the design. By advising the Company, the equipment can be withdrawn from service to ensure that damaged equipment is not delivered to another property.

Helpful hints

- Never weld on the shell of anhydrous ammonia pressure vessels.
- Do not use copper, brass, zinc or galvanized fittings in contact with anhydrous ammonia.
- Do not repair injection tubes etc. by using brazing or silver solder. The only suitable method of carrying out repairs is by electric or oxyacetylene welding using mild steel rods.
- Gloves and goggles should be used when clearing blocked injection tubes. The metering device should be closed off and all product allowed to blow down before attempting to clear blocked tubes.
- Ensure all pressure has been dissipated before attempting to remove hose end valves or screwed fittings.
- Injection tubes should be blocked to stop the ingress of mud-building wasps when the applicator will not be used for an extended period.

Acknowledgement

The assistance of the staff from Consolidated Fertilizers Ltd. in providing technical information is acknowledged.

Agricultural Census 1978-79 Season

PRIMARY producers in Queensland are reminded that their annual statistical returns for the year ended 31 March 1979 are now due for lodgment with the Australian Bureau of Statistics, 345 Ann Street, Brisbane, 4000.

The statistics from this collection provide a reliable picture of production trends in rural industry, and are extensively used by growers' organizations, government authorities, and private enterprise.

It is in producers' own interests that comprehensive and factual information should be available to anyone interested in the advancement of rural industry and the analysis of its problems.

Producers interested in trends in rural industry generally, or in particular segments, are invited to inquire about the Bureau's statistical service relating to the free issue of annual bulletins covering most items of production in Queensland.

Collection forms together with reply-paid envelopes have been posted to primary producers. If a form has not been received, producers should write to the Deputy Commonwealth Statistician, Brisbane or telephone (07) 33 5011, extension 5403.

The return is compulsory under the provisions of the *Census and Statistics Act* 1905, which also guarantees the confidentiality of information on individual returns. Statistics are published only in the form of aggregates prepared from the figures supplied by individual producers.

Co-operation in forwarding returns without delay will assist in the completion of the 1978–79 Agricultural Census and early publication of results.

Economic feeding of the working dog

IN their natural state, dogs caught their own prey and ate all the internal organs which are rich in protein, various vitamins, minerals, and all other essential factors.

Raw meat is the natural food for a dog, and popular rumours that feeding raw meat will cause distemper or other diseases are quite incorrect. There is, of course, the danger of *Echinococcus* tapeworms, which cause hydatids in humans.

All uncooked offal from cattle, kangaroos, wallabies and sheep should not be fed to working dogs. The liver and lungs are the most dangerous and should never be fed. As cooking must be done so thoroughly (boiling for 40 to 60 minutes) to render offal safe, it must be concluded that feeding offal at all is an unjustifiable risk.

Ideally, dogs should be treated for tapeworms every month to lower the risk of transmission to humans, especially in New South Wales and Victoria.

During the war years (1939–45) when meat supplies were restricted, the following rations for dogs were recommended by the Australian Veterinary Association. They are still suitable where meat is scarce or dear.

- Pollard, 20 parts; bran, 6 parts; crushed barley, 25 parts; meat meal or meat scraps, 20 parts; salt, 1 part; bone meal, 3 parts; plus chopped vegetables, which can be fed either raw or cooked.
- Horse meat, 20 parts; crushed maize, barley wheat or pollard, 76 parts; salt, 1 part; bone meal, 3 parts; plus cooked or raw vegetables. In this ration, the horse meat, if available in quantity, can be fed to make up 80% of the ration and the amount of cereals and vegetable reduced.
- Crushed cereals, maize, barley, wheat and pollard, 66 parts; bran, 10 parts; meat scraps, 10 parts; meat meal, 10 parts; salt, 1 part; bone meal, 3 parts; plus raw or cooked vegetables.
- Home-made dog biscuits can be prepared by cooking cereals and meat meal in the proportions of 1 part meal to 4 parts of cereals, to which add 3% of bone meal and a little salt.

Another method of feeding dogs is to use an ordinary commercial laying ration as sold for poultry or, better still, chicken-rearing ration. This can be lightly cooked and a little fresh meat added to it. This usually provides a most suitable ration for dogs.

The above rations are better if lightly cooked, either adding water and baking like bread or making into a porridge. They can, however, be mixed with water and fed raw if the dog will eat them. Cooking adds to the palatability.

Dogs require a weight of food daily from 3% (large dogs) to 5% (small dogs) of their body weight—in the wet form (25% solids).

These requirements will obviously vary according to work performed, lactation, growth, and gestation. Commonsense will govern the amount needed in these situations.

For a more balanced diet, the dog should be given a varied diet that is, canned and dried dog food one day, home-made cereal-based food the next.

Growing dogs should not be fed solely a meat diet due to its lack of calcium.

Always allow the dog access to non-splintering bones, as a source of calcium.

This article was prepared by D. R. Gilmore of Veterinary Services Branch in response to an inquiry from Mr E. N. Lewis, 'Riverie', Jericho.

Modern methods of flower production

by Margaret E. McKay.

A broad view of world floriculture shows that the rose is the best selling flower in every country.

Little else to do with the industry is standard. Different nations have developed their own scale of production and technology to fit their own requirements and consumer demands.

The large farms of the United States contrast with the minute land pockets of the Netherlands. The Australian economy owes little to floriculture, yet to the Dutch the floral contribution is highly significant. A Frenchman will buy large, red flowers while his Dutch neighbour prefers anything small.

The author, Margaret McKay, recently studied the flower growing industries in Israel, Europe and South Africa. This article contains some of the information she collected while overseas.

Gladioli

Gladioli are an important flower crop, both in Queensland and overseas. In Israel, the southern States of the United States and South Afrcia, gladioli are grown primarily as a winter crop. However, in Europe, production is restricted to the summer months.

Gladioli are grown as a field crop, except for a limited amount of early summer production in Europe under plastic greenhouses.

European crop management system

The method of field gladiolus production in Europe involves a different crop management system to that used in Florida, South Africa and Queensland. At present, production methods in Israel and California are intermediate between the two systems but tend towards that used in Europe. In Florida, planting material is re-used after flowers are harvested. In Europe, however, planting material is discarded so that flower growers do not produce corms and vice versa.

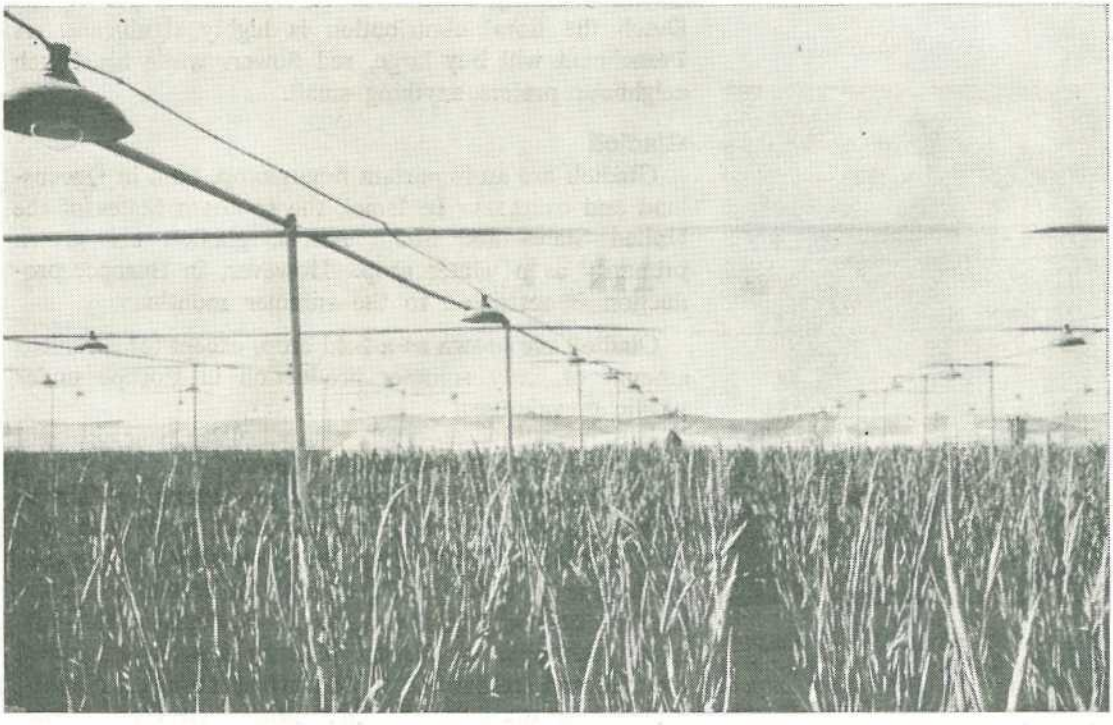
Although the European system may appear to be wasteful, it has many advantages over that used in Florida, particularly for disease control. Research has shown that it is possible to rid small corms and cormlets of the fungal diseases which are carried in them but this is not possible with the large corms which are used for flower production. In Europe, 'clean' planting material is always used instead of risking flower production with diseased stock.

Economically, the European system compares favourably as the cost of purchasing new stock is offset by increasing the plant density, reducing the cropping season by 4 to 6 weeks (as corm production is no longer necessary) and also by savings in the very labour intensive areas of digging, cleaning, dipping and cold storage.

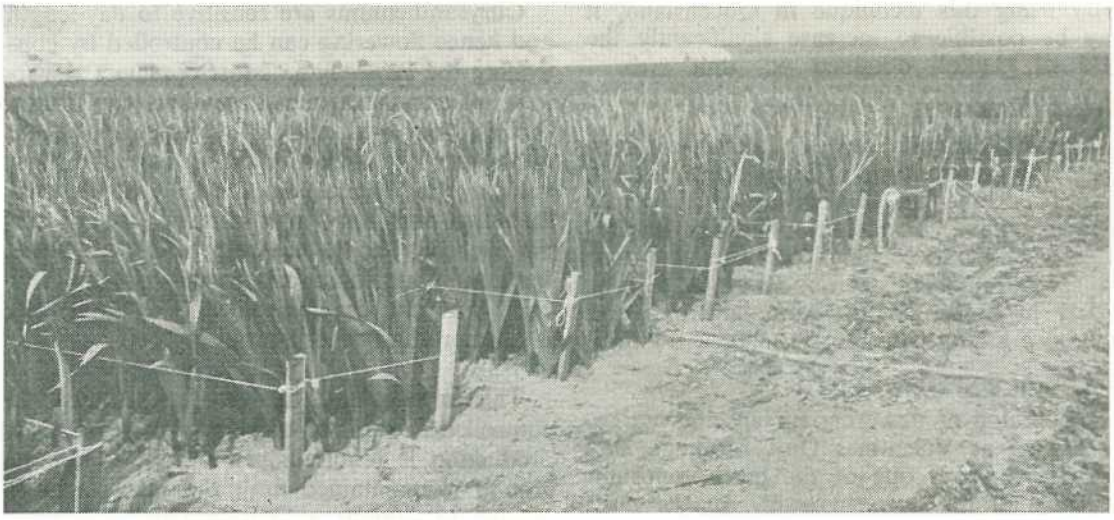
Volunteer cropping

In California, gladioli growers use volunteer cropping to reduce production costs per unit area. Corms planted and cropped in one season are allowed to remain in the ground over winter. In the following spring, they germinate and subsequently flower, after which the corms are discarded. The soil temperatures during the winter must be 8°C to break the corm dormancy.

Timing of volunteer crops is difficult, as the second flowering depends on the maturity of the cultivar and is not influenced by the planting date. Flowering time can be manipulated slightly by using mulches. A clear plastic mulch increases soil temperature and causes earlier flowering. A straw mulch if applied when the soil is cool delays flowering.



High density planting of gladioli under light in Israel.



Bed system of gladioli production with plastic greenhouses for early summer harvested crops in France.

Field production of chrysanthemums in Florida with lights and black-out plastic for year-round daylight control.

