Queensland
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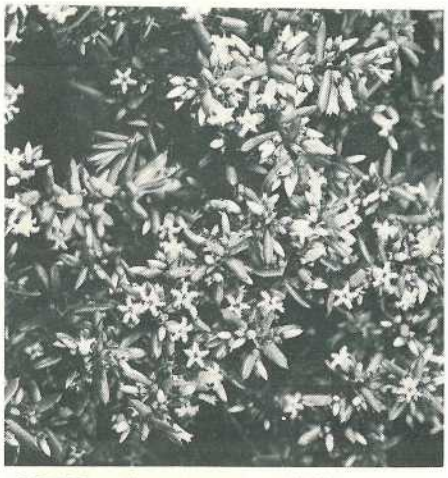

COVER. A common wildflower on Queensland's wallum heaths is *Leucopogon ericoides*. See 'The bearded heaths of south-eastern Queensland' in this issue. Photograph by K. Williams.

QUEENSLAND AGRICULTURAL JOURNAL

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# Contents



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# Basilisk signal grass—a productive

*by D. S. Loch, Agriculture Branch.*

SINCE its release in 1966, signal grass *(Brachiaria decumbens)* has become a popular pasture grass in the humid tropics of north Queensland.

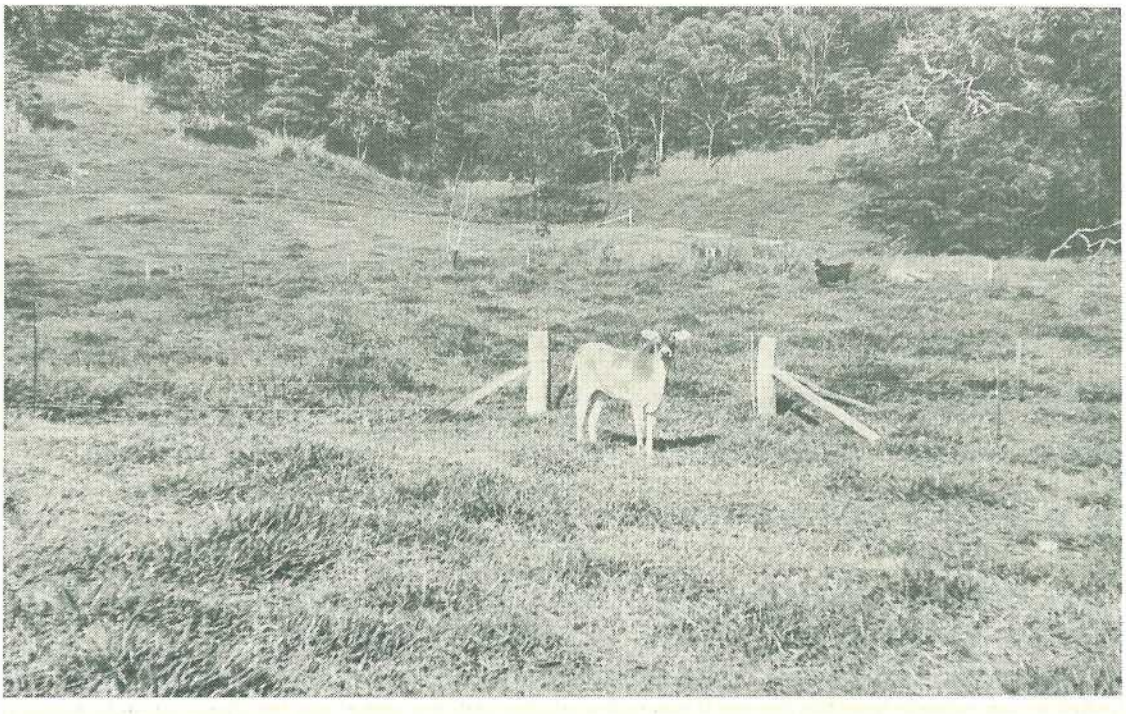
On the wet tropical coast and adjacent tablelands, increasing areas have been sown to signal grass, particularly where pure grass pastures are to be fertilized with nitrogen. Its high productivity under intensive use, tolerance of low fertility conditions, and relative freedom from pests and diseases account for much of the interest in signal grass.

At present, only one cultivar, Basilisk, is available in Queensland although different lines are used commercially in other countries. Basilisk was introduced from Uganda in 1930 and proved highly productive in a number of cutting and grazing experiments at South Johnstone. However, poor seed germination was the major barrier to its commercial release until Dr B. Grof showed that the germination of freshly harvested seed can be improved by acid scarification or by ageing in storage.

## Description

Basilisk is a vigorous, trailing perennial grass with short, dark-green leaves (1·0 to 1·5 cm wide and less than 20 cm long). The erect stems arise from a long stoloniferous base and root down from the lower nodes. These stems are generally no more than 30 to 45 cm high during the vegetative stage of growth; but with the onset of flowering, they elongate rapidly so that inflorescences (or seed-heads) are carried up to 1 m above the ground.

In each seed-head, there are two to seven branches attached almost at right angles to the central stalk. It is from this appearance (that is, like a railway signal) that the common name, signal grass, is derived.



*High beef production is possible if Basilisk pastures receiving fertilizer nitrogen are used intensively.*

# pasture plant for the humid tropics

## Climatic requirements

Basilisk is best suited to a humid, tropical environment where the dry season is not longer than 4 to 5 months. In such areas, it remains green during dry periods and is more drought-resistant than para grass (*B. mutica*) or pangola grass (*Digitaria decumbens*).

In common with other grasses suited to the humid tropics, Basilisk is readily frosted. In frost-free situations, however, its winter production is superior to that of pangola grass.

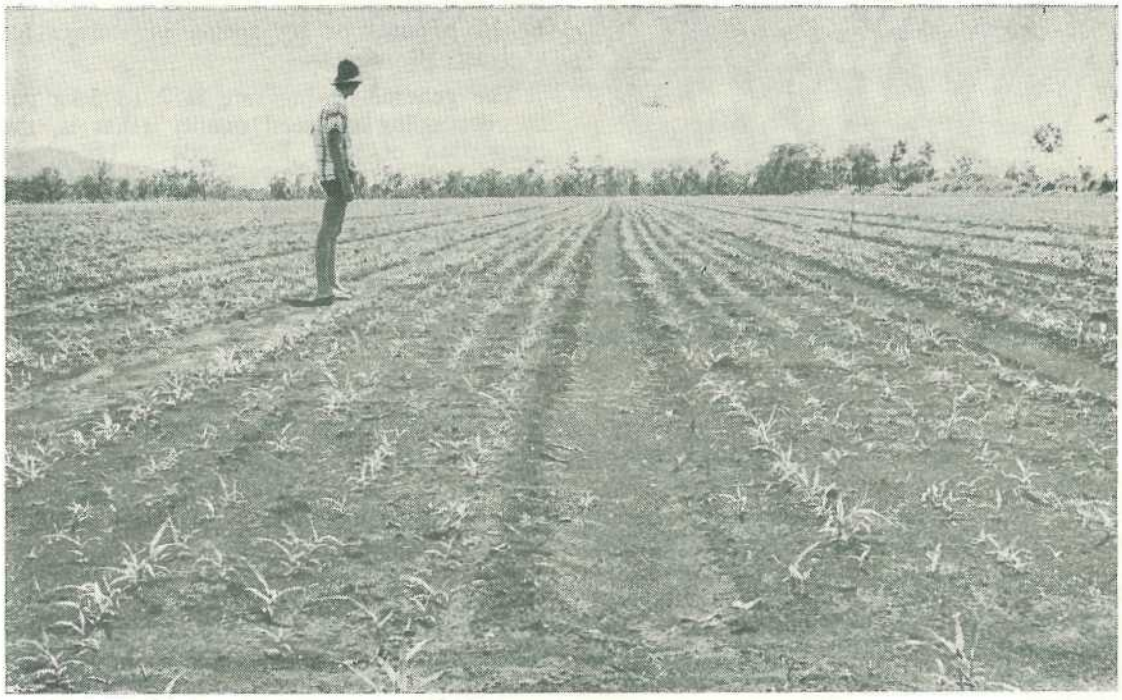
Although signal grass has become naturalized in parts of coastal southern and central Queensland, Basilisk has not been extensively planted in sub-tropical Queensland, even in high rainfall, frost-free situations. This reflects the availability of a range of satisfactory alternative species for sub-tropical areas, particularly before seed of Basilisk became readily available in the last decade.

## Soils

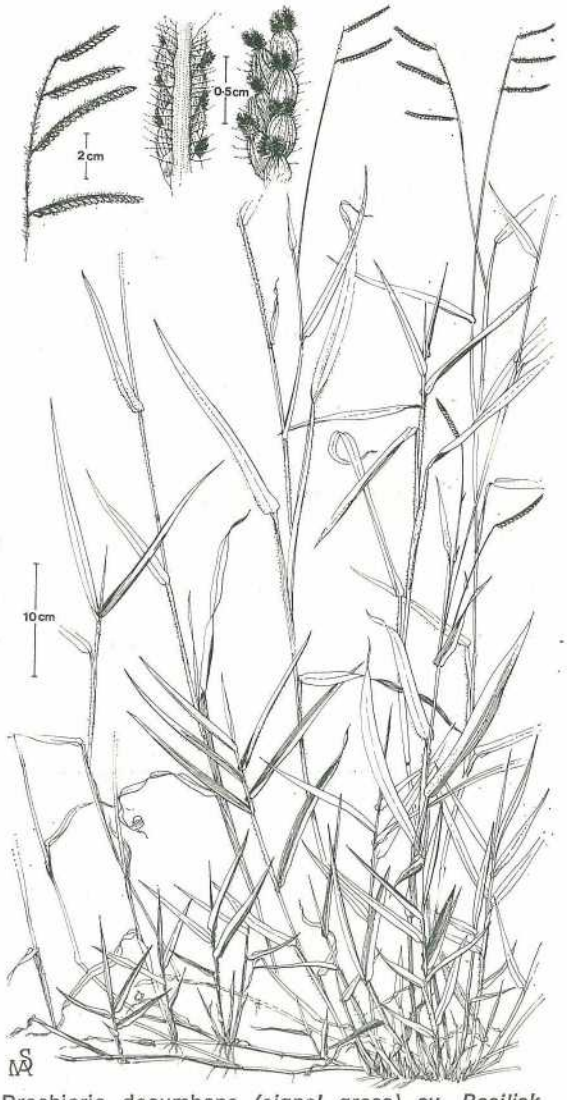
Basilisk grows well on a wide range of well-drained soils. It does not tolerate intermittently flooded or waterlogged conditions and, in such situations, other species such as para grass are preferable.