However, if volunteer cropping is going to be used successfully, disease control is critical. Land should be new or fumigated, and planting material free of diseases and pests. During the initial crop, leaf diseases such as *Botrytis* and insects such as thrips should be carefully controlled.

Plant density and artificial light

When gladioli are grown under short winter days, flowering percentage, the size of the flower spike and the number of florets per spike are reduced. This is aggravated if the corms are planted at high densities of 450 000 corms per ha.

However, commercial growers in Israel are using lights (at night) to increase the day-length and thus avoid this depression in flower yield and quality even at high plant densities.

They use 150 watt reflectorized incandescent lights spaced at 3 m x 3 m and raised 2.8 m above the ground. The lights are left on continuously from dusk to dawn. Under these lights, the corms are planted at densities of 450 000 corms per ha. This density is very high, almost 3 times that commonly used for commercial plantings in Queensland.

By using this technique in Queensland, it may be possible to increase significantly the yield of gladioli obtained per unit area.

Chrysanthemums

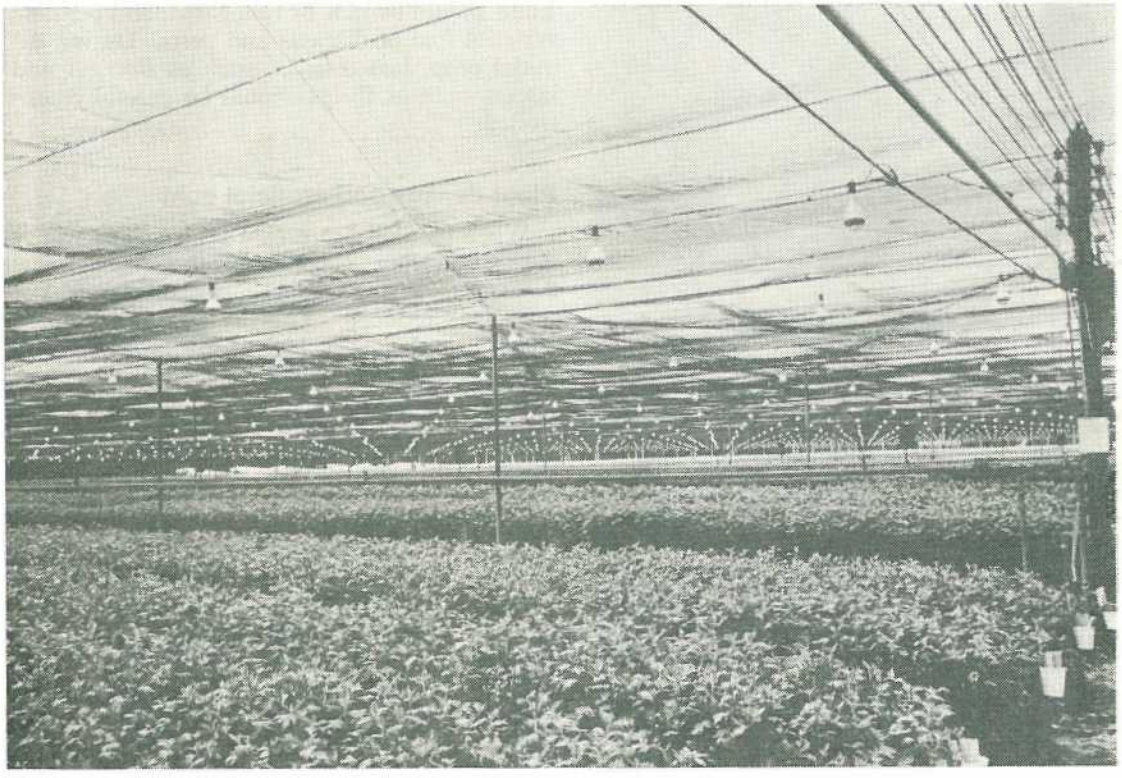
Chrysanthemums are a versatile crop which can be produced as large single flowers, a spray of smaller flowers or as a potted flowering plant. In addition they can be produced year-round or timed precisely to flower for specific market dates. There is a wide variety of flower colour, form, and size and they have a long vase life.

Timing of flowering

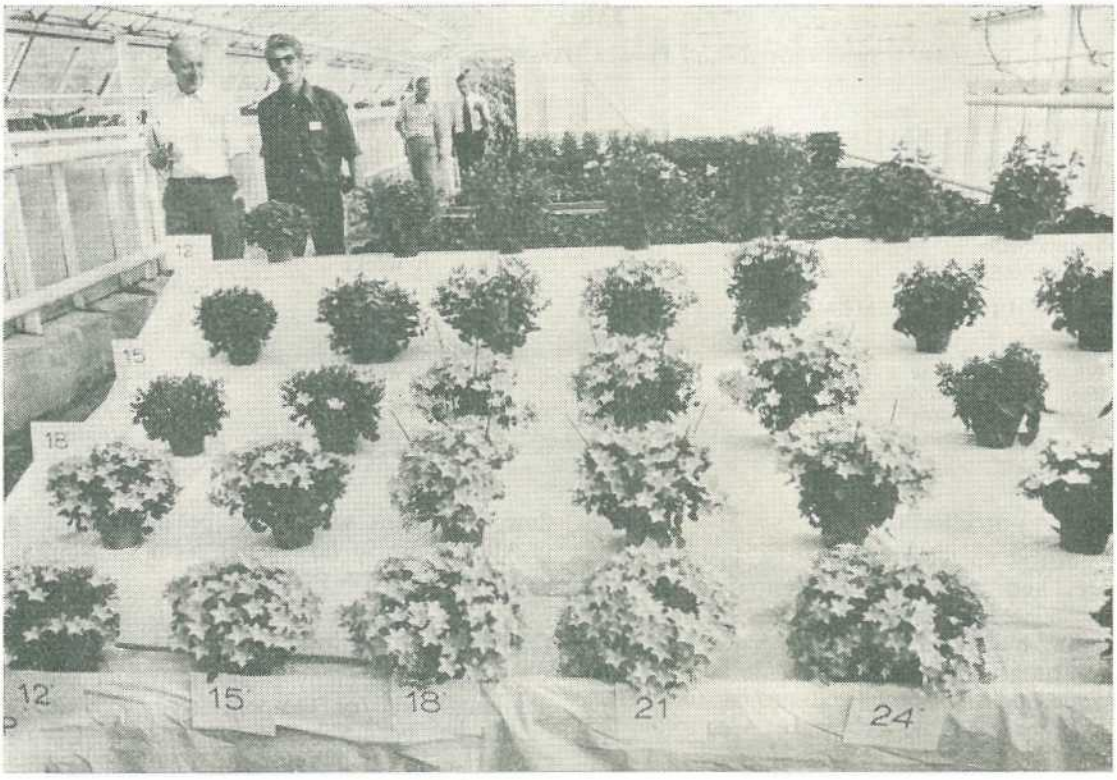
The timing of flowering for specific market dates such as Valentines Day, Mother's Day and Christmas is one of the most important problems of the flower grower. In the past, crops like chrysanthemums could only be produced seasonally. However, with the use of lights and black-out cloth or plastic, year-round chrysanthemum production is possible. In addition, chrysanthemums can be timed precisely to flower for specific market dates.

Chrysanthemums are sensitive to day-length and hence flowering can be controlled by controlling the day-length. Most commercial varieties of chrysanthemums are short day plants, that is, they will not flower unless the light period per day is shorter than a certain critical value. The critical day-length for chrysanthemums does vary with different commercial varieties but for the majority it is 14.5 hours for flower bud initiation. However, the flower buds will not develop unless the day-length is shorter than 13.5 hours.

This means that the day-length must be controlled in summer and winter if year-round production is required. In winter, vegetative growth is maintained until the plant is large enough to support a long-stemmed flower by the use of artificial light. In summer, flower bud initiation must be promoted by the withdrawal of light in order to reduce the length of the natural day. Withdrawal of light in this case means darkness—shading is not sufficient.



Large scale chrysanthemum propagation in Florida.



Influence of day and night temperatures on flowering of Campanula isophylla.

A stem length of 60 to 75 cm is required for cut flowers. Hence there is no advantage in producing a plant, at flowering, taller than 90 cm. Research in the United States and Europe has shown that long days under which vegetative growth occurs are required for approximately 21 days in summer and 28 days in winter. This is required before application of the short day treatment which promotes floral initiation and development.

The day-length is increased by using lights. The light intensities required are 107 Lux, which is achieved by spacing 150 watt reflectorized incandescent lights at 3 m^2 and placed 2.8 m above the ground. Cool, white fluorescent lights can also be used for lighting. However, installation costs are usually higher.

Growers commonly use either night-break or cyclic lighting systems. The night-break system involves applying 4 hours of continuous light in the middle of the dark period. Cyclic lighting is widely used in the United States. This system uses a series of light and dark cycles. Lights are switched on for 10 minutes and off for 20 minutes and this is repeated for 4 hours. The cyclic lighting system has an advantage in reducing the operating costs of the lights. Further information on lighting flower crops can be obtained from the Department of Primary Industries' advisory leaflet 'Artificial Light for Out-of-Season Flowers'.

To shorten day-length in summer, black-out plastic or cloth is required. This can be attached to the trellis and pulled across the beds in the late afternoon and removed in the morning. This minimizes the problem of excessive heat build-up under black plastic. Both lighting and black-out can be controlled automatically by using a time clock.

TABLE 1

TIME FROM FLORAL INITIATION TO FLOWER HARVEST FOR SOME CHRYSANTHEMUM VARIETIES

Variety	Photoperiod Response Group (Time from commencing short days to flowering)	Colour
STANDARDS		
Mefo	10 weeks	White
Nob Hill	10 weeks	White
Yellow Nob Hill	10 weeks	Yellow
Yellow Mefo	10 weeks	Yellow
Yellow Shoesmith	10 weeks	Yellow
SPRAY CHRYSANTHEMUMS		
Polaris	9 weeks	White
Cream Princess Anne	10 weeks	Cream
Bright Golden Anne	10 weeks	Yellow
Improved Princess Anne	10 weeks	Apricot
Princess Anne Superb	10 weeks	Pink
Gay Anne	10 weeks	Bronze

Planning production

Firms such as Yoder Bros. in the United States and DCK and Framptons in Europe help growers in those countries by supplying planting material for a production programme. This programme is planned jointly by the grower and the specialized propagator. They also give a valuable technical service to aid the growers.

Varieties have been classified into groups on the basis of the time taken from flower bud initiation to flower harvest. This depends upon the variety and environmental factors such as temperature, but is usually between 8 and 11 weeks.

By using this information (see table 1) production can be planned. For example, if rooted chrysanthemum cuttings are planted in the last week in May, pinched 2 weeks later, grown under long days for 4 weeks and then under short days, they should flower in the middle to the end of September.

Pot chrysanthemums

Unlike cut flower production, it is desirable to produce flowers on short stems for potted flowering plants. Thus short days, under which floral initiation occurs, are applied to pot chrysanthemums for the entire crop.

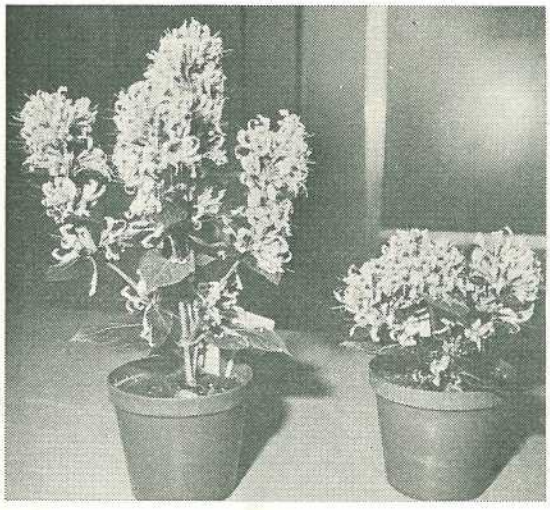
Growers usually plant 3 to 6 chrysanthemum cuttings per pot. They are pinched so that in each pot there would be 9 to 18 flowering stems which can be dis-budded to produce a single flower per stem or a spray of smaller flowers per stem.

Control of flowering

Flowering in many plants is influenced by day-length and/or temperature. Knowledge of this has been valuable to commercial floriculture as it has increased the range of plants that can be used.

Year-round aster production is feasible by controlling day-length. Under short winter days, aster plants rosette, that is, the leaves grow close together as the plant has very short internodes. If temperatures are above 19°C in winter, small flowers on small stems are produced. The use of artificial lighting during this period prevents rosetting, delays flowering and allows elongation of plant stems followed by flower bud formation and development.

Natural day-lengths or natural day-lengths plus artificial light which give an effective day-length of 15 hours or more are necessary for the production of good quality asters. The additional light should be applied when the seedlings form their first true leaf and continued until the flowers are ready to be cut or until the natural day-length is 15 hours or more. For South-east Queensland, this means that some additional artificial light should be applied for most of the year with perhaps the exception of December and January.



Use of growth regulators to control plant habit of Hypoestes aristata.

When carnations are grown under long days, the time from floral initiation to flower harvest is reduced so that lights can be used to increase the number of flowers for a specific market date.

Azaleas are being used as a year-round flowering potted plant, as flowering in azaleas is influenced by day-length and temperature. Floral initiation takes place at night temperatures of 17°C or above in most varieties and under short day-lengths.

At temperatures below 15·6°C, irregular budding will result. After the bud has been formed, a low temperature treatment is required to trigger flowering. They are placed in a cold room at 4·5°C for approximately 6 weeks and will flower approximately 4 to 6 weeks after removal from the cold room.

In the United States and Europe, poinsettias have become a symbol of Christmas. They flower naturally in winter and in the southern hemisphere have not been a Christmas crop. However, flowering is influenced by day-length and temperature and it is feasible to produce flowering poinsettias in any season. Short days of 12 hours promote floral initiation in poinsettias. Short days must be continued until the bracts are well-developed otherwise chlorophyll may develop in the bracts and discolour them. Night temperatures of 17°C are desirable during the short day treatment. Under higher night temperatures, the time from floral initiation to flowering will be reduced and the plants will often be of poorer quality.

Growth regulators

The use of growth regulators such as Alar^{R}, B-Nine^{R} and Cytocel^{R} have given additional control of plant form. They are used commercially on pot chrysanthemums to reduce plant height and also on many other potted flowering plants such as poinsettias and azaleas.

A plant such as *Hypoestes aristata* which has an unsuitable form for use as a flowering potted plant can be changed into an attractive flowering plant by the use of a growth regulator. It is likely that growth regulators will become widely used in commercial floriculture in the future.

Fibreboard cartons used for packing gladioli in overseas countries to allow flowers to be packed vertically.

Post-harvest handling

The aim of the commercial flower producer is to provide the consumer with a high quality flower which has a long vase life so that the consumer is satisfied and will return to buy some more flowers. For this to be accomplished, the grower, the wholesaler and the retailer must each apply all available knowledge to maximize the post-harvest life of a cut flower. It has been estimated that one-third of the cut flower life is influenced by the pre-harvest environment and the remaining two-thirds by the handling and environment the flower is exposed to after harvest.

All flowers including gladioli should be placed in water in a cold room at a temperature of 4·5 to 8°C to remove field heat after picking and before grading. Allowing flowers to wilt before they are placed into water may cause a severe reduction in vase life.

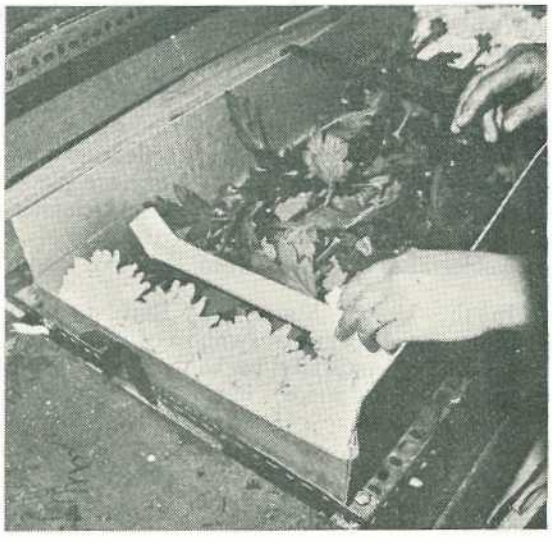
It is important to use clean buckets and to change the water regularly. With roses, which have a very poor vase life, a chemical preservative should be added to the water. These preservatives usually contain sugar, acid and substances to prevent microbial growth.

If possible, flowers should be kept cool from picking to when they reach the consumer. In the United States and Israel, packing sheds are often air-conditioned and packed boxes are returned to the cold room before shipment by air or refrigerated trucks. Sometimes ice is packed into the box with the flowers to help maintain a lower temperature during transport.

Flowers are packed in fibreboard cartons for shipment. The gladioli hamper measures 33 x 33 x 127 cm^3 and is always transported in an upright position to prevent bending or breakage of the tips of the spike.

The fibreboard cartons used for chrysanthemums, carnations and roses are shallow and only two layers of bunches are placed in the box to prevent crushing of the petals. A partial partition is stapled into the box on top of the stems to prevent movement of the bunches in the box and bruising of the petals.

Ice packed into boxes of roses to maintain cool temperatures during shipment.



Packing of standard chrysanthemums using a buff to prevent breaking of the heads.

Fibreboard hampers can be very eye-catching and are suitable for carrying advertising. Many growers in the United States and Europe identify their flowers like this or by placing a small tag on the bunches.

Bunches of spray chrysanthemums, carnations and roses are sleeved in cellophane or paper before packing. This helps to prevent the neck of the flower stem breaking during packing and unpacking. It can also be used to help the retailer display bunches attractively and as an advertisement for the grower.

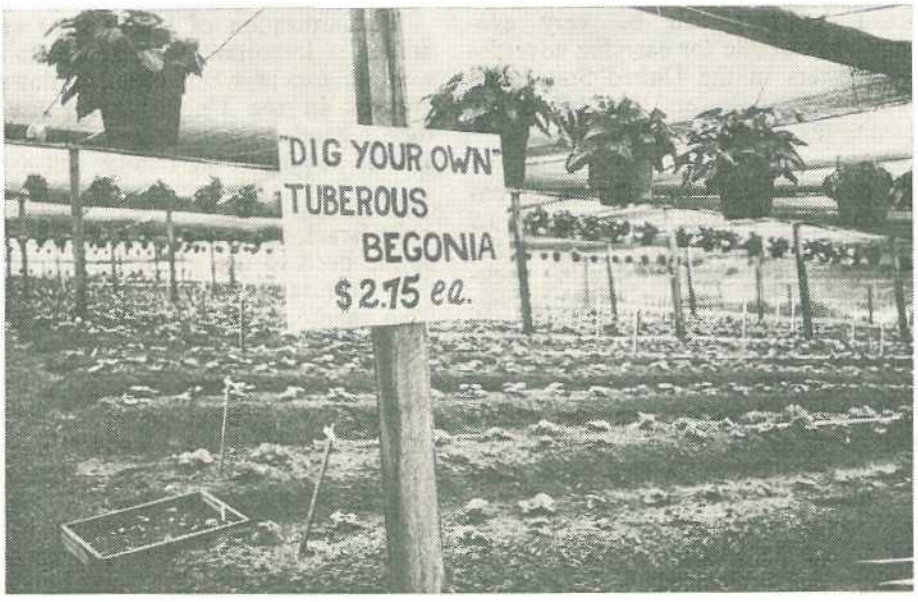
Standard chrysanthemums can be easily broken during transport and are packed very carefully in shallow boxes. A buff or a small cardboard pillow is used to support the flower head. In Europe, standard chrysanthemums are sleeved in the field to prevent damage at this stage and during shipment.

Standardization of bunch sizes and quality grades is important so that a retailer knows what to except when ordering flowers. Many growers in the United States use coloured rubber bands to denote the grade of the flower. This is helpful to the retailer and the packer.

In Israel, the flower growers are very aware of the need to use good packing methods for their flowers as they are shipped to the European market where the quality standards are very high.

They use chemical preservatives to prolong vase life for most cut flowers. The varieties of gladioli which are difficult to open from tight bud, such as Oscar, are pulsed with a 20% sugar solution for 24 hours at 15 to 16°C before packing. All roses and carnations are treated with Chrysal R before shipment.

Flower stalls are found on many street corners in Holland.



Innovative marketing venture in California.

In Queensland, growers must also pack and handle flowers correctly after harvesting. As in Israel, many flowers are consigned long distances to interstate markets. The temperatures in Queensland are high and consequently the importance of cooling flowers cannot be over-emphasized. Unless the consumer is provided with a good quality flower with a long vase life, buyer resistance will result.

Marketing

The average person's attitude to flowers is generally accepted as being culturally based. An Australian tends to buy flowers for special occasions only while the European thinks nothing of buying flowers for decorative purposes each day of the week. Does cultural background really account for 100% of this difference or has the Australian lacked the opportunity to buy good quality, reasonably priced flowers?

In Europe, ornamentals have become part of people's lives because their marketing systems both at the wholesale and retail level have made ornamentals readily available to everyone. They do not have to go looking for flowers and pot plants because they see them everywhere.

The value of flower exports from Holland last year was approximately A$334 million. In Holland, flowers are marketed by the Dutch-clock system. There are 13 district markets, the largest being at Aalsmeer which has a covered area of 16 ha and 10 operating clocks. The price per item is shown on the clock and it reduces until a buyer bids for the flowers.

The lower quality grades of flowers are bought by the street vendors who market them on impulse. In comparison to the quality of flowers sold in Australia, the quality of poor grade flowers in Holland is excellent. The street vendors display their flowers attractively as do the growers or agents in the other European flower markets.

In the United States, the demand for flowers fluctuates a great deal. Flowers are always in demand for a holiday such as Mother's Day and Christmas. However, the American consumer is not as regular a weekly customer as a person in Europe.

The Americans know how to set the scene for selling and impulse marketing is developing. Wholesale nurseries have attractive sales areas. They use clever slogans for advertising such as 'plants make wonderful pets'. Mass marketing outlets and garden centres attractively display flowers and plants. In some supermarkets, flowers were displayed in refrigerated display cases to maintain the quality of the flowers.

Another interesting and innovative marketing idea is a 'dig your own tuberous begonias' garden in California. This nurseryman also sells hanging baskets and provides tables and chairs. His concept is 'this is your garden, please enjoy it'.

New publication on rural economy

THE *Quarterly Review of the Rural Economy* is a new magazine issued by the Bureau of Agricultural Economics, Canberra. It replaces the long-established *Quarterly Review of Agricultural Economics*.

The February edition of the new magazine was released in Canberra in March by B.A.E. Director, Mr Geoff Miller.

The introductory issue of *Rural Economy* was released last November and was followed by Volume 1, Number 1, dated February, 1979.

Mr Miller said *Rural Economy* aims at providing regular assessments of the farm sector and its component industries, reviews of major factors influencing that sector and summaries of B.A.E. research. It is written in a readable, non-technical manner.

He said the February issue predominantly features material from the 1979 National Agricultural Outlook Conference held earlier this year. Summaries of all commodity outlook statements delivered at the conference are included, along with keynote addresses by bureau and industry spokesmen.

The bureau's estimates of farm returns and incomes are those presented at the conference.

Winter grazing crop varietal guide—1979

compiled by S. R. Walsh, Agriculture Branch.

IN QUEENSLAND, oats are the main winter grazing crop. Other grazing crops include barley, wheat, canary and rye grass.

Oats are usually classified according to their rate of growth to the first grazing and the accompanying table details the characteristics of a number of oat varieties.

Minhafer is an example of a quick-growing variety which has an erect plant habit and high early growth rate. Algerian, on the other hand, has a slower growth rate and is prostrate in habit. The slow-maturing varieties are usually easier to manage in a forage programme.

Stout, a new oat variety introduced from America, is an erect-growing variety, resistant to most common strains of crown rust. It has a medium to high grain yield. Stout was released by the Department of Primary Industries in 1977.