## Compatibility with legumes

The only legume so far known to form a stable productive association with Basilisk over a long period is hetero (*Desmodium heterophyllum*) which is a prostrate, strongly stoloniferous perennial. However, seed production of hetero presents immense difficulties and, as yet, there is no hetero seed commercially available.



*Atrazine helps the rapid establishment of weed-free stands of Basilisk.*



Brachiaria decumbens *(signal grass) cv. Basilisk.*

In the long term, the dense, vigorous growth of Basilisk suppresses most other legumes. Some, however, do form satisfactory associations with Basilisk in the short term; these include centro (*Centrosema pubescens*) and Cook and Endeavour stylos (*Stylosanthes guianensis*) on the wet tropical coast, and Tinaroo glycine (*Glycine wightii*) and Greenleaf desmodium (*D. intortum*) on the adjacent tablelands.

## Nitrogen-fertilized pastures

In view of its long-term incompatibility with most legumes, it is not surprising that most sowings of Basilisk have been for pure grass pastures fertilized with nitrogen. On the wet tropical coast, it is useful to have about 25% of the farm sown to a vigorous stoloniferous grass. If adequately fertilized with nitrogen, such pastures can support large numbers of cattle between August and November when feed is in short supply. In this way, the stocking pressure on more vulnerable grass-legume mixtures can be reduced during their period of slow growth.

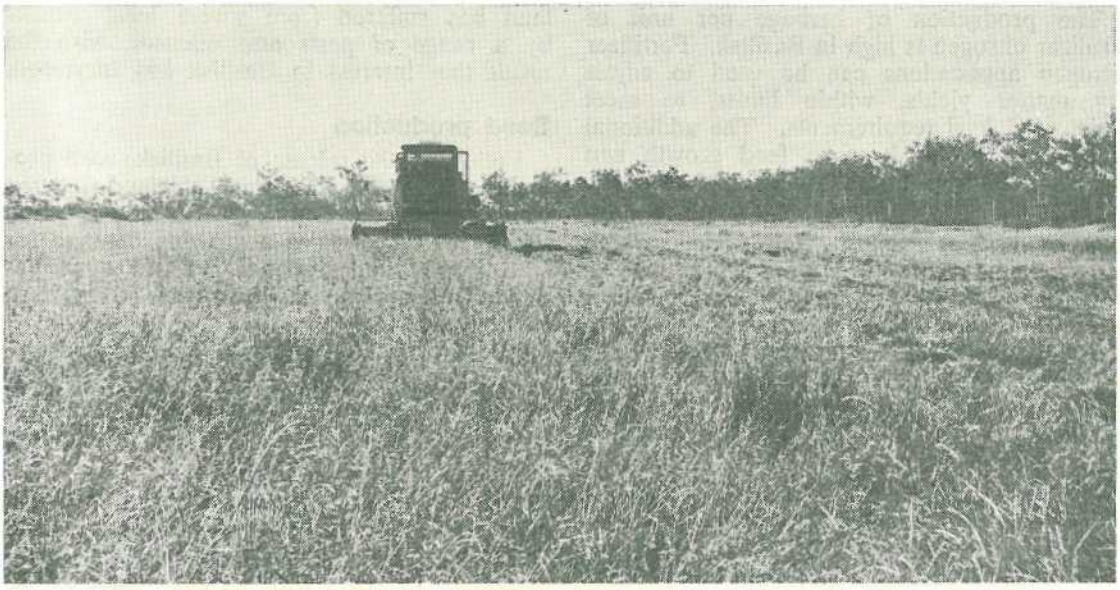
On well-drained soils, Basilisk is the preferred grass for nitrogen-fertilized pastures. It is more productive during winter, and more drought-tolerant than alternative species such as para grass. It makes very efficient use of fertilizer nitrogen and withstands heavy grazing.

## Establishment

Germination of freshly harvested seed is impeded by complex dormancy mechanisms. However, this can be improved by scarification with concentrated sulphuric acid for 10 to 15 minutes or by ageing in storage for at least 10 months.

The general sowing rate is 2 to 5 kg per ha, depending on seed quality (that is, the proportion of pure live seed). There are approximately 220 000 seeds per kg of pure seed, and this relatively large seed facilitates establishment in rough seedbeds; however, better results can be expected from well-prepared seedbeds. Local recommendations for establishment fertilizer requirements should be followed. Seedling growth is rapid and, in the absence of weed competition, a high initial plant population can provide a complete ground cover within 3 months.

The herbicide, atrazine, has been used successfully in the establishment of commercial seed crops on the Atherton Tableland. Basilisk has a high degree of tolerance to pre-emergence applications of atrazine which, even at relatively low rates, gives very good control of a wide range of annual weeds. The most suitable rate is 2·5 kg of 80% product per ha; this gives satisfactory weed control and does not damage establishing Basilisk seedlings.



*Large quantities of Basilisk seed have been harvested in north Queensland during the last decade.*

## Management

It is essential to manage Basilisk pastures intensively to achieve high liveweight gains. Basilisk withstands heavy grazing and trampling, and is palatable when maintained in a short, leafy condition; however, rank, coarse, stemmy growth is not well accepted by stock so all forms of deferred grazing should be avoided.

The protein content of Basilisk can be increased markedly by nitrogen fertilization, particularly during the cooler, drier period of the year when plant growth is slower. Well-timed applications of fertilizer nitrogen to pure Basilisk pastures can therefore produce high quality, out-of-season feed. However, the rate of nitrogen application must be geared to the expected stocking rate so that accumulation of old material is minimized; as the age of regrowth increases, there is a decline in the crude protein level accompanied by increases in crude fibre content, and poor animal production will result.

With regard to other measures of pasture quality such as digestibility, intake, and calcium and phosphorus levels, Basilisk is adequate and appears comparable with other sown grasses suited to moist tropical areas. However, as with other grasses, digestibility falls with increasing maturity of the pasture.

Local recommendations for maintenance fertilizer application should be followed. These have been discussed in 'Maintenance fertilizer strategies for wet tropics pastures' in the March-April 1978 issue of the *Queensland Agricultural Journal*. A copy of this journal can be obtained from district advisers.

## Productivity

In cutting experiments, Basilisk has performed well compared with a wide range of other perennial grasses at South Johnstone and other sites in north Queensland. Dry matter yields can be increased by lengthening the cutting interval, but animal production would suffer because of the accompanying fall in pasture quality.

The production of herbage per unit of fertilizer nitrogen is high in Basilisk. Fertilizer nitrogen applications can be used to adjust dry matter yields, within limits, to meet anticipated feed requirements. The additional high quality, out-of-season feed growth can therefore increase animal production.

This has been demonstrated in grazing experiments at South Johnstone, which recorded the high beef production that is possible if Basilisk pastures receiving fertilizer nitrogen (N) are used intensively. With a constant heavy stocking rate of 4·55 beasts per ha and 196 kg N per ha year, liveweight gains of 1 030 and 869 kg per ha were recorded in 1965/66 and 1967/68 respectively. These compared with 740 and 693 kg per ha at 3·45 beasts per ha and the same fertilizer, and 592 and 553 kg per ha at 3·45 beasts per ha and no fertilizer nitrogen.

In another grazing experiment in northern Cape York Peninsula, Basilisk compared favourably with common guinea grass (*Panicum maximum*). This was particularly so at high stocking rates and low rates of phosphate fertilizer, where guinea grass pastures became overgrazed and required destocking.

## Weeds

Basilisk is an ideal grass for smothering weeds. Its dense vigorous growth, marked response to fertilizer nitrogen, and rapid recovery following heavy stocking enable it to compete successfully with most weeds.

## Pests and diseases

Basilisk is relatively free of pest and disease problems particularly in comparison with pangola grass. Since 1971, pangola grass in the Ingham–Cooktown area of north Queensland has suffered from severe local attacks by a range of pests and diseases, with the result that interest in Basilisk has increased.

## Seed production

Following the release of Basilisk, seed production from the Atherton Tableland and the East Palmerston and Tully areas increased rapidly in response to a growing demand for seed locally and overseas. Small quantities of seed have also been harvested in southern Queensland.

A boom occurred during the period 1974 to 1976 when large quantities of seed were exported to Brazil. This market subsequently collapsed and smaller quantities of seed are now produced in Queensland.

Seed crops can be grown at any time during the warmer months in north Queensland, depending on rainfall and management practice. In years with an early start to the wet season, two crops are possible; the first (and major) one of these is harvested early in the calendar year, and the second ripens in about May. However, when the wet season is relatively short, one seed crop per year is more usual. Harvesting is by 'all-crop' headers, and many commercial crops produce cleaned seed yields of the order of 100 to 200 kg per ha crop.

## Eradication

Because of its dense vigorous growth, Basilisk, on occasions, can become a weed. It has been known to invade existing stands of pasture and smother them out and this is undesirable if the resultant Basilisk pasture cannot be managed intensively so that it is productive and useful. However, it can be readily ploughed out and seedling regeneration should not be a serious problem where annual crops are grown.

# New style carcase evaluation contests

*by D. Llewelyn, Beef Cattle Husbandry Branch and J. P. Nisbet, Slaughtering and Meat Inspection Branch.*

*Interested graziers test their live animal assessment skills at the Warwick Judging contest.*

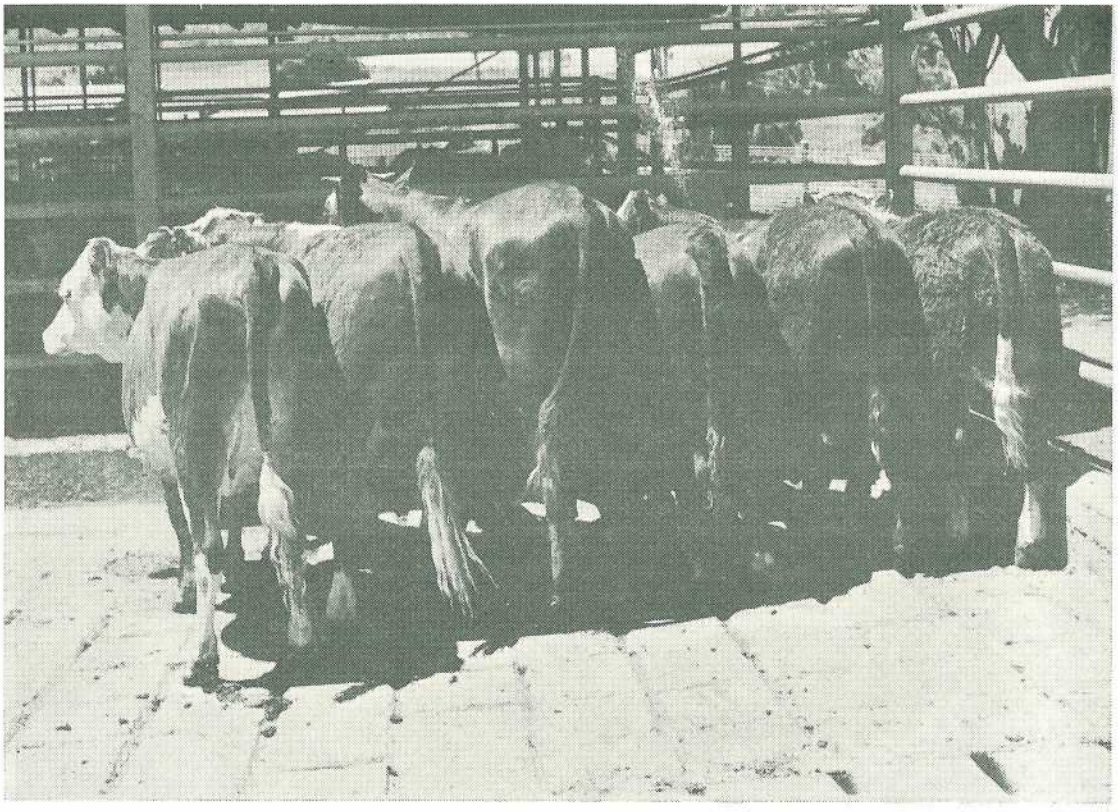
THE ability to assess fat cattle on the hoof in terms of their carcase merit has always been a useful attribute for beef producers to possess.