As a result of the excellent seasonal conditions in 1978, ample seed supplies of the recommended varieties should be available for the 1979 season.

Where seed of a recommended variety is unavailable, farmers should contact their local Agricultural Extension Officer or consult the table of oat varietal characteristics to determine a useful alternative.

Corvette barley is a useful grazing crop suitable for sowing from April to August and is recommended for most districts.

If late planting in July and August is necessary, barley will give faster grazing and higher grazing yields than oats.

Canary is also recommended for sowing from February to April as an alternate grazing crop.

Where irrigation is available, the use of nitrogen fertilized rye grass is also recommended for certain districts. Your local Agricultural Extension Officer can advise the appropriate varieties for your district.

Planting rates

Planting rates fall between:

Oats—rain-grown: 30 to 50 kg per ha.
Irrigated: 40 to 70 kg per ha.
Irrigated sod seeded: 50 to 90 kg per ha.

Barley—30 to 60 kg per ha.

The rates should be adjusted to the variety, type of crop, soil moisture, soil type, district, irrigated or rain-grown and planting time. These rates are dependant on local conditions and your Shire Agricultural Extension Officer should be consulted.

Fertilizer

The type and rate of fertilizer is related to soil type, soil moisture, irrigated or rain-grown, cropping history and planting time. Your Agricultural Extension Officer should be consulted on the crop requirements for your soils and district.

Recommendations

Region (Shires)	Varieties
Northern Region	
(Ayr, Bowen, Proserpine, Hinchinbrook, Dalrymple and Thuringowa Shires)	Irrigated—Camellia, Saia, Stout Rain-grown—Not recommended
Capricornia	
(Livingstone, Fitzroy, Broadsound, Nebo, Calliope, Emerald, Peak Downs, Belyando, Bauhinia, Banana and Duaringa Shires)	Grazing oats—Algerian, Camellia, Minhafer, Stout Hay oats—Minhafer, Stout Grazing barley—Corvette
Burnett	
(Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, Biggenden, part Tiaro, Woocoo, Hervey Bay, Monto, Eidsvold, Gayndah and Mundubbera Shires)	Grazing oats—Algerian, Camellia, Minhafer, Garry, Saia, Bentland, Stout Grazing barley—Corvette
South Burnett	
(Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, and part Rosalie Shires)	Grazing oats—Algerian, Cooba, Camellia, Minhafer, Stout Grazing barley—Corvette
Near North Coast	
(Widgee, Noosa, part Tiaro, part Kilkivan, Maroochy and Landsborough Shires)	Grazing oats—Algerian, Camellia, Minhafer, Saia, Stout
Moreton	
(Caboolture, Pine Rivers, Redlands, Albert, Beaudesert, Moreton, Esk, Kilcoy, Boonah, Gatton and Laidley Shires)	Grazing Oats—Algerian, Camellia, Minhafer, Saia, Bentland, Stout Grazing barley—Corvette
Darling Downs	
(Chinchilla, Wambo, Pittsworth, Millmerran, Jondaryan, Crow's Nest, part Rosalie, Cambooya, Clifton, Allora, Glengallan, Rosenthal, Stanthorpe and Inglewood Shires)	Grazing oats—Algerian, Cooba, Camellia, Minhafer, Garry, Stout Grazing barley—Corvette
Near South-west	
(Waggamba, Balonne, Murilla, Tara, Taroom, Bungil, Booringa, Bendemere and Warroo Shires)	Grazing oats—Algerian, Camellia, Minhafer, Garry, Bentland, Stout, Benton Hay oats—Minhafer, Bentland, Stout Grazing barley—Corvette

CHARACTERISTICS OF OAT VARIETIES

Variety	Growth to flowering	Early plant habit	Growth to first grazing	Frost tolerance	Rust resistance		Seed colour	Awns	Tillering ability	Grain yield
					Crown	Stem				
Recommended varieties:										
Algerian ..	Sl.	Prostrate	Sl.	Good	S.	S.	Brown	Fine†	Good	Fair
Bentland ..	Med.–Sl.	Erect	V.Q.	Fair	S.	S.	Yellow	Few fine	Fair	Fair
Camellia ..	Med.–Sl.	Semi-prostrate	Med.–Sl.	V. good	S.	V.S.	Yellow	Few fine	Good	Fair
Cooba ..	Sl.	Prostrate	Sl.	V. good	V.S.	S.	Light brown	Nil	V. good	V. good
Garry ..	Sl.	Semi-erect	Q.	Fair	Mod.R.	Mod.R.	Yellow	Few strong*	Fair	Fair
Minhafer ..	Med.–Sl.	Erect	Q.	Fair	Mod.R.	Mod.R.	Cream	Few strong	Fair	Fair
Saia	Med.–Sl.	Semi-erect	Med.	Poor	S.	V.S.	Black	Medium	Fair	Poor
Stout ..	Med.	Erect	Q.	Fair	R.	R.	Cream	Nil	Fair	V. good
Others may be sown when seed of above is not available										
Avon ..	Med.	Erect	Med.	Poor	S.	V.S.	Cream	Nil	Poor	Poor
Belar ..	Med.	Semi-erect	Med.	Fair	S.	S.	Light brown	Strong*	Good	Good
Benton ..	Med.–Sl.	Erect	Q.	Fair	S.	S.	Yellow	Fine	Fair	Fair
Blackbutt ..	Sl.	Semi-prostrate	Med.	Good	S.	V.S.	Light Brown	Strong	Good	Fair
Coolabah ..	Med.	Semi-erect	Med.	Good	V.S.	S.	Cream	Strong*	Good	Fair
Fulghum ..	Q.–Med.	Semi-erect	Med.	Good	V.S.	S.	Light brown	Nil	Fair	Good
Klein ..	Sl.	Prostrate	Sl.	V. good	S.	S.	Light brown	Fine†	V. good	Fair
Lampton ..	Sl.	Semi-erect	Med.	Poor	S.	S.	Light brown	Strong	Fair	Fair
Landhafer ..	V.Sl.	Semi-prostrate	Med.	Good	S.	S.	Brown	Fine†	Good	Fair
Rodney ..	V.Sl.	Erect	Q.	Fair	S.	S.	Cream	Few strong*	Fair	Fair

Sl. = Slow; Mod.R. = Moderately Resistant; Med.–Sl. = Medium Slow; R. = Resistant; Q. = Quick; † = Awns on both grains; V.S. = Very Susceptible; S. = Susceptible; V.Sl. = Very Slow; *Strong awns indicated by twisted black base.

The Grevilleas of South-eastern Queensland

IN 1810, the celebrated British botanist, Robert Brown, described more than 20 closely related new plants belonging to the family Proteaceae from Australia.

To these, he gave the name Grevillea in honour of Charles Greville, one of the founders of the Horticultural Society of London and a vice-president of the Royal Society.

Grevilleas are woody plants ranging in size from prostrate shrubs to large trees yielding millable timber. The leaves are alternate and there is great variation in size, shape and texture. They vary from entire leaves about 1 cm long to fern-like, deeply-divided leaves 15 cm or more in length.

The flowers have four perianth parts, called tepals, four stamens and an ovary containing one cell. The tepals are joined into a tube which splits along the upper side to release the long style which curves out like a hairpin. At that stage, the stigma remains enclosed in the fused upper end of the tube, which is called the limb. In many species, the tube is swollen towards the base and the upper end of the tube is curled under. Eventually the limb splits into four parts, the stigma is released and the style straightens out. A sessile anther can be seen in a little depression on the inner side near the end of each tepal.

The flowers are arranged in short umbels with a few flowers or, more commonly, in racemes. These are dense and crowded with all the flowers on one side of the rhachis, somewhat like a toothbrush, or arranged all around the rhachis like a bottlebrush.

by Beryl A. Lebler, Botany Branch

The fruit is a follicle—a dry fruit developed from a single-celled ovary. It has thin, leathery walls and the dry remnants of the style persist on the fruit. As soon as the fruit matures, it splits along the upper edge to release one or two seeds. These can have a narrow wing at one end, be entirely without wings or have a membranous wing surrounding the seed.

One grevillea from north Queensland is an exception. It has large globular fruits with hard woody valves like the fruits of a hakea.

There are more than 245 species of grevillea and with the exception of a few species from New Caledonia, New Guinea and the New Hebrides, they are found only in Australia. The majority grow in Western Australia and their flower colour ranges from white or yellow to orange, pink, red or purple. In South-eastern Queensland, the flowers are creamy-white or yellow, golden-orange, orange-red, lavender-pink or wholly or partly green.

Nine grevilleas are native to south-eastern Queensland. These are: *Grevillea hilliana*, *G. banksii*, *G. robusta*, *G. sinuliflora*, *G. leiophylla*, *G. floribunda*, *G. arenaria* var. *canescens*, and two species at present still unnamed one from Mt. Greville, and the other from Coochin Hills.

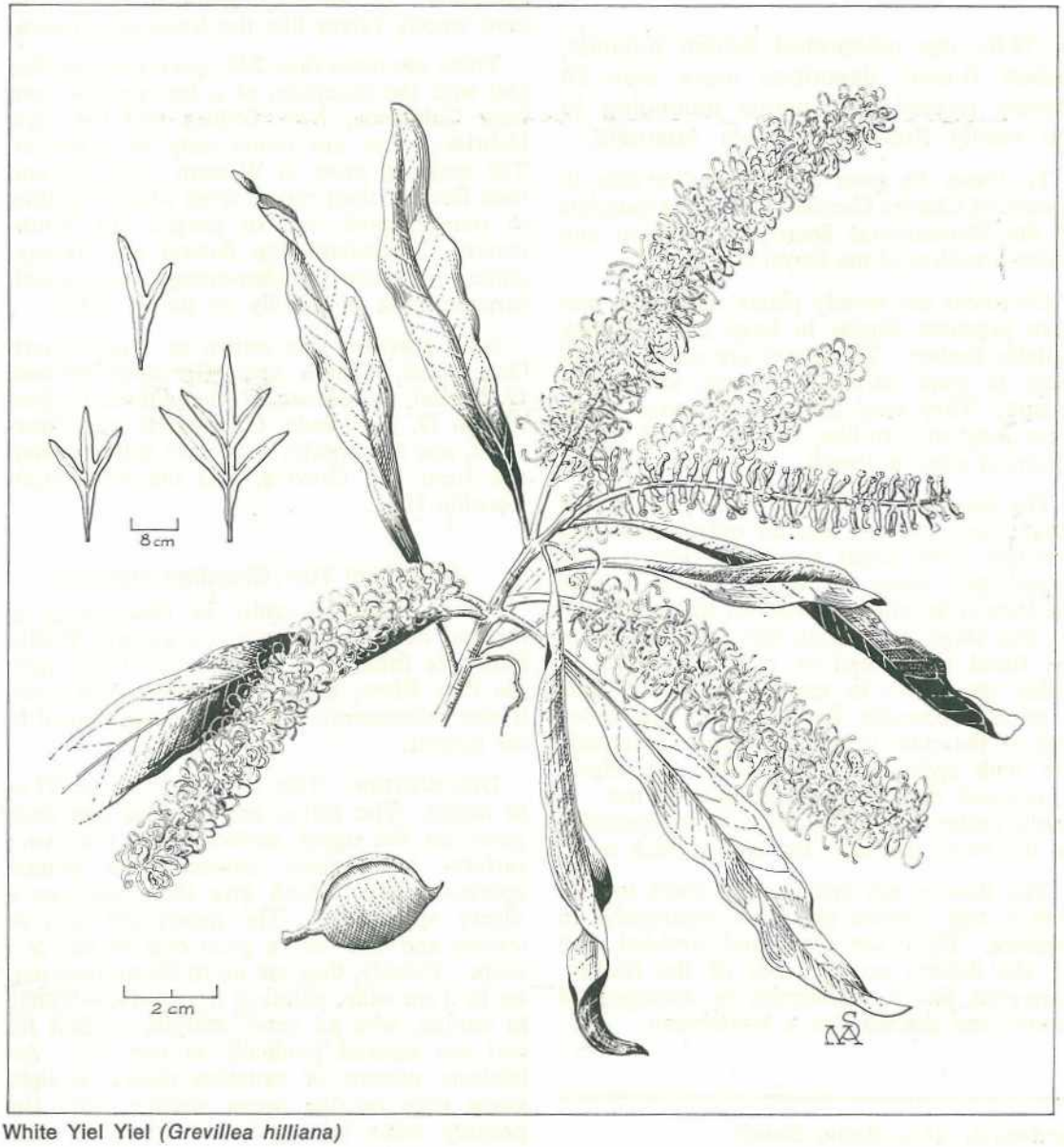
White Yiel Yiel *(Grevillea hilliana)*

The Colonial Botanist in Queensland at the end of the nineteenth century was Walter Hill. He found this plant in the forest near the Pine River, north of Brisbane, and when it was subsequently described it was named in his honour.