It will become even more important with the introduction of carcase classification systems into the Australian marketing scene.

Under classification, carcases will be split into groupings according to age, sex, weight and fat cover.

Producers aiming to supply a particular market will benefit by knowing its exact requirements and being able to assess them on the live animal.

Over the years, carcase competitions have served as a good guide in this regard. Greater accuracy in terms of specifications will now be needed for the future, and it is here that 'Live Animal Carcase Judging Competitions' can be useful.



*Can you select the best local trade carcase? It is harder than it looks according to the men who tried it.*

Two such competitions were organized with the Warwick Show and Rodeo Society and Killarney Fat Cattle Exhibition Committee. The contests were seen as an aid to producers in developing the necessary live animal assessment skills for the future. They also attempted to demonstrate the requirements for local trade cattle in the southern downs area.

## The contest

Competitors were asked to judge six specially selected animals and to assess their suitability for the local trade. Assessments were given for carcase weight, muscle development, finish and distribution of fat. The system of scoring is represented in table 1.

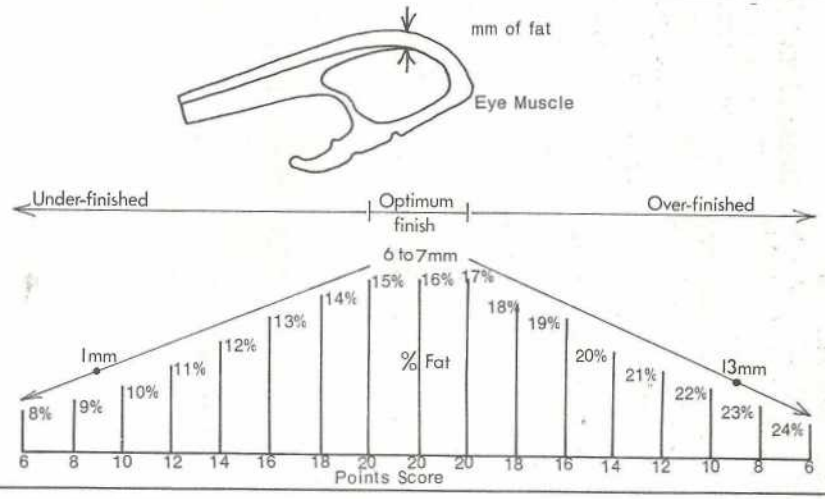
The winner of the competition was the person whose scoring most closely matched the actual carcase assessment scores. Carcases were evaluated using the Australian Beef Carcase Appraisal System (ABCAS) modified to the specifications set for local trade by butchers in the Warwick area.

## What butchers want

It would be fair to state that the ideal carcase for any particular market is one having a maximum amount of muscle, minimum bone and an optimum amount of fat for that market.

Butchers prefer young cattle because the meat is usually tender and customers prefer tender meat. They do not like excess fat because it reduces the yield of salable meat and takes time and money to trim off.

*Table 1*

| | Carcase No. | | | | | | Scoring Guide |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| **Dressed Weight (lbs)** | | | | | | | Hot dressed weight, kidney and channel fat in |
| **Total Muscling** | | | | | | | Exceptional 20-25 Average 9-13<br>Good 14-19 Poor 5-8 |
| **Finish (Fat %)**<br>Over-finished ☐<br>Optimum finish ☐<br>Under-finished ☐ | | | | | | |  |
| **Evenness of Finish**<br>(Fat Distribution) | | | | | | | Excellent 13-15 Fair 8-11<br>Good 11-13 Bad 4-8 |
| | | | | | | | |

A survey of 30 butchers in the Warwick area revealed that requirements were for young steers or heifers between 165 kg (350 lb.) and 205 kg (450 lb.) dressed weight with an optimum finish of 6 to 7 mm (¼ in.) of fat over the rib eye area.

The range of acceptable fat levels can vary between 3 and 10 mm of fat over the eye muscle, even though 6 to 7 mm is the optimum.

## The results

A reasonable cross-section of the industry including a majority of beef producers, with some livestock agents and meatworks' buyers, took part in the competition.

### Dressed weights

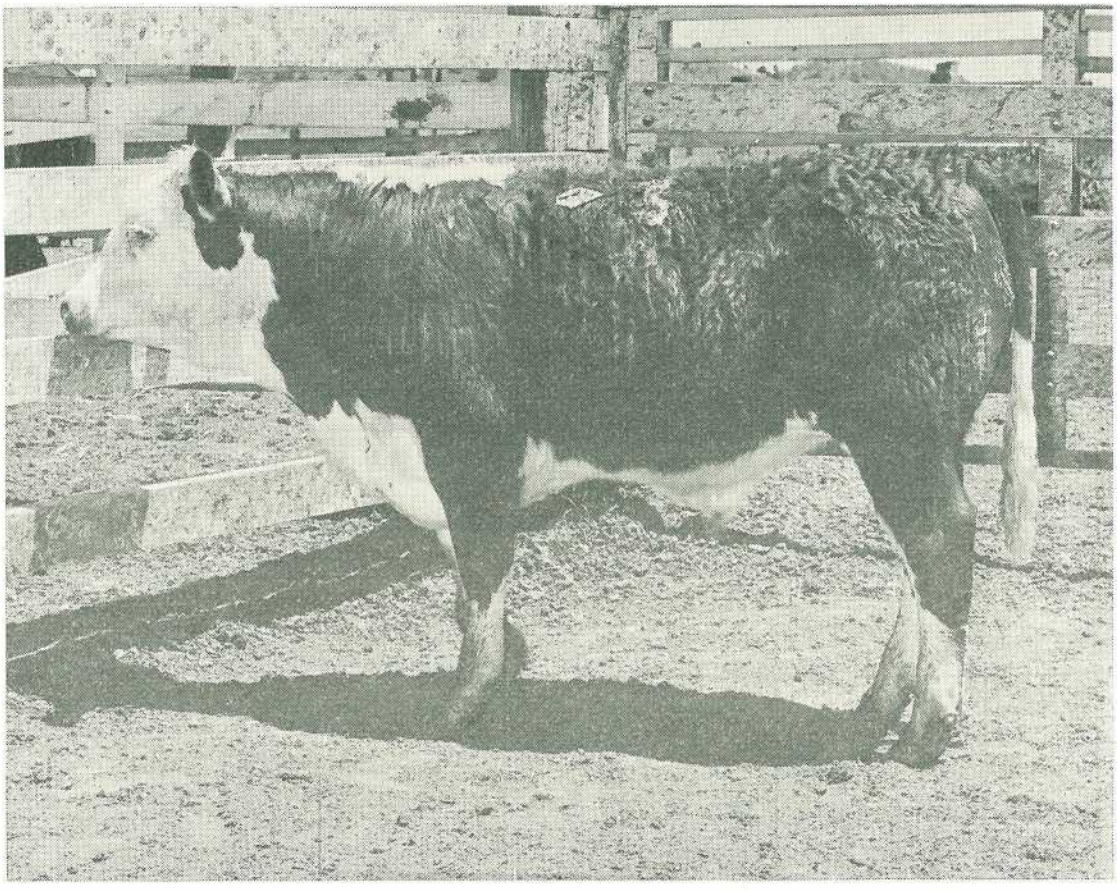
There was a marked tendency to under-estimate dressed weights of cattle.

Of the competitors, 89% under-estimated dressed weights to some extent, while only 11% over-estimated.

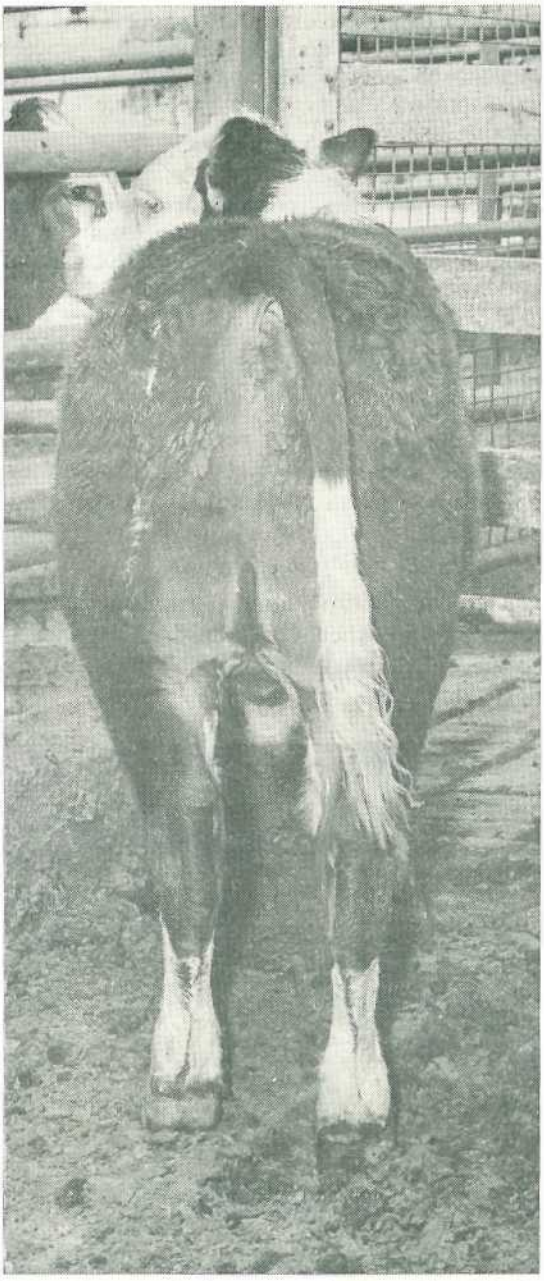
The competitors' accuracy in assessing dressed weights over six head of cattle is shown in the following scale.

DRESSED WEIGHT ASSESSMENTS

Within 11·5 kg—(25 lb.) of dressed wt.—24% of competitors
Within 23 kg—(50 lb.) of dressed wt.—39% of competitors
Within 34 kg—(75 lb.) of dressed wt.—32% of competitors
Over 34 kg—(75 lb.) of dressed wt.— 5% of competitors

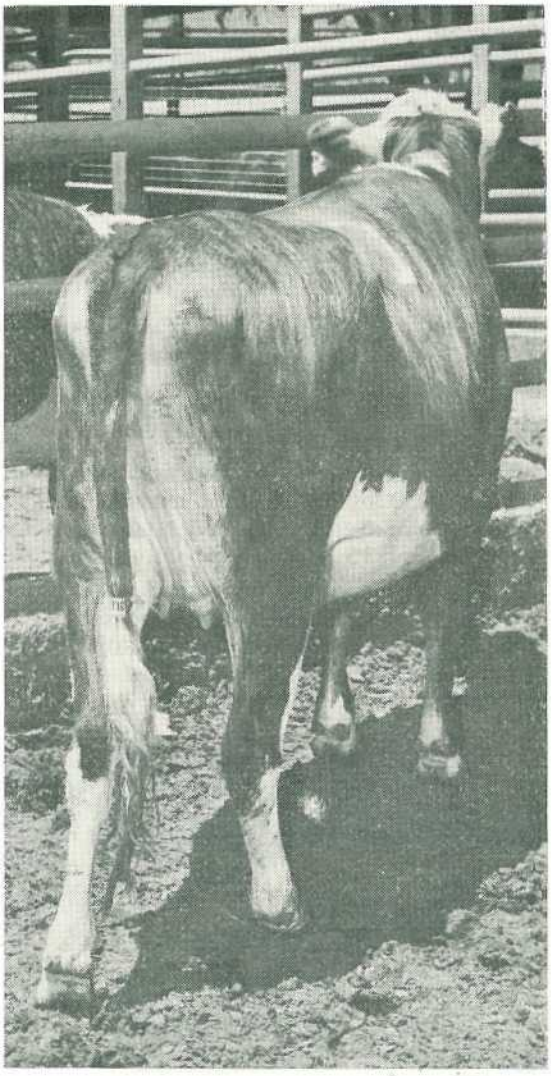


*This steer is an ideal local trade animal. He shows excellent muscling and an ideal finish for butchers' requirements. There is no waste fat to be trimmed off.*



*Width through the lower rounds generally indicates good muscling.*

Competitors were asked to assess hot, dressed weights with kidney and channel fats in. This may have contributed to some degree to the overall under-estimation of dressed weights.



*This heifer is poorly muscled yet overfat—as indicated by the deposits in the pin bone area.*

Of the other three attributes, competitors showed most skill in assessing evenness of finish, and least skill at estimating total muscle development, while the assessment of finish (fat %) was intermediate.

This could well be because the traditional aspects of conformation tend to be most closely associated with evenness of finish or distribution of fat within the carcase.

## Muscling

Points for muscling for each carcase were allocated by halving the total points scored for carcase length and eye muscle on the ABCAS system. This system relates to the overall degree of muscling or amount of salable red meat in the carcase.

While the proportion of muscle in the carcase does not vary nearly as much as the proportion of fat, and muscling measurements still lack some precision, it was evident that many producers do not distinguish between aspects of conformation relating to muscle development, and those reference points relating to finish.

Over half the competitors could only correctly assess less than three animals (in terms of 'poor', 'average', 'good' or 'exceptional' muscling) out of the six that were put up.

MUSCLING SCORE—ON SIX ANIMALS

Correct assessment of 5 or more animals—10·5% of competitors
Correct assessment of 3 or 4 animals—31·5% of competitors
Correct assessment of less than 3 animals—58·0% of competitors

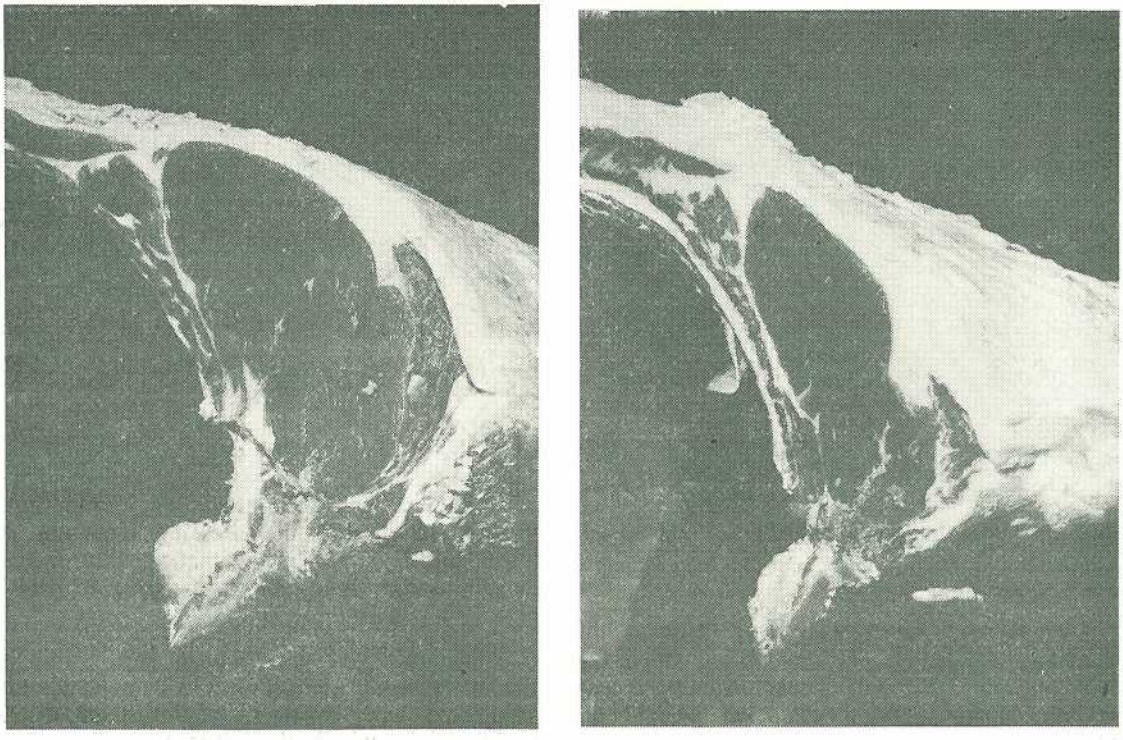
## Finish (fat percentage)

This was based on an average carcase of 182 kgs (400 lbs.) with a fat measurement of 6 and 7 mm over the tenth rib, giving a fat percentage of 15 to 17% as optimum.

Of the competitors, 75% had a tendency to under-estimate actual fat measurements while only 16·6% of competitors over-estimated. There was also 8·4% who showed no marked trend either way.

In other words, most people over-estimated butchers' actual requirements in terms of the amount of finish required for local trade cattle.

The competitors' ability to score animals correctly as either under-finished, optimally-finished, or over-finished, is shown in the next table.



*The left eye muscle shows excellent development with just the right amount of fat cover, while the right eye muscle is poorly developed with excessive and wasteful fat cover.*

FINISH (FAT %) SCORE—OUT OF SIX ANIMALS

Correct assessment of 5 or more animals—15·8% of competitors
Correct assessment of 3 or 4 animals—31·6% of competitors
Correct assessment of less than 3 animals—52·6% of competitors

This is a surprisingly poor result considering that assessments on only three descriptions of finish were used in this case. Admittedly, the optimum category carried a range of only 2 mm of fat and this might be stretching the precision of assessment for anybody at their first attempt in such a competition.

However, the overall result reinforces our opinion that the butchers' idea of an optimum —finished animal and the producers' idea are in fact quite different.

### Evenness of finish

This is an assessment of the distribution of fat over all primal cuts.

Compared to the other two aspects, competitors showed good skill in assessing evenness of finish.

The competitors' ability to place animals into the correct four categories for 'evenness of finish' is shown in the following table. This is the ability to state correctly whether each animal was either 'bad', 'fair', 'good' or 'excellent' in terms of its evenness of finish.

EVENNESS OF FINISH (DISTRIBUTION OF FAT) SCORE—OUT OF SIX ANIMALS

Correct assessment of 5 or more animals—37·8% of competitors
Correct assessment of 3 or 4 animals—48·6% of competitors
Correct assessment of less than 3 animals—13·6% of competitors

## Live animal assessment skills

Carcase evaluation on the hoof is largely a matter of experience. Producers who regularly enter carcase competitions or sell cattle on weight and grade to the meatworks usually have quite good assessment skills.

However, for a long time, many producers have regarded the finished steer as the end product of their endeavours.

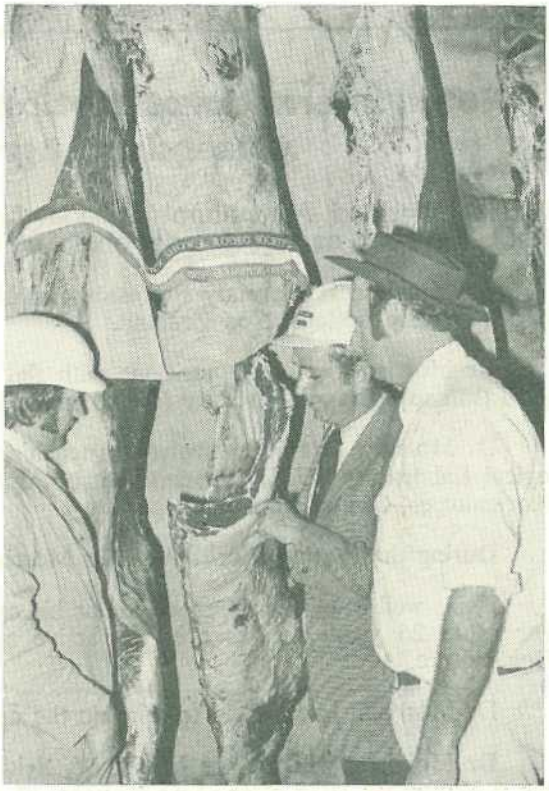
It is fast becoming necessary to think more in terms of producing beef of a certain specification for a particular market. To do this with reasonable accuracy, we must fully develop our live animal assessment skills.

### Assessment of dressed weights

This obviously depends on having a good knowledge of liveweights and the dressing percentage of various classes of cattle.