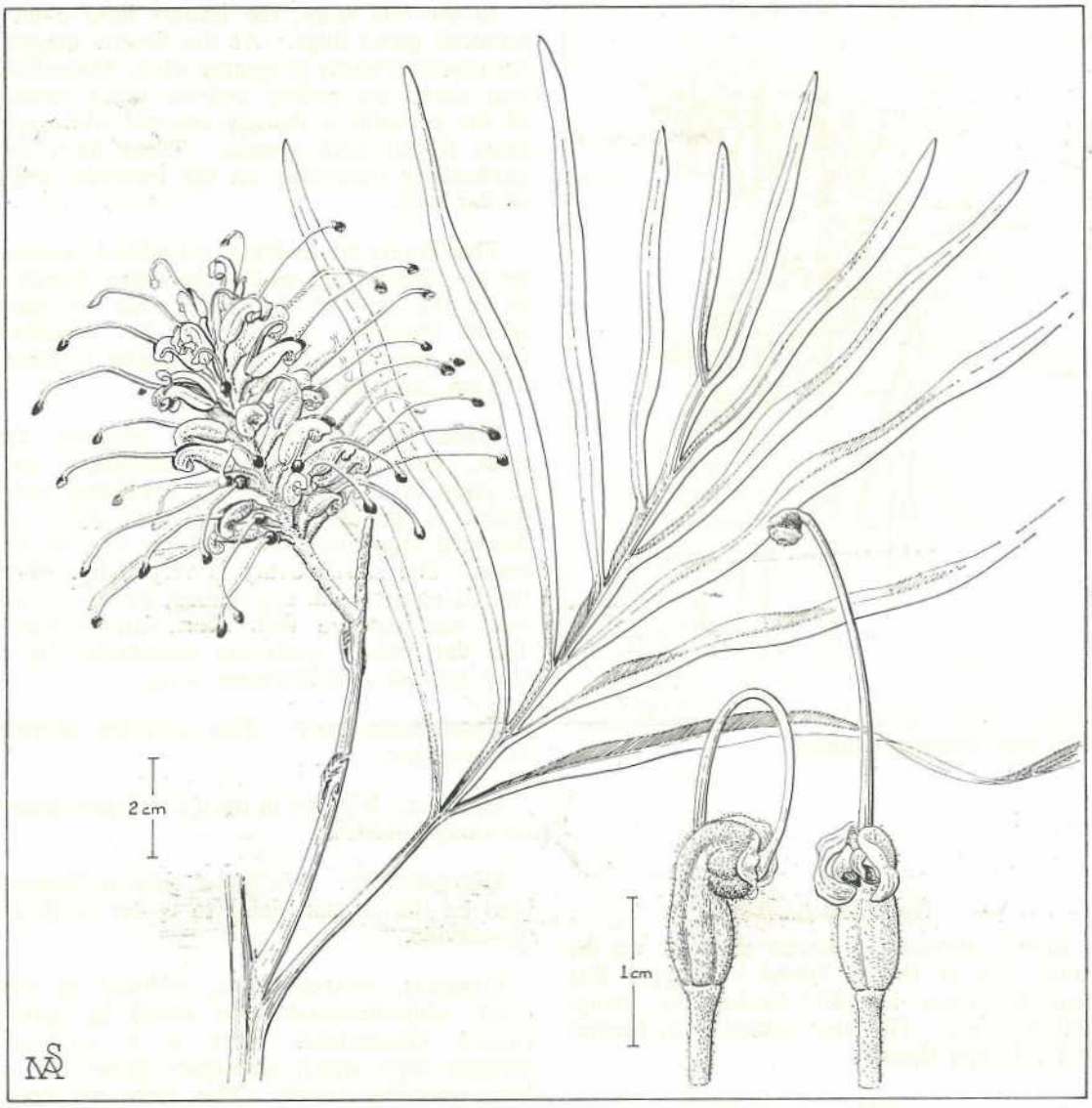
DESCRIPTION. This is a tree up to 27 m in height. The leaves are glabrous and dark green on the upper surfaces, and the lower surfaces are densely covered with minute appressed hairs which give these surfaces a silvery appearance. The leaves are firm in texture and can vary a great deal in size and shape. Usually, they are up to 20 cm long and up to 3 cm wide, elliptical to obovate—oblong in outline, with an entire margin, a blunt tip and are tapered gradually to the base. An intricate pattern of venation shows as light green lines on the upper surface, with the primary veins joining an intramarginal vein

0·3 to 0·4 cm from the margin. Sometimes leaves can be found with one to three lobes in the upper part. Other leaves have five to seven deeply-cut lobes up to 13 cm long. These lobed leaves can be 30 cm long.

The flowers are creamy-white, 1 cm long and have a slender tube. They are crowded in dense cylindrical racemes 10 to 20 cm long. The outer surface of the perianth is minutely silky. In the bud stage, the inflorescence is greenish in colour. As the flowers mature and change colour the segments separate from one another, and when they split apart completely the stigma is released and the style straightens out partially but remains hooked at the end.



White Yiel Yiel *(Grevillea hilliana)*



Grevillea banksii

The fruit is egg-shaped, about 2·5 cm long and is hard and flattened and a narrow wing surrounds the seed.

FLOWERING TIME. This grevillea flowers early in summer.

HABITAT. It is found in rain forest.

DISTRIBUTION. It grows only in New South Wales and Queensland, from as far south as the Clarence River to as far north as Cooktown.

GENERAL REMARKS. White Yiel Yiel has been brought into cultivation but is not grown extensively. The common name Yiel Yiel was applied by the aborigines in northern New South Wales to trees belonging to the family Proteaceae, and white alludes to the colour of the timber.

Silky Oak *(Grevillea robusta)*

Grevillea banksii

Robert Brown discovered this tree on the stony hills of Facing Island in Keppel Bay near Gladstone in 1802 during his voyage with Flinders. He later named it in honour of Sir Joseph Banks.

DESCRIPTION. This is a slender, erect tree 3 to 6 m high with widely-spaced, ascending branches and sparse foliage. Young parts of the plant have a dense covering of appressed, rusty hairs. The leaves are deeply pinnatisect with up to 11 linear or lanceolate segments divided almost to the midrib. They are dark green and glabrous on the upper surface and the lower surface is silvery with a dense covering of short, appressed white hairs. The margins are slightly recurved. The whole leaf can be up to 30 cm long and the segments 18 cm long and 1 cm wide.

In the bud stage, the flowers have a pronounced green tinge. As the flowers mature, the colour changes to creamy-white. Magnification shows the pedicel and the outer surface of the perianth is densely covered with erect hairs tipped with glands. These hairs are particularly noticeable on the recurved limbs of the buds.

The flowers are in dense, cylindrical racemes up to 10 cm long, which are either terminal or in the axils of the leaves near the ends of the branches. Each flower has a pedicel 0·5 cm long and the perianth tube is about 1·5 cm long and 0·4 cm wide.

When the segments finally separate, the thick, white, glabrous style straightens out. It ends in a down-curving, thickened cone which is sometimes flushed with red. A flattened stigmatic cone is at the end of the cone. The sessile ovary is very hairy. The fruit is compressed, egg-shaped, about 1·5 cm long and covered with short, brown hairs. The flat, brown seeds are surrounded by a very narrow membraneous wing.

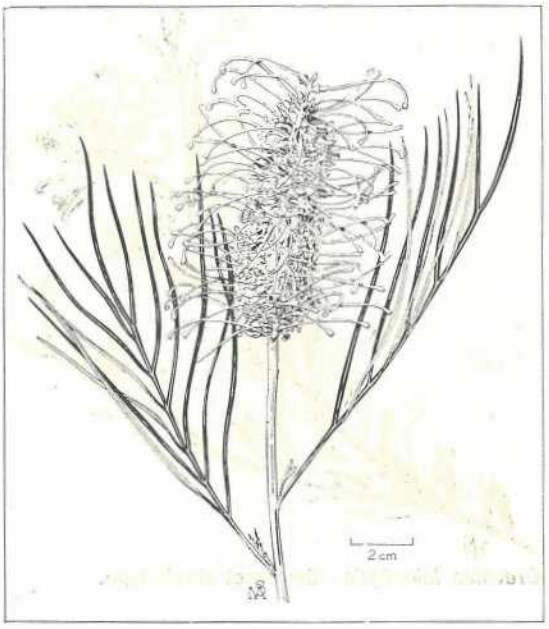
FLOWERING TIME. This grevillea flowers in springtime.

HABITAT. It grows in open eucalyptus forest on stony hillsides.

DISTRIBUTION. It is found only in Queensland on the coastal plains to as far north as Townsville.

GENERAL REMARKS. In addition to the erect, white-flowered form found in south-eastern Queensland, there is a prostrate shrubby form which sometimes grows into a low, sprawling shrub. This plant has been found along the central Queensland coast at Round Hill Head and on the Keppel Islands. Both red and white flowering plants of this prostrate form have been found in the one population, those with red flowers usually blooming during summer. In the region between Maryborough and Bundaberg, plants of the erect tree form have been found with red flowers.

The popular, red-flowering shrub commonly grown in home gardens throughout the world is a selected form whose origin is unknown.



Grevillea sp. 'Coochin Hills'

Silky Oak (*Grevillea robusta*)

Allan Cunningham, famous both as an explorer and botanist, found this plant in 1827 'on the banks of the Brisbane River in thick, moist woods'. A latin adjective meaning stout or strong in growth was chosen as the specific epithet since this was the first grevillea of tree proportions to be found. In fact Cunningham wrote 'with the exception of the araucarias, none of the forest trees surpassed the grevillea in height.'

DESCRIPTION. This is a tree which can grow to a height of 36 m with relatively short branches which spread almost parallel to the ground. The rather leathery leaves are pinnate with pinnatifid lobes and have up to 25 lobes which are again divided or lobed. Young leaves are bronze green. Mature leaves can be 15 cm or more long and are green on the upper surface and grey-green beneath. This surface is covered with appressed, silky hairs.

The rich, golden-orange flowers are crowded in branched inflorescences consisting of several racemes. These are found on old wood or growing in the axils of the lower leaves. A single branch of the inflorescence can have up to 100 flowers. These are all turned to the upper side of the rhachis. The pedicels are more than 1 cm long and are tinged with red. Both inner and outer surfaces of the perianth are glabrous. The outside of the perianth is golden-orange and the inner surface is often deep red.

When the perianth falls, the inflorescence is still colourful since the orange styles persist. The glabrous green ovary is also clearly seen. The fruits are about 1·85 cm long, very oblique and the seeds are winged all around.

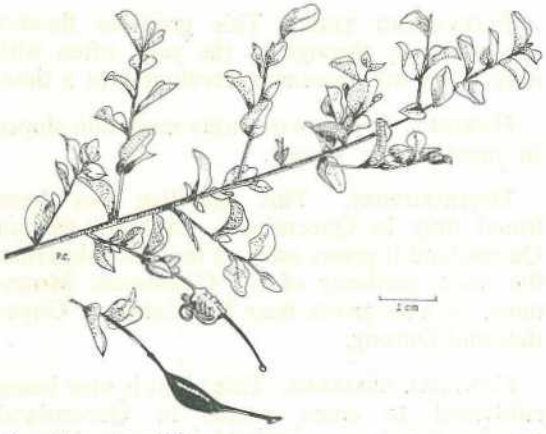
FLOWERING TIME. Silky oaks flower in springtime.