Knowledge of liveweights will improve with the use of scales both in saleyards and on the property.

Dressing percentages can be markedly affected by variations in feed and water intake and transport as well as the age and condition of the animal.



*The authors, John Nisbet and Dave Llewelyn, discussing carcase points with Mr Bill Gross of Warwick.*

The following figures approximate the normal dressing percentages for cattle at different levels of body condition weighed straight off feed and water.

| Condition | Dressing % (approx) |
|---|---|
| Store steers | 48 |
| Forward store steers | 50 |
| Fat steers | 52 |
| Very fat steers | 54 |

### Assessing muscle development

The generally recognized reference points for muscling include length and thickness, with a wide stance both in front and behind. Greater thickness through the stifle area than through the rump indicates excellent muscling. Very little fat is laid down in the stifle area, however, fatness can disguise poor muscling over the rump.

Forearm thickness and bulging also indicates good muscle development as very little carcase fat is ever deposited there.

### Assessing finish

With respect to fat cover, important visual reference points include the brisket, the flank and again the rear view.

The underline of a steer for local trade requirements should be cut up in the flank. Deep, full flanks are filled with waste fat.

The handling points for assessing finish are over the ribs, especially the back ribs, the point of the shoulder, and the centre of the topline, particularly in the rump area.

### Conclusion

These competitions proved to be most successful in the Warwick district.

However, with slight variation this type of competition could be altered to suit any given trade requirements or classifications as needed for different markets in various areas of the State.

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## Noted international horticulturalist appointed Director, Queensland Agricultural College

THE Queensland Agricultural College Council has approved the appointment of Dr T. M. Morrison as director designate of the College.

Dr Morrison is currently Professor and Head, Department of Horticulture, Landscape and Parks, Lincoln College, New Zealand.

Dr Morrison has held positions with the Department of Scientific and Industrial Research (Soil Bureau), Otago University (New Zealand) and Lincoln College (New Zealand).

Dr Morrison has been involved in teaching and research programs at the ARC Radiobiological Laboratory (U.K.), Department of Agriculture—Oxford University and Department of Floriculture—Cornell University.

During the Second World War, Dr Morrison saw service with the Fleet Air Arm.

He is well known and respected for his contribution to horticultural research and science. For some 25 years he has been an active member of the Royal New Zealand Institute of Horticulture.

Dr Morrison is expected to take up the appointment in January 1979.

Dr Morrison will replace Mr N. W. Briton, C.B.E., the present Director who retires on the 6 November 1978 after some 40 years of service with the College.

# Maize planting guide 1978-79 season

*compiled by S. R. WALSH, Agriculture Branch.*

MAIZE hybrids recommended for planting in the 1978-79 season are listed below.

The hybrids have not been ranked in order of preference. Those listed 'for trial' should only be sown in limited areas to evaluate their performance.

To minimize the risk of loss through adverse seasonal and other conditions, it is suggested that two or more hybrids of maize should be sown.

### Plant populations

The planting rate will be governed by such factors as soil type, variety, climatic conditions, district, planting time and soil moisture.

The plant population for rain-grown crops will vary between 20 000 and 30 000 plants per hectare. The rate should be increased to establish about 50 000 plants per hectare when the crop is grown under irrigation.

Seed is available commercially in a range of shapes and sizes. Selection from this range can be made to suit the type of planting machinery being used.

The size usually ranges between 2 600 to 4 500 seeds per kg.

Most commercial seed companies mark on the container the seed count per kilogram.

APPROXIMATE PLANTING RATE KILOGRAMS PER HECTARE FOR A GIVEN PLANT POPULATION

| Plants/ha | Seed kg/ha | | | |
|---|---|---|---|---|
| | 2 500 seeds/kg | 3 000 seeds/kg | 3 500 seeds/kg | 4 000 seeds/kg |
| 15 000 | 6·5 | 5·5 | 4·75 | 4·0 |
| 20 000 | 9·0 | 7·5 | 6·0 | 5·5 |
| 30 000 | 13·0 | 11·0 | 9·5 | 8·0 |
| 50 000 | 22·00 | 18·5 | 15·8 | 14·0 |
| 60 000 | 26·0 | 22·0 | 19·0 | 16·5 |

## DISEASE

The main diseases affecting maize are leaf blight, head smut and maize dwarf mosaic.

### Common leaf blight

The fungus *Drechslera turcica* produces grey or light-brown, large, spindle-shaped leaf spots commonly up to 15 x 2 cm in size. A description and colour plate of this disease appeared in the August 1974 edition of the *Queensland Agricultural Journal*. Late maturing hybrids have effective blight resistance. These include the QK, PQ, and GH hybrids. Mid season and early maturing hybrids with moderate resistance to the disease include Q739 and XL389. The reaction of some recently released hybrids is unknown and, in south-east Queensland, XL81 is no longer resistant to common leaf blight due to the development of a second strain of the fungus.

### Maydis leaf blight

Maydis leaf blight (*Drechslera maydis*) is restricted to north Queensland. The change by seed producers from using T cytoplasm to N cytoplasm has effectively controlled this disease in south Queensland.

### Head smut

In north Queensland and certain areas of the South Burnett region, head smut caused by *Sphacelotheca reiliana* is prevalent. Grain yields may be seriously reduced in crops with a heavy infection because the grain is replaced by a mass of fungal spores.

Seed treatments may destroy externally borne spores on the seed but will not protect a crop against infection from smut in infected soil.

The reaction of all hybrids is not known. But those least susceptible to this disease include XL81, XL389, Q739, Q1280 and GH128, XL99, XL399 and the QK lines QK413 and QK487.

### Maize dwarf mosaic

This disease can be present in many south Queensland maize crops if susceptible hybrids are grown. Maize dwarf mosaic is caused by infection with the Johnson grass strain of sugarcane mosaic virus which is transmitted by aphids.

Infected plants of susceptible hybrids show conspicuous stripes or mosaic and ringspot patterns. Severe stunting may result, particularly when plants are infected early. The virus is maintained between seasons in Johnson grass and stand-over fodder sorghum.

Disease control cannot be effectively achieved with insecticides and Johnson grass cannot be economically eradicated in all situations. Control of the disease is achieved by sowing resistant hybrids. Recommended hybrids with resistance to maize dwarf mosaic are listed below—

Highly resistant: Q692, Q739, QK217, QK231, GH128, Q1280

Moderately resistant: GH390, PQ500, XL306, XL81, XL389, XL399, XL99, RX204, Sergeant.

### Wallaby ear

This disease is associated with infestation by a small, pale-coloured leafhopper and is generally more severe in late plantings in coastal districts.

Affected plants are dark green and stunted. The leaves stand out stiffly at sharp angles to the stalk and the veins on the under surface are very prominent. Ear development on severely affected plants is very poor.

The following hybrids have been the most susceptible in Departmental trials: XL99, XL399, Q1280, GH128. The reaction of some of the more recently released hybrids is unknown.

### Maturity

Hybrids may vary in maturity depending on the environment in which they are sown.

The recommendations are basic information only and further details should be sought from your local Agricultural Extension officer.

| Region | Planting Time | Hybrids |
|---|---|---|
| **Far Northern** | | |
| Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Etheridge, Hinchinbrook Shires | Dec–mid Feb | M: QK 217, QK 231, QK 487 (QK413, QK487 for severe head smut areas)<br>*For trial*<br>M: QK690, QK694 |
| **Northern** | | |
| Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires | *Irrigated*<br>Mar–Jul | MS: XL99, XL399,<br>M: XL81<br>*For trial*<br>M: Sergeant |

| Region | Planting Time | Hybrids |
|---|---|---|
| **Capricornia** | | |
| Livingstone, Fitzroy, Calliope, Broadsound Shires | Dec–Jan | S: Q692<br>M: QP500, XL81<br>MQ: Q739<br>*For trial*<br>M: Sergeant |
| Banana, Duaringa Shires .. .. .. | Dec–Jan<br>end Dec–end Jan | S: GH390<br>MS: XL99<br>M: XL81, Sergeant |
| **Burnett** | | |
| Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, Part Biggenden, Hervey Bay, Part Tiaro, Woocoo Shires | late Aug–early Sep | S: Q1280, GH128<br>GH390, GH134<br>MS: XL99<br>M: XL81, DK805A<br>*For trial*<br>M: Sergeant |
| Gayndah, Mundubbera, part Biggenden Shires | late Aug–early Sep<br>mid Nov–early Jan | MS: XL99, XL399<br>M: XL81, Sergeant |
| Eidsvold, Monto Shires .. .. .. .. | mid Nov–early Jan | MS: XL99, XL399<br>M: XL81, Sergeant |
| **South Burnett** | | |
| Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires | mid Nov–mid Dec .. .. | MS: XL99, XL399<br>M: XL81, Sergeant |
| **Near North Coast** | | |
| Widgee, Noosa, part Tiaro, Maroochy, Landsborough Shires | Nov–Jan | S: GH390<br>MS: XL99, XL399<br>M: XL81, Sergeant |
| **East Moreton** | | |
| Caboolture, Pine Rivers, Redlands, Albert, Beaudesert Shires | Sep–Dec | S: Q1280, GH128, GH390<br>M: XL81<br>MQ: Q739<br>*For trial*<br>M: Sergeant |
| | Sep–Dec | |
| **West Moreton** | | |
| Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires | Sep–Dec | S: Q1280, GH128, GH390<br>M: XL81<br>*For trial*<br>M: Sergeant |
| | Sep–Dec | |
| **Darling Downs** | | |
| Wambo, Chinchilla Shires .. .. .. | Sep–Nov | S: Q692<br>MS: XL99, XL399<br>M: XL81, Sergeant<br>PQ500<br>MQ: Q739, XT664<br>Q: XL306 |
| | Oct–Dec | M: XL81, PQ500<br>MQ: Q739, XT644<br>Q: XL306<br>*For trial*<br>M: RX 204 |
| | Sep–Nov | |



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| Region | Planting Time | Hybrids |
|---|---|---|
| **Darling Downs** (cont'd) | | |
| Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie Shires | Oct–Dec | MS: XL99, XL399<br>M: XL81, Sergeant<br>PQ500<br>MQ: XL347<br>Q: XL306 |
| Clifton, Allora, Cambooya, Rosenthal, Glengallan Shires | Oct–Dec | MS: XL99, XL399<br>M: XL81, Sergeant, PQ500<br>Q: XL306 |
| | | *For trial* |
| | Oct–Dec | M: RX79 |
| Stanthorpe Shire .. .. .. .. .. | Nov–Dec | M: XL81, Sergeant |
| | *Irrigated*: (All Darling Downs Shires) | |
| | Oct–Dec | S: Q692<br>MS: XL99, XL399<br>M: XL81, Sergeant<br>PQ500<br>MQ: Q739 |
| **Near South West** | | |
| Balonne Shire | *Irrigated only* | |
| | Oct–Dec | MS: XL99, XL399<br>M: XL81 |

KEY—
S=Slow maturity;
M=Medium maturity;
Q=Quick maturity;
MS=Medium slow maturity;
MQ=Medium quick maturity

## Queensland Pocket Year Book now available

THE 1978 edition of the Queensland Pocket Year Book is now available. This popular, all-purpose reference book is compact yet contains 172 pages of information on all major facets of the economic and social life of Queensland—population, education, health, government, prices, labour, earnings, agriculture, industry, retail trade etc.

This publication is available from The Deputy Commonwealth Statistician, Statistics House, 345 Ann St., Brisbane, Q. 4000. The price is 70 cents plus 35 cents postage.

ABOVE. Mr Peter Venamore and Mr George Bowhay examine crop damage at 'Buckinbah'.

BELOW. The electric fence at 'Buckinbah'—note the pig tracks outside the fence.

# Don't let feral pigs eat your profit

*by P. C. Venamore, Beef Cattle Husbandry Branch and W. D. Hamilton, Agriculture Branch.*

FERAL pigs can cause devastation in many crops. In the past few years, some grain sorghum crops in the St. George district have been totally wiped out.

An attempt has been made to halt their destruction by the use of an electric fence.

## The property

Mr George Bowhay of 'Buckinbah', St. George, has recently developed a new area for irrigated cropping. The area farmed is east of the St. George Irrigation Area and water is supplied from Buckinbah Weir which is part of the supply system for the St. George Irrigation Area.

## The crop

After timber clearing, the new area was ploughed several times, scarified, land planed and furrowed out. Some 45 kg per ha of nitrogen fertilizer as anhydrous ammonia were applied before the area was planted to sorghum.

The variety used was Yates NK233 and it was planted in January. Adequate rainfall was received for most of the season and only two irrigations were applied. Two applications of monocrotophos were applied at flowering for midge control. The crop had a yield potential in excess of 5 t per ha.

## The problem

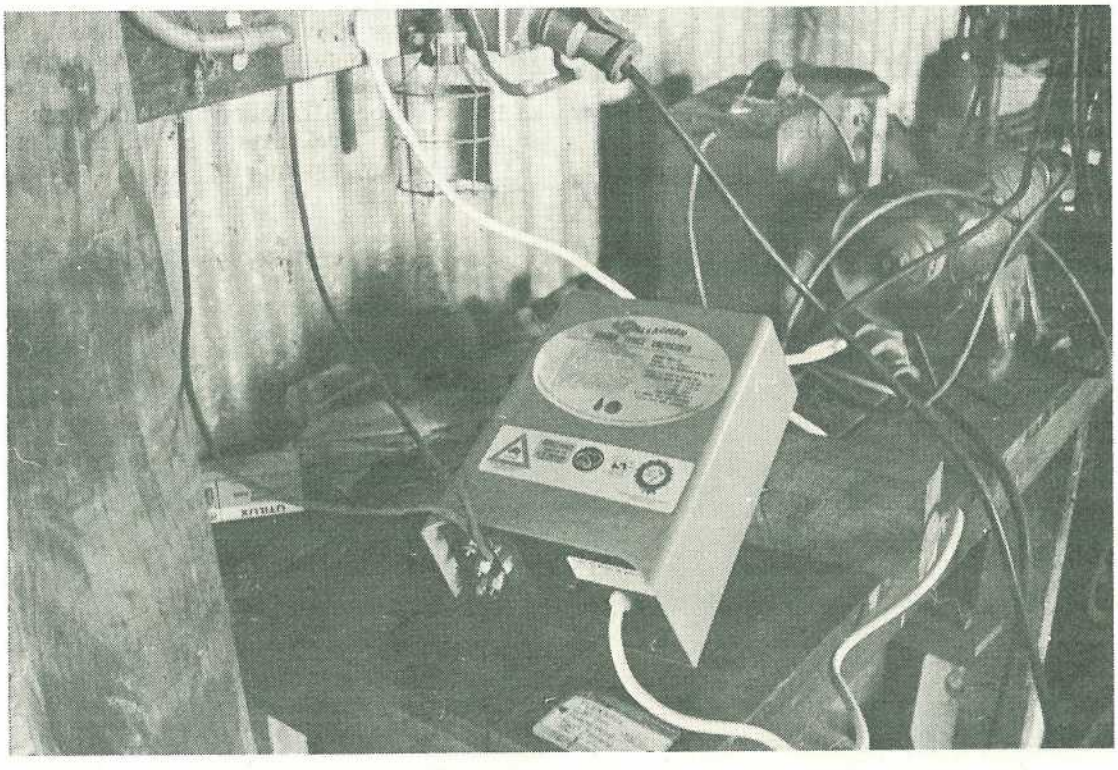
As flowering commenced, Mr Bowhay discovered that feral pigs were destroying large areas of crop. As this was the only sorghum crop in the vicinity, hordes of feral pigs travelled in to devour the crop.

It was an ideal feeding ground for them as there was adequate water and protection. Control methods such as poisoning, shooting and trapping had not proved successful so Mr Bowhay decided to erect an electric fence.

## The attempted solution

A grader was used to clear and level the fence line around the crop. An electric fence was erected using 16 guage high tensile wire, old railway sleepers as strainers and 'pig-pegs'. The hardwood pig-pegs measured 5 x 2·5 x 60 centimetres, and were drilled and pointed.

The wire spacings from ground level were 10, 12·5 and 15 centimetres, with the electrified wires placed top and bottom. Strainer posts were spaced 300 metres apart and pig pegs at 10 metres (see figure 1). The distance around the paddock was 4 kilometres, with the power unit being a 240 volt Gallagher energizer.



*The 240 volt Gallagher energizer set up in a nearby shed.*

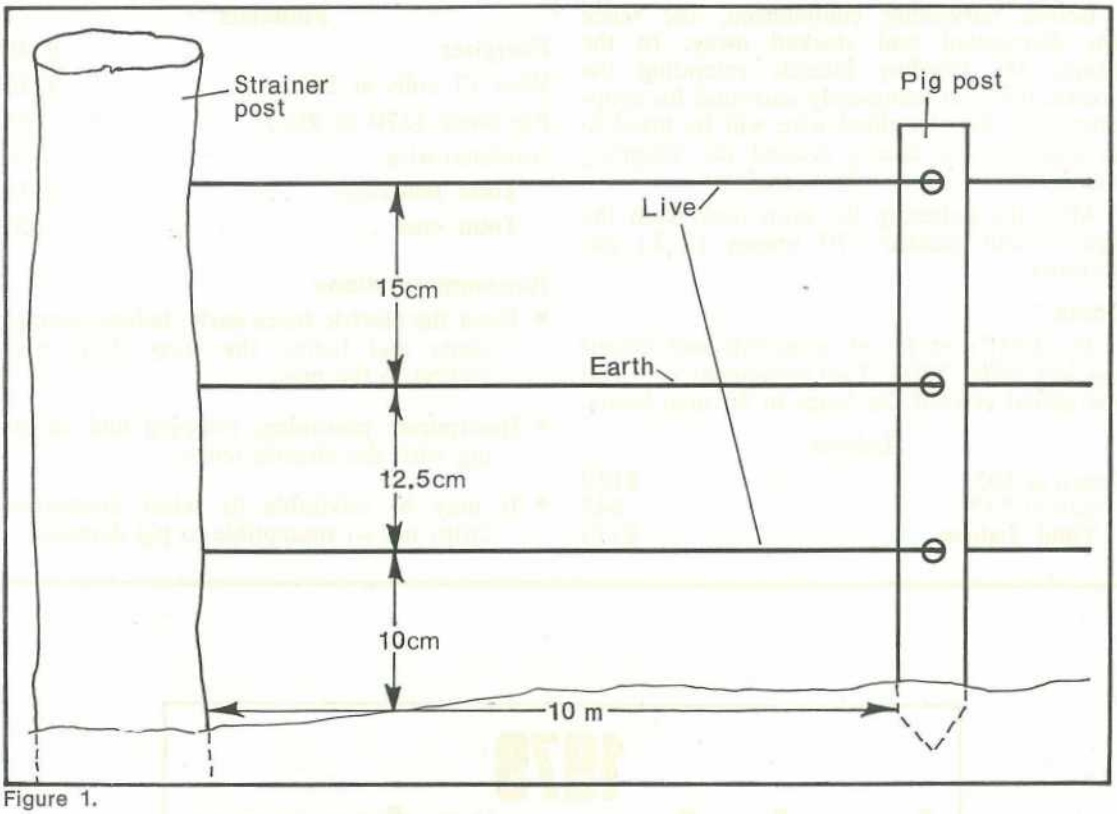
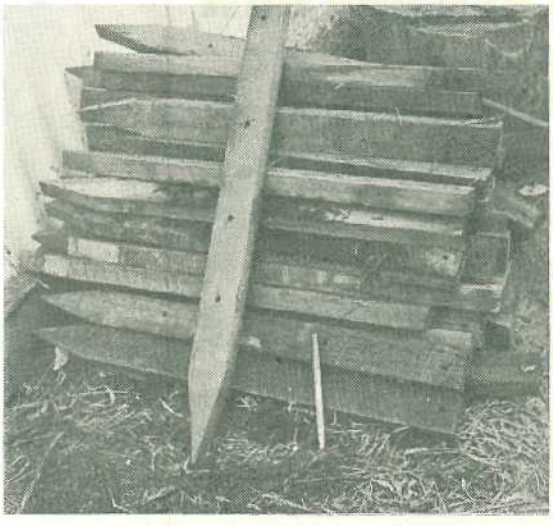


Figure 1.



*'Pig-pegs'—the pegs were put in the ground up to the bottom hole.*

The fence maintained a high current and only reduced in efficiency when a few porcupines were found across the bottom wire. Four steel posts were used to maintain good earthing in the fence.

The electric fence was effective in preventing pigs entering the crop. At times, many pigs were seen walking along the fence line but made little effort to go through the fence. Also, there was no evidence of pigs trying to burrow under the fence. Piglets would touch the wires, bounce back and run away squealing.

Very little damage to the fence occurred, in fact, the only maintenance necessary was to straighten a few pig pegs.

It must also be mentioned that due to crop density, some pigs were fenced in and therefore shooting was incorporated in an effort to stop further crop damage. In Mr Bowhays' opinion, about 28 hectares were destroyed out of a total area of 75 hectares.

Before harvesting commenced, the fence was dismantled and stacked away. In the future, Mr Bowhay intends extending the electric fence to completely surround his cropping area. An electrified wire will be fitted to all conventional fences around the cropping area by means of an offset insulator.