HABITAT. This tree grows in rain-forests, usually along creeks or on river banks.

DISTRIBUTION. Silky oak is found only in the coastal areas of New South Wales and Queensland, from as far south as the Clarence River to as far north as Maryborough.

GENERAL REMARKS. This was one of the first native plants to be brought into cultivation in Australia. Seedlings of this grevillea are very popular overseas as an indoor pot plant because of the almost fern like appearance of the finely divided leaves.

The common name silky oak was given to this plant by the early timber cutters. Newly split wood looked silky and its grain resembled that of the English oak.



Grevillea singuliflora

Grevillea sp. 'Coochin Hills'

DESCRIPTION. This is a slender, erect and rather sparse tree which can reach a height of 3 to 4 m. Fine, silky appressed hairs cover the stems and the young leaves giving them a golden appearance. Mature leaves are dark green and glabrous on the upper surface, pale and silky beneath. They are pinnate, with linear leaflets about 10 cm long and 0·2 cm wide. These taper to a fine point. The leaves are not flat as the leaflets are held at an angle to the rhachis giving the leaf a dihedral appearance like a bird in flight. The margins of the leaflets are recurved.

In the young stages, before the stigmas are released, the inflorescences have an overall creamy-yellow appearance. Short, appressed, golden-brown hairs cover the outer surfaces of the flowers. The inflorescences are terminal with the flowers crowded into cylindrical racemes. These can be 15 cm long and 8 cm wide, when the flowers are fully mature and the styles have straightened out. The flowers are arranged in pairs all around the rhachis. The thick, creamy-white styles can be 3·5 cm long and the sessile ovary is green and is densely covered with silky white hairs.

At the beginning of the flowering season, a plant produces normal flowers. Later, the same plant produces abnormal flowers with two styles.

The fruits are dark brown, hairy, flattened and egg-shaped, and contain two seeds which are surrounded by a narrow wing.

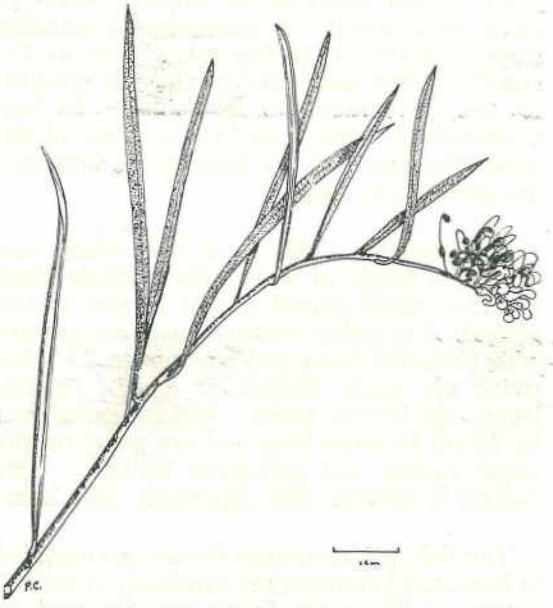
FLOWERING TIME. This grevillea flowers spasmodically throughout the year, often with only a few inflorescences developing at a time.

HABITAT. It grows on stony mountain slopes in mixed open forests.

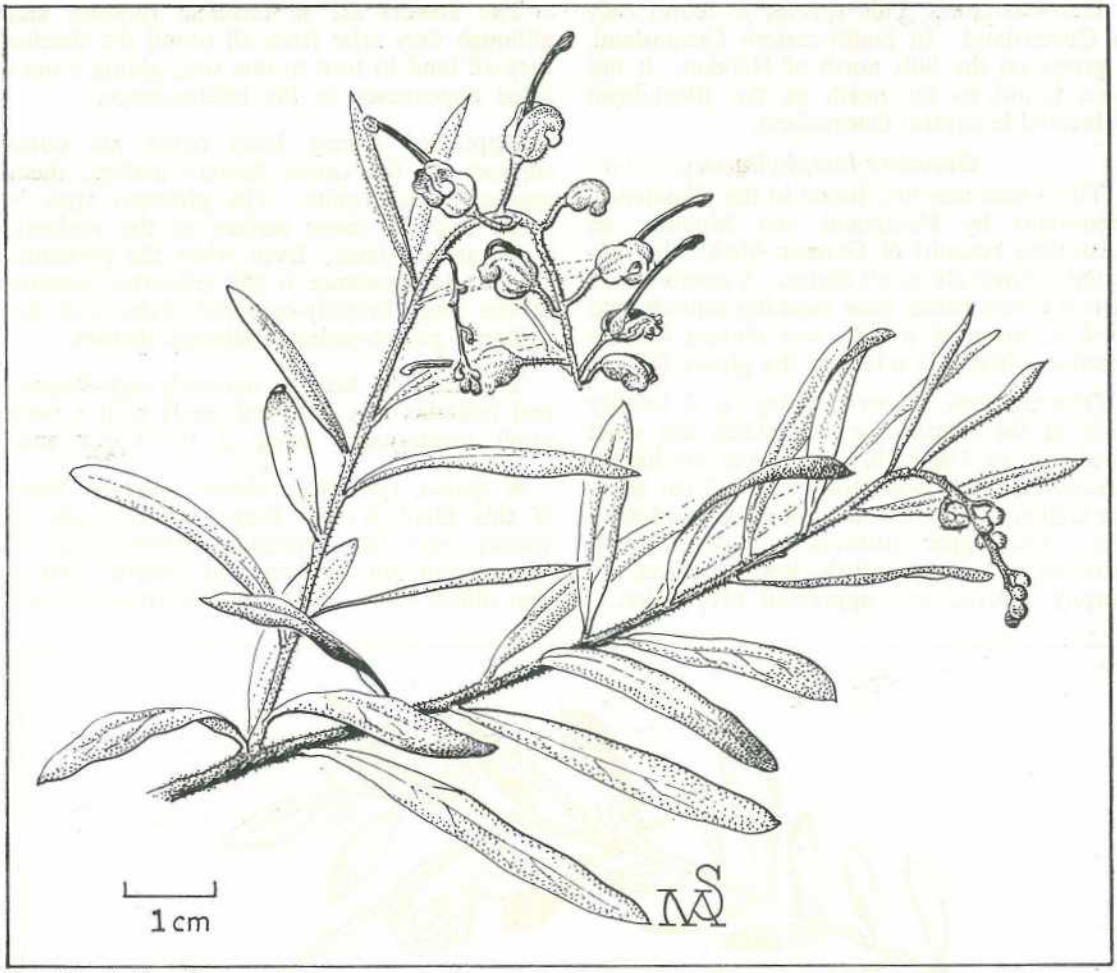
DISTRIBUTION. This grevillea has been found only in Queensland. In South-eastern Queensland it grows only on the Coochin Hills, the most northerly of the Glasshouse Mountains. It also grows near Mundubbera, Gayndah and Durong.

GENERAL REMARKS. This plant is now being cultivated to some extent in Queensland gardens but is not available commercially.

Grevillea leiophylla—the erect shrub type.



Grevillea leiophylla—the sparse, sprawling, almost prostrate form.



Grevillea floribunda

Grevillea singuliflora

This shrub was first discovered in 1845 on the banks of Dogwood Creek, a tributary of the Condamine River, by Ludwig Leichhardt during an expedition from the Moreton Bay settlement to Port Essington. It was given the specific epithet meaning single-flowered because the inflorescence usually consists of only one flower.

DESCRIPTION. This is a glabrous, much-branched shrub less than 1 m high with many twiggy branches. The leaves are simple, orbicular or broadly ovate, almost sessile, and less than 1·5 cm long. They end in a blunt tip and the midrib is produced beyond the lamina to form a short mucro. They are glabrous, slightly darker in colour on the upper surface, firm in texture, but not leathery and have undulate margins.

One or rarely two flowers are borne on slender, pale green pedicels in the axils of the terminal leaves. The flowers are glabrous less than 1 cm long, about 0·6 cm wide and are pale green and almost transparent. The perianth tube is slightly swollen at the base and recurved under the globular limb. The fruits are about 1·5 cm long and egg-shaped.

FLOWERING TIME. This grevillea flowers from late winter to the middle of spring.

HABITAT. It grows on grassy slopes in open eucalyptus forest.

DISTRIBUTION. This species is found only in Queensland. In South-eastern Queensland, it grows on the hills north of Helidon. It has been found as far north as the Blackdown Tableland in central Queensland.

Grevillea leiophylla

This shrub was first found in the Glasshouse Mountains by Ferdinand von Mueller, an Australian botanist of German birth, who collected extensively in all States. A combination of two Greek words *leios* meaning smooth, and *phyllon,* meaning a leaf, was chosen for the specific epithet. It refers to the glossy foliage.

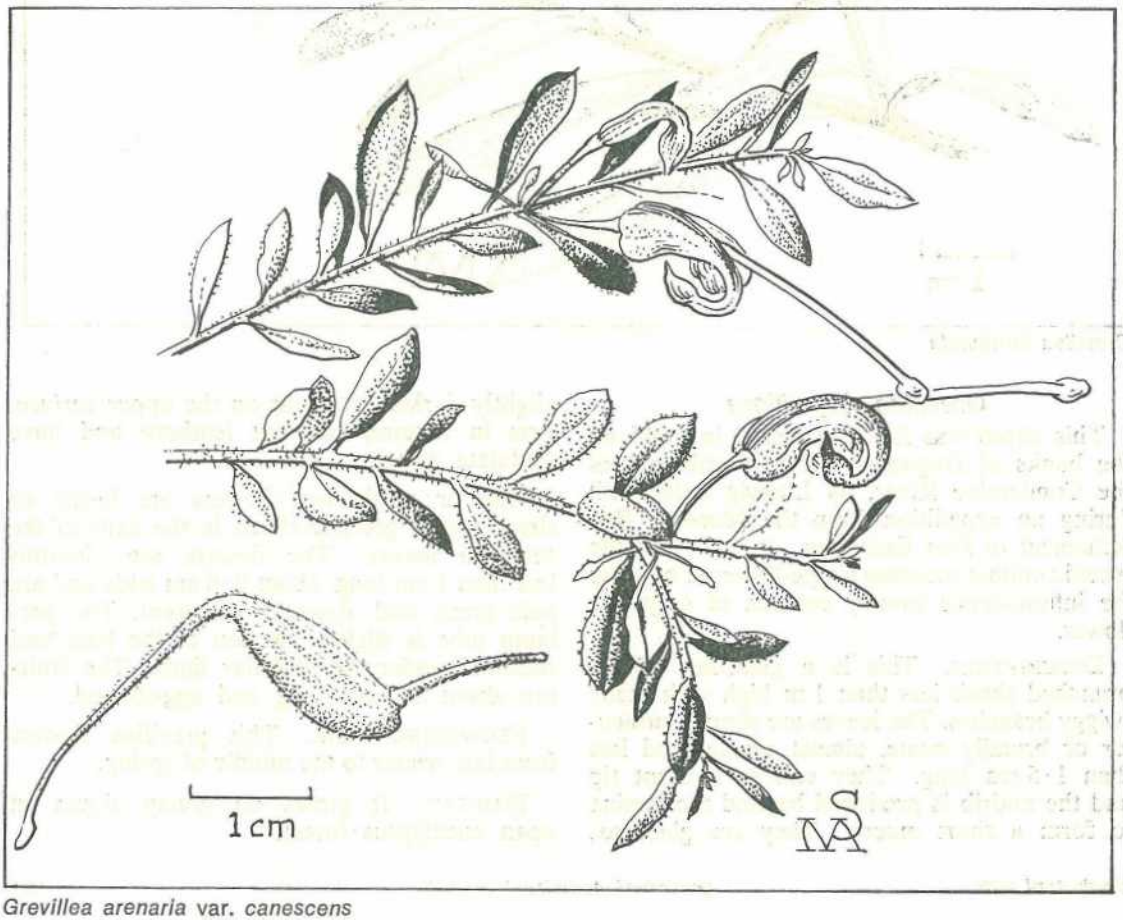
DESCRIPTION. Plants growing in a locality such as the Glasshouse Mountains are erect shrubs up to 1 m high. The leaves are linear-lanceolate, up to 3 cm long and 2·3 cm wide, are leathery in texture, and have recurved margins. The upper surfaces are dark green, glabrous and glossy and the lower surfaces are densely covered with appressed silky hairs.