After the battering the crop took from the pigs, it still yielded 170 tonnes (2·3 t per hectare).

## Costs

The total cost for all materials and labour was just under $600. Two permanent men and one casual erected the fence in 40 man hours.

**Labour**

| | |
|---|---|
| 2 men at $65 | $130 |
| 1 man at $45 | $45 |
| **Total Labour** | $175 |

**Materials**

| | |
|---|---|
| Energizer | $140 |
| Wire (7 coils at $30) | $210 |
| Pig posts (270 at 20c) | $54 |
| Insulated wire | $10 |
| **Total materials** | $414 |
| **Total cost** | $589 |

## Recommendations

- Erect the electric fence early, before damage starts and before the crop offers protection to the pigs.
- Incorporate poisoning, trapping and shooting with the electric fence.
- It may be advisable to select alternative crops not so susceptible to pig damage.

# Quality assurance

THE development of 'Quality assurance' can be followed from the start of the century.

The first step started with operator quality control where one operator was responsible for the quality of his products. The early 1900s brought foreman quality control, where one man, the foreman, assumed total responsibility for the product produced by his people.

World War I brought inspection quality control, where full time inspectors examined final product quality on almost a continuous basis.

World War II brought statistical quality control where a certain percentage or fraction of the final product was examined—the individual units selected either at random or by some pre-determined pattern (for example, the first box off every second pallet etc.).

Unfortunately, to this day, some sections of the food industry still regard quality control in this light—a mere sorting programme—separating substandard from satisfactory produce.

All of these methods of 'control' refer only to the final product. Satisfactory produce was made available to the market, while the unsatisfactory product was disposed of in the best and cheapest way available to the manufacturer. None of the methods attempted to improve the yield of satisfactory produce or reduce the costs associated with wastage.

Gradually, however, greater control of manufacturing processes, within the factory, is becoming more evident and more recently the term quality assurance is being heard quite frequently.

*by Patricia C. Loane, formerly of Dairy Research Branch.*

This term, although used by the media, manufacturers, consumers and public in general, does not appear to be fully understood. It is interchanged indiscriminately with quality control.

Quality control in fact refers to actual in-factory inspection and laboratory testing to ensure that the final product, as it emerges from the production line, meets quality specifications.

Quality assurance on the other hand, has been called TOTAL quality control. It refers to all functions and all facets of management, that is, it embraces the entire manufacturing process. It is a totally integrated and co-ordinated approach to quality.

There are three major areas involved in quality assurance:

- Careful selection of raw ingredients.
- In-factory control of manufacturing processes.
- Control of storage and distribution practices.

It must be emphasised, however, that the objective of total quality control is cultivating an attitude in ALL personnel in the organization toward

- Improving the standard of quality.
- Increasing the confidence or assurance of achieving this standard.
- Using the most efficient and economical means available.

Practice has demonstrated that this constant and overall surveillance or control of all facets of the manufacturing process results in marked and appreciable savings associated with reductions in:

- Delays and stoppages due to equipment and plant break-down.
- Delays and stoppages due to lack of adequate training of factory operatives.
- Delays and stoppages due to quality problems (for example of raw or initial ingredients).
- Scrap, rectification, downgrading and/or re-inspection of product.

- Complaints, replacement, customer compensation.
- Loss of customer good-will, loss of employee morale.

Obviously, paralleling these reductions in costs is the increase in a manufacturer's assurance that his product will comply with market or customer specifications. With this assurance comes bargaining power, increase in market share, customer goodwill, and increase in sales.

In 1972, the Dairying Research Committee made available to the Otto Madsen Dairy Research Laboratory a grant to formulate sampling programmes to increase our manufacturers' assurance of meeting Japan's specifications for coliform-free butter and cheddar cheese.

Coliforms are organisms that are destroyed by pasteurization temperatures. Their presence in processed products is an indication of post-pasteurization contamination and poor factory hygiene. As a result, food products are registered or discounted in price if they are found to contain these organisms. The investigations that ensued involved examining the entire manufacturing processes of both products. The objective was to identify those sampling sites that would enable prediction, at the point of manufacture, of final product quality—in these cases—in terms of coliforms present.

## Butter (coliform-free)

There are two important sampling points—the initial heat-treated cream and the buttermilk:

- Coliforms in the initial heat-treated cream result in coliforms in the final butter. The quality of the initial cream cannot be over emphasised.
- The buttermilk proves to be most reliable in predicting bacteriological quality of the finished butter (that is, if there are coliforms in the buttermilk, there will be coliforms in the final butter). Buttermilk quality could also be used as an indicator of equipment sanitation during production.

There is no threshold value or level of tolerance for coliforms at either sampling point. Both samples should be free of coliforms.

## Cheddar cheese (coliform-free)

There are again two important sampling points—the vat after all the additions of starter, rennet, etc., (just before setting) and the cheese at 1-day-old:

- Any contamination in the vat (before setting) results in large numbers of coliforms in the final curd and in the cheese after 4 weeks of storage.
- The 1-day-old cheese or the final curd (just before salting) if contaminated with *E. coli I* means that the cheese after 4 weeks and sometimes even after 6 months of storage will still be positive for this type of coliform.

It was found that the whey sampled during manufacture cannot be relied upon to predict the quality of the final cheese. Any whey sample tested for coliforms is therefore a wasted sample.

These two sampling programmes demonstrate how assurance can be achieved in one small area of total quality control. Being able to predict, virtually at the point of manufacture, the quality of the final product increases assurance of compliance while minimizing costs of analyses and extensive final product testing.

# Sampling seeds

*by T. J. Brewer, Standards Branch.*

CARE should be taken in sampling all seed lines.

Most lines contain some other seeds and impurities which can vary throughout the lot and, as a result, influence the sample.

'Seed' is usually distinguished from 'grain' by the manner in which it is used. Grain is generally produced for milling, oil expression, stock feeding or human consumption.

When coarse grains and oil seeds are required for planting a new crop, seed is selected from crops possessing desirable physical attributes such as high yield, freedom from disease and freedom from prohibited or harmful contaminants. This seed is often treated with chemicals for insect or disease control and should not be used for any purpose other than for sowing.

Seeds such as pasture grasses and pasture legumes have little value for milling, oil expression or as processed feed and are therefore used only for sowing. These seeds are generally produced as a by-product of pasture production.

Seed for planting can be sampled for a number of reasons. The two most important are:

- To determine the planting value of the seed.
- As a basis for commercial transactions at various times between harvest and planting.

*Seed testing is a Government service to agriculture in Queensland and is carried out by the Standards Branch Seed Testing Laboratory.*

Seed testing is a government service to agriculture in Queensland and is carried out by the Standards Branch Seed Testing Laboratory at Meiers Road, Indooroopilly and at the Toowoomba Seed Testing Laboratory at Tor Street, Toowoomba. These laboratories undertake purity and germination testing of seed samples for farmers, merchants and governmental officers.

There are no limitations on who may draw samples or on the manner in which they may be drawn. However, a sound knowledge of sampling procedures and sampling intensity is essential if the results which are obtained from the sample are to have any significant value.

In a number of instances, seed samples are drawn by Departmental Officers or Authorized Officers of Commodity Boards. These officers are trained in all aspects of seed sampling and the authority vested in them by their position gives samples drawn by them a greater value. These officers regularly draw samples of seed offered for sale or distributed by Boards to ensure that high seed quality is maintained.

Private persons including farmers and seed merchants can draw and submit samples for their own use. These samples carry no official status.

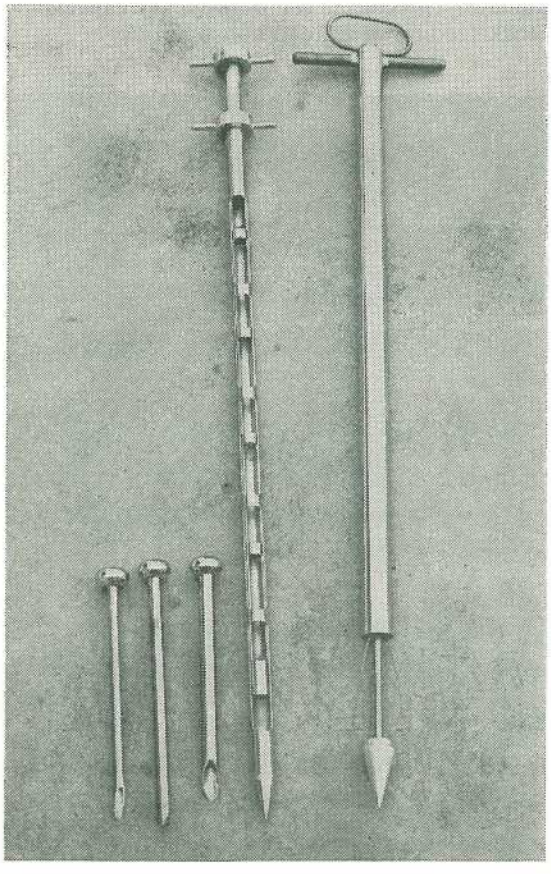
The equipment required for seed sampling varies in accordance with factors such as the kind and size of the seed and the type of package or bulk container.

In most cases, seed is contained in bags which are best sampled with the use of a seed trier. Several different types of triers are available for the purpose. Chaffy seeds such as buffel grass which are not free-flowing are sampled with a special trier, which has been designed especially for that purpose.

If a suitable trier is not available, a representative sample can be drawn by hand. The method is simply to make a fist and insert the closed hand into the seed, open the fingers in order to obtain a portion, then close the fingers. The hand is withdrawn ensuring that the fingers remain tightly closed about the seed so that none escapes.

When seed is being cleaned or handled in such a way as to be presented in a constant stream, a representative sample can be drawn directly from this stream. This method of sampling is the most convenient and should provide an accurate and representative sample.

The composite sample is made up from a number of primary samples. The manner in which these primary samples are drawn and the intensity at which they are drawn affects the validity of the sample. It should be noted that in all cases the accuracy of the results of any analyses of seed samples can be no better than the degree to which the samples represent the bulk from which the samples were drawn.