The flowers are in terminal racemes and although they arise from all round the rhachis they all tend to turn to one side, giving a one-sided appearance to the inflorescence.

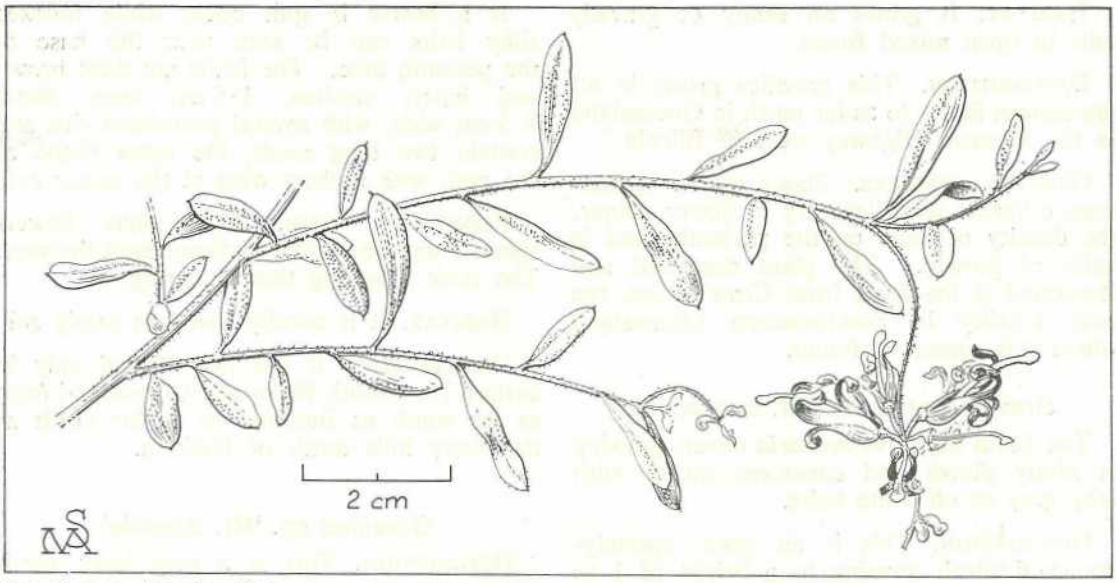
Appressed silvery hairs cover the outer surfaces of the cerise flowers making them appear lavender-pink. The glabrous style is cerise and the inner surface of the perianth is the same colour. Even when the perianths fall, the inflorescence is still colourful because of the long, brightly-coloured styles and the bulbous, golden-yellow, glabrous ovaries.

The fruit is brown, narrowly egg-shaped, and contains two flattened seeds with a very small membranous wing at the upper end.

A sparse, sprawling, almost prostrate form of this plant is also found which tends to sprawl over the vegetation surrounding it. Apart from this difference in growth habit it also differs in its longer and narrower leaves.



Grevillea arenaria var. *canescens*



Grevillea sp. 'Mt. Greville'

FLOWERING TIME. It flowers in spring and summer.

HABITAT. The erect form grows on the steep slopes of mountains and the prostrate form is found in poorly-drained wallum flats.

DISTRIBUTION. This plant grows only in coastal Queensland to as far north as Burrum Heads.

Grevillea floribunda

This plant was first discovered in 1817 in the mountains near Port Jackson by Allan Cunningham.

The Latin adjective meaning free-flowering or producing abundant flowers was chosen for the specific epithet apparently because of the floriferous nature of the plant.

DESCRIPTION. This is a spreading, open shrub about 1·5 m high with appressed silky hairs forming a dense covering on the young twigs and the lower surfaces of the leaves. These are nearly sessile, oval-oblong, up to 4 cm long and end in a blunt point. Silky appressed hairs cover both surfaces of the young leaves making them appear rusty, but they disappear from the upper surfaces of older leaves which are dark green but slightly scabrid.

The inflorescence is a loose terminal cylindrical raceme, often 2·5 cm long with about ten flowers. Both rhachis and pedicels are covered with minute, reddish-golden hairs. These are also scattered on the perianth. Mature buds are less than 1 cm long. The limb is globular, the perianth is broad and pouched at the base, and narrowed and very revolute above the middle. Most of the perianth is orange-red, but the base is tinged with yellow.

The style is straight and about 1·5 cm long, red in colour and covered with appressed, golden hairs. Dense, long, white hairs form tufts just above the swollen base on the inside of the perianth. The ovary is also covered by long, white spreading hairs. The pod is black, slightly ribbed, less than 1·5 cm long, and contains two long seeds (the same shape as the pod) with a short wing at the upper end.

FLOWERING TIME. This plant flowers spasmodically throughout the year with most flowers appearing in late winter or spring.

HABITAT. It grows on sandy or gravelly soils in open mixed forest.

DISTRIBUTION. This grevillea grows in all the eastern States to as far north in Queensland as the Dawson Highway west of Biloela.

GENERAL REMARKS. Plants of this species from different localities vary in flower colour, the density of hairs on the perianths and in habit of growth. The plant described and illustrated is the form from Crow's Nest, the only locality in South-eastern Queensland where this species is found.

Grevillea arenaria var. *canescens*

The Latin adjective *arenaria* means growing in sandy places and *canescens* means with ashy grey or off-white hairs.

DESCRIPTION. This is an open, sparsely-branched shrub growing to a height of 1 to 2 m, often branching from ground level. The branches are thin and twiggy and are densely covered with short, brown, shaggy hairs. The leaves are obovate-oblong, up to 2 cm long and 0·8 cm wide; and end in a very short point. The margins are recurved. Both surfaces of the leaves have a dusty appearance which is caused by the presence of minute, white hairs which are denser on the lower surface.

The flowers are relatively inconspicuous and are borne in racemes with only a few flowers. Sometimes the racemes appear to be terminal because of the strong development of adjacent shoots at the time of flowering. Although four flowers are sometimes found in the inflorescence, more often there are only one or two. The pedicels are almost as long as the perianth. The racemes are reflexed. At first glance, the flowers appear to be glabrous. Closer examination shows a scattering of very short, white to pale brown hairs. The lower half of the perianth is apple green. A red flush is on either side of the split in the tube and the main part of the upper half is rosy red on both the inner and outer surfaces. The apple green style is about 3 cm long and ends in a large, flattened stigmatic disc. Spreading, white hairs are scattered over the style. The mature flower measures 3 cm from the base of the perianth to the tip of the style.

If a flower is split open, white reflexed silky hairs can be seen near the base of the perianth tube. The fruits are dark brown and hairy, swollen, 1·5 cm long, about 0·5 cm wide, with several prominent ribs and contain two long seeds, the same shape as the pod, with a short wing at the upper end.

FLOWERING TIME. This plant flowers sparsely and intermittently throughout the year. The peak flowering time is spring.

HABITAT. It is usually found in sandy soil.

DISTRIBUTION. It has been found only in eastern New South Wales and Queensland from as far south as Bathurst to as far north as the stony hills north of Helidon.

Grevillea sp. 'Mt. Greville'

DESCRIPTION. This is a very leafy shrub which can grow to a height of 1·5 m but is usually only 60 to 90 cm high. The branches spread from the stem and usually the weight of the leaves causes the tips of the branches to droop.

The leaves are obovate, up to 3 cm long and 0·8 cm wide, green on the upper surface with a sparce scattering of short, appressed, white hairs. The leaves are thin in texture and have entire, flat margins.

The flowers are in sparse terminal racemes, about 3 cm long, with up to six flowers. Long, appressed silky hairs are scattered over the outside of the perianth and also on the rhachis and pedicels. The mature perianth is about 1·5 cm long and 0·2 to 0·3 cm wide. The lower half of the flower is pale green and the upper half pink. The inner surface is glabrous and orange red. Sparse, minute hairs are scattered over the style and the curved upper portion of the stigma.

FLOWERING TIME. This species flowers intermittently from summer to late autumn.

DISTRIBUTION. It has been collected only from Mt. Greville and Mt. Maroon, south-west of Brisbane.

HABITAT. It grows on the stony upper mountain slopes where it is common in rock crevices and is the dominant undershrub in open eucalyptus forest.

Field Key

1. Trees to 36 m 2

   Woody shrubs to 3 m 4

2. Leaves entire, elliptical to obovate-oblong to 20 cm long; or lobed or deeply pinnatifid with 3 to 7 lobes up to 13 cm long. Flowers creamy-white, pubescent on outer surface
   Grevillea hilliana

   Leaves pinnatisect or pinnate 3

3. Leaves pinnatisect, with up to 11 linear or lanceolate segments. Flowers creamy-white
   Grevillea banksii

   Leaves pinnate or with pinnatifid or bipinnatisect lobes. Flowers golden-orange, glabrous
   Grevillea robusta

4. Leaves pinnate with linear leaflets. Flowers creamy-yellow, pubescent
   Grevillea sp. 'Coochin Hills'

   Leaves entire. Flowers lavender-pink, orange-red or wholly or partly green 5

5. Leaves glabrous, orbicular or broadly ovate, with undulate margins. Flowers pale green and almost transparent, glabrous
   Grevillea singuliflora

   Leaves pubescent at least on lower surface, leaves lanceolate, oval to oblong, or obovate 6

6. Leaves linear-lanceolate. Flowers lavender-pink with silky hairs on outside of perianth
   Grevillea leiophylla

   Leaves oval, oblong or obovate. Flowers orange-red or mainly green 7

7. Leaves oval to oblong, to 4 cm long. Flowers orange-red, pouched at base
   Grevillea floribunda

   Leaves obovate to oblong, to 3 cm long. Flowers mainly green 8

8. Leaves obovate-oblong, up to 2 cm long, margins recurved. Flowers apple green in lower half, rosy red in upper half
   Grevillea arenaria var. *canescens*

   Leaves obovate, up to 3 cm long, margins flat. Flowers pale green in lower half, pink in upper half with orange-red inside
   Grevillea sp. 'Mt. Greville'.

Measuring grain yields from test strips

by J. H. Cutler, Agriculture Branch.

A simple, accurate method of measuring yields from grain crops which can be used to check fertilizer responses, varietal performance etc. has been developed.

The method involves the weighing of grain as it is augered out of the header.

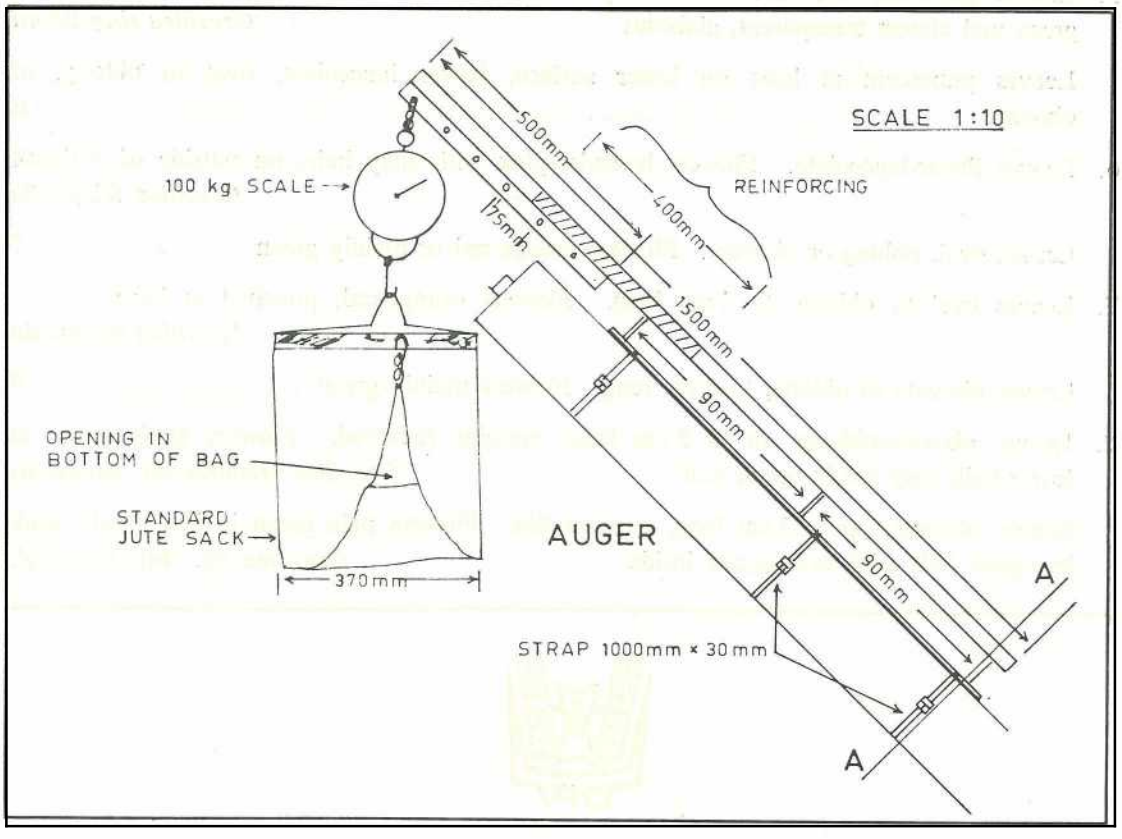
A metal arm is strapped to the header auger to support a set of 100 kg clockface scales and a bottom-releasing weighing bag.

The apparatus is arranged to allow grain to be slowly augered into the bag. When the bag is near full, the auger is stopped and the weight recorded. A hook which holds up the open bottom is released from the metal rimmed mouth of the bag and the grain falls into the truck or field bin.

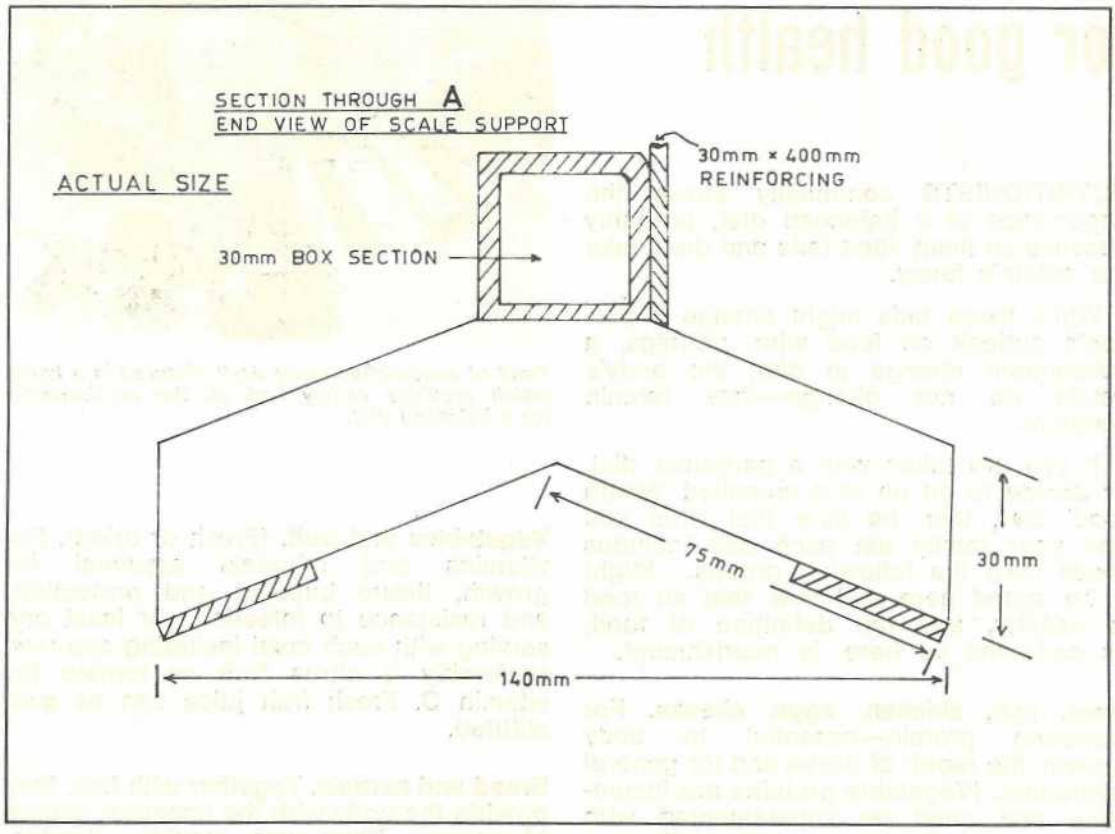
With this device, 1 tonne of grain can be weighed with 99% accuracy in less than 5 minutes.

The apparatus is simple and could be constructed in any workshop with a welder. Construction details are shown in the diagrams.

The bag shown is a standard size jute bag. Although this is satisfactory, a larger bag is much easier to use. If the header auger is well braced, heavier sack lots could be weighed thus speeding the operation. The bag is supported by a 50 mm metal rim which holds the opening rigid and allows easy hooking on to the scales.



The device is strapped to the header auger with 1 metre long straps which have self-locking buckles. These are necessary to enable the straps to be pulled and kept tight. During harvesting, the supporting arm can be left on the auger but it is wise to remove the scales to prevent any damage. A 40 mm 'D' shackle and a short length of chain allow easy removal of the scales and adjustment to keep the bag directly under the auger.



CHANGING YOUR ADDRESS?

Please let us know as soon as possible if you intend changing your address.

Because the addressed wrappers and Journals are printed separately, changes cannot take effect until the next batch of wrappers is printed.

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

If possible, two months' notice should be given to ensure your Journal is sent to the correct address.

A balanced diet for good health

Tired of sandwiches every day? Pictured is a lunch which provides variety and all the requirements for a balanced diet.

NUTRITIONISTS continually stress the importance of a balanced diet, probably because so many food fads and diets take the public's fancy.

While these fads might change a person's outlook on food with, perhaps, a subsequent change in diet, the body's needs do not change—they remain constant.

If you are taken with a particular diet, or decide to go on to a so-called 'health food' diet, then be sure that what you and your family eat each day includes foods from the following groups. Might it be stated here and now that all food is healthy, and the definition of food, as concerns us here, is nourishment.

Meat, fish, chicken, eggs, cheese. For complete protein—essential to body growth, the repair of tissue and for general well-being. (Vegetable proteins are incomplete and must be supplemented with animal protein for good nutrition.) Recommended daily amount—at least one serving of any of these foods with each meal, assuming there are three meals a day.

Milk and cheese. Primarily for its protein and calcium content. Calcium is essential for strong bones and teeth. Children should have 500 to 700 ml of milk per day. Cheese may be substituted—30 g (1 oz.) is equivalent to 200 ml of milk.

Vegetables and fruit. (Fresh or dried). For vitamins and minerals essential for growth, tissue building and protection, and resistance to infection. At least one serving with each meal including one raw, preferably a citrus fruit or tomato for vitamin C. Fresh fruit juice can be substituted.

Bread and cereals. Together with fats, they provide the body with the cheapest source of energy. They also provide vitamins, minerals, vegetable protein and, if not highly refined, many provide essential fibre for a high residue diet. Amount depends on total energy needs.

Fats—butter, margarine, oil, cream, fat in meat etc. These provide energy, promote a feeling of appetite satisfaction and aid in the assimilation of certain nutrients. Those listed are 'visible' fats: other foods such as nuts, lean meats, egg yolk, milk and cheese contain 'invisible' fats and should be taken into consideration if fat intake has to be kept to a minimum. Recommended daily requirement: 15 to 30 g (½ to 1 oz.).

---

by Mrs Tess Mallos, Australian Meat and Livestock Corporation.

A balanced diet and the school lunch.

From the above, it can be clearly seen that complete protein is essential for growing children. For example, a child in its adolescent years requires more complete protein than an adult as growth is more rapid at this stage.

A lunch consisting of a sandwich or two with butter or margarine and filled with meat or any of the other protein foods: cheese (if not included in the sandwich): a piece of fruit (fresh or dried): citrus fruit juice or a tomato, would give the child a wholesome, nutrient-balanced lunch and contribute to the daily requirements.

If sandwiches do not appeal, pack a lunch box with slices of meat or other protein foods, salad vegetables and buttered bread or a roll (preferably wholemeal).

As meat appeals greatly to most children and is a complete protein food, here are some meats to consider adding to the lunch box, either as a sandwich filling, or as part of a 'finger' lunch. By the way, it is a good idea to pack a well-chilled fruit drink in the lunch box in warm weather to keep foods fresh until lunch time.

Meat suggestions for the school lunch.

Slices or fingers of roast beef, lamb, veal or pork.

Slices or fingers of corned beef, lamb or tongue.

Sliced meat loaf, luncheon sausage (devon, fritz etc.).

Meat balls or rissoles.

Crumbed lamb cutlets or veal steak.

Grilled lamb cutlets or chops.

Meat is not only important for protein, it also contains valuable minerals such as iron and vitamins from the very important 'B' group. Include meat in the family's diet daily and you can be assured that you and yours will enjoy good health.

Subscribe now

'The Queensland Agricultural Journal'

Concession rate available

Persons eligible for concession rate include commercial farmers whose principal source of income is from primary production, students of agricultural courses, libraries and educational institutions (all resident in Queensland). Students' applications should be endorsed by the lecturer or teacher.

QUEENSLAND AGRICULTURAL JOURNAL

ORDER FORM

Subscription Rates—

Ordinary — $8.00 per annum (Australian Currency)

Concession rate — $3.00 per annum

NAME Mr / Mrs / Miss .....
(SURNAME IN BLOCK LETTERS) (INITIALS)

PRESENT ADDRESS ..... POSTCODE .....

PREVIOUS ADDRESS (if applicable) .....

OCCUPATION .....

I hereby enclose $ for years subscription (2 year limit).

Signature .....

New Subscriber ☐

Renewal ☐

(Tick the one that applies)

Office Use Only

71679—S. R. Hampson, Government Printer, Queensland

Some Queensland Wattles

Acacia resinicostata

This very attractive wattle was first found on the Carnarvon Range and grows only in Queensland. It is a rounded shrub reaching a height of 3 m and has always been found growing on sandstone in open eucalyptus forest or rusty gum woodland. It blooms late in winter.

Yellow prickly Moses *(Acacia hubbardiana)*

This wattle is found only in Queensland, on the coastal lowlands and the mountain peaks to as far north as Bundaberg. It grows both in wallum swamps and dry sclerophyll forests on mountain slopes and is a spreading shrub to 2 m in height. The flowers have a faint, sweet perfume. The main flowering period is in spring.

---

by Beryl A. Lebler, Botany Branch

Pretty wattle *(Acacia decora)*

This very showy wattle with its brightly-coloured, perfumed flowers is found only in Queensland and New South Wales from as far south as the Liverpool Plains to as far north as the Cooktown–Laura area. It grows in sandy soil in open eucalyptus forest on stony hillsides, or sandstone ridges, or in granite sand in gullies. It flowers in winter and early spring.

Acacia viscidula

In spring, this wattle can be found flowering in New South Wales and Queensland from the Lachlan River to the Glasshouse Mountains. It can vary in habit but is usually a slender shrub to 3 m and usually grows in alluvial soils along creek banks, on the margins of eucalyptus forest or on the lower slopes of mountains.

Some Queensland Wattles

Acacia resinicostata

Yellow prickly Moses *(Acacia hubbardiana)*

Pretty wattle *(Acacia decora)*

Photographs by officers of Botany Branch

Acacia viscidula