*Specially-designed triers are available for sampling different seeds.*

These primary samples must be drawn from a sufficient number of bags to ensure representative selection. The minimum number of bags to be sampled or the comparative sampling intensity of a bulk lot is as follows:

### Bagged seed

(Bags or containers of similar size)

| | |
|---|---|
| 1 to 5 packages . . | Sample each package taking not less than five primary samples. |
| 6 to 30 packages . . | Sample at least each third package but never fewer than five packages. |
| 31 packages or more | Sample every fifth package but never fewer than ten packages. |

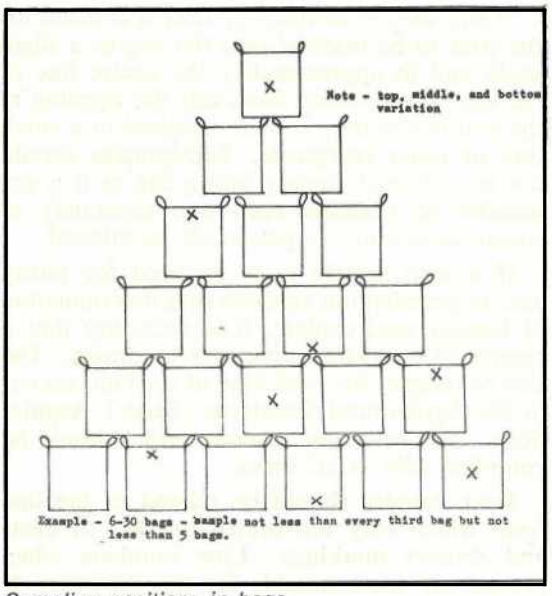
### Bulk seed

(Seed held in bulk bins, wagons, heaps, or streams of seed during handling)

| | |
|---|---|
| Up to 500 kg . . | At least five primary samples except that for very small lots (50 kg) fewer but not less than three samples need be taken. |
| 501 to 3 000 kg . . | One primary sample for each 300 kg but not less than 5 primary samples. |
| 3001 to 20 000 kg . . | One primary sample for each 500 kg but not less than 100 primary samples. |

If more than 20 000 kg is contained in a seed line, the seed should be divided into separate lots of not more than 20 000 kg and each lot sampled separately.

Seed by its nature is not homogeneous in that it is made up of a collection of particles of various sizes. The different rates of movement of these particles particularly in transit can cause segregation. For this reason, primary samples should be drawn from the top, bottom, and middle of alternate bags as they are sampled. Seed held in bulk should have primary samples drawn at varying depths not just from the top layer.




*Sampling positions in bags.*

Primary samples should be approximately equal in size and each should be examined at the time of sampling to ensure that there is no apparent variation. If variation is apparent, that portion of the total (that is, bag or bin from which that primary sample was drawn) should not be included in that line but be considered to be a different lot and sampled separately.

It is essential that only seed from the same source be grouped into a line. If it is apparent that two or more separate lines may be present in a seed lot, indicated by markings or different types of bags, each should be sampled separately.

When all the primary samples are bulked together, the quantity may be greater than is required for the composite sample. In this case, the seed is thoroughly mixed and divided by quartering until a sample of suitable size is obtained.

Equipment used in seed sampling such as triers, scoops, etc., should be thoroughly cleaned at the completion of sampling each line in order to prevent the possibility of contamination.

When seed is sampled by trier it is usual for the trier to be inserted into the bag at a slight angle and to approximately the centre line of the bag. Seed which flows out the opening at the end of the trier is then collected in a small tray or other receptacle. Sub-samples should not be collected directly into a bag as it is not possible to examine each one separately to ensure uniformity as previously mentioned.

If a seed sample is to be used for purity and/or germination analyses or a determination of foreign seed content, it is necessary that a sample of a recommended size be drawn. The size of samples for each kind of seed are set out in the Agricultural Standards (Seeds) Regulations. This minimum sample weight should be complied with at all times.

Seed samples should be related to the line from which they are drawn by way of clear and distinct markings. Line numbers when present are most suitable for this purpose. If no line identification is present, it is recommended that all bags and the sample be marked with a corresponding number or letter. This practice will be of value if more than one person is involved in evaluating the seed from any results which are obtained.

If seed samples are drawn for the purpose of moisture determination, it is essential that they be placed in a moisture-proof container immediately after sampling. Tins with press-on lids have been found to be quite suitable. It should be noted that polythene bags are not sufficiently moisture-proof for this purpose.

When samples are drawn for the purposes of a complaint under the provisions of Section 75 of the Agricultural Standards (Act) 1952–1972, all provisions of that section must be complied with in all respects.

### Hints on Sampling

- Ensure that all bags to be sampled are from the same source and are of the same lot.
- Ensure that all equipment to be used is suitable and clean.
- Ensure that a representative number of bags are sampled and that each sub-sample is drawn from a different position.
- Ensure that the identification of the sample and the seed lot are clearly marked.

## Chick pea—a likely new crop

PURE seed of a commercial chick pea variety for Queensland farmers could be available in 2 or 3 years.

The Department of Primary Industries is already evaluating this new crop at the Hermitage Research Station near Warwick.

Some farmers are keen to grow chick peas on the basis of expected yields and current market prices. The peas are used for culinary purposes.

There are several lines that could have commercial potential. The next step is to produce pure seed of the best of these lines. This could take three or four seasons.

Pure seed production involved selection, roguing and multiplication. If this were not done, growers would lose potential yield because of crop unevenness, and plants with different maturity times and other undesirable characteristics.

The Department hopes to grow chick peas, a winter crop, at Stanthorpe during the summer to speed up pure seed production. Pure seed should be available by 1980 or 1981.

As part of the trial work, the entire Australian chick pea collection had been sown to help with the selection of the best of the available lines. This was also done last year.

Chick peas were not yet grown commercially in Australia.

# Soybean varietal guide 1978-79

*compiled by S. R. WALSH, Agriculture Branch.*

**SOYBEAN varieties recommended for planting in Queensland in the 1978-1979 seasons are listed below.**

December is the main planting time but under some situations this period may be extended from November to January. The crop has critical requirements for cultivation, nutrition, moisture, and weed and insect control.

Plant maturity and plant height are decreased by shortening day length and the planting rate should be increased with the later plantings and the row spacing reduced.

The planting rate should aim at establishing a plant stand of 200 000 to 350 000 plants per hectare. The rate should be increased when sown under irrigation to 400 000 to 450 000 plants per hectare.

The rate will be governed by time of sowing, soil type, variety and local conditions; the lighter rates for early sowing and the heavier rates for late sowing.

Late January plantings in coastal regions should be avoided because of the possibility of rust developing and causing severe losses.

Although Semstar is recommended in certain situations, it is susceptible to bacterial pustule and wildfire; these diseases may cause reductions in yield.

Two soybean varieties, Collee and Flegler, were released by the Department of Primary Industries in 1976. A limited area of Flegler was grown commercially in 1977 and seed supplies of this variety may be restricted in the coming season.

| Region | Planting Time | Varieties |
|---|---|---|
| **Far North Queensland—** Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Hinchinbrook Shires | Dec–mid Jan .. .. | Ross, Improved Pelican, Daintree |
| **North Queensland** Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires | Dec–mid Jan .. .. | Ross, Gilbert |
| **Capricornia** Livingstone, Fitzroy, Calliope, Broadsound Shires | Dec–early Jan .. .. | Davis, Wills |

| Region | Planting Time | Hybrids |
|---|---|---|
| **Capricornia** (con't) | | |
| Emerald Shire | *Irrigated* | |
| | mid Dec–mid Jan .. .. | Wills, Davis |
| | mid Jan–mid Feb .. .. | Davis |
| | *Raingrown* .. .. .. | not recommended |
| Banana, Duaringa Shires | *Irrigated* | |
| | Dec .. .. .. .. | Davis, Wills, Flegler |
| | early–mid Jan .. .. | Davis, Flegler |
| | *For trial* | |
| | early Dec .. .. .. | Collee |
| | *Raingrown* | |
| | Dec .. .. .. .. | Davis, Flegler, Wills |
| | early–mid Jan .. .. | Davis, Flegler |
| **Burnett** | | |
| Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, Biggenden, Hervey Bay, part Tiaro, Woocoo Shires | Dec–early Jan .. .. | Davis, Bragg, Wills |
| Gayndah, Mundubbera Shires .. .. .. | Dec–early Jan .. .. | Davis, Semstar |
| | *For trial* | |
| | Dec–early Jan .. .. | Flegler |
| Monto, Eidsvold Shires .. .. .. .. | Dec–early Jan .. .. | Davis, Wills, Semstar |
| | *For trial* | |
| | Dec–early Jan .. .. | Flegler |
| **South Burnett** | | |
| Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires | late Nov–early Jan .. | Davis, Bragg, Semstar |
| | *For trial* | |
| | late Nov–early Jan .. | Flegler |
| **Near North Coast** | | |
| Widgee, Noosa, part Tiaro, Maroochy, Landsborough Shires | mid Nov–end Dec .. .. | Wills, Bragg |
| | *For trial* | |
| | mid Nov–end Dec .. .. | Flegler |
| | mid Nov–end Jan .. .. | Davis, Semstar |
| **East Moreton** | | |
| Caboolture, Pine Rivers, Redlands, Albert Shires | mid Nov–mid Jan .. .. | Davis, Bragg, Wills, Collee |
| | *For trial* | |
| | mid Nov–mid Jan .. .. | Flegler |
| **West Moreton** | | |
| Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley, Beaudesert Shires | *Irrigated* | |
| | Dec–early Jan .. .. | Davis, Bragg, Wills, Collee |
| | *For trial* | |
| | Dec–early Jan .. .. | Flegler |
| | *Raingrown* | |
| | Nov .. .. .. .. | Collee |
| | Nov–early Jan .. .. | Davis, Bragg, Wills |
| | late Jan .. .. .. | Davis |
| | *For trial* | |
| | Nov–early Jan .. .. | Flegler |
| **Darling Downs** | | |
| Wambo, Chinchilla Shires | *Irrigated* | |
| | Nov–Dec .. .. .. | Davis, Bragg, Collee |
| | *For trial* | |
| | Nov–Dec .. .. .. | Flegler |
| | *Raingrown* | |
| | Nov–Dec .. .. .. | Semstar |
| Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie, Cambooya Shires | *Irrigated* | |
| | Nov–Dec .. .. .. | Davis, Bragg, Collee, Hill |
| | early Jan .. .. .. | Davis |
| | *For trial* | |
| | Nov–Dec .. .. .. | Flegler |
| | *Raingrown* | |
| | Nov–Dec .. .. .. | Collee, Hill |

| Region | Planting Time | Varieties |
|---|---|---|
| **Darling Downs** (cont'd) | | |
| Clifton, Allora, Rosenthal, Glengallan Shires | *Irrigated* | |
| | Nov–Dec .. .. .. | Davis, Bragg, Collee |
| | *For trial* | |
| | Nov–Dec .. .. .. | Flegler |
| | *Raingrown* | |
| | Nov–Dec .. .. .. | Davis, Bragg, Collee |
| | early Jan .. .. .. | Davis |
| | *For trial* | |
| | Nov–Dec .. .. .. | Flegler |
| Stanthorpe Shire .. .. .. .. .. | Nov .. .. .. .. | Davis, Wills, Collee, Hill |
| | Dec .. .. .. .. | Davis, Collee, Hill |
| Inglewood Shire | *Irrigated* | |
| | late Nov–Dec .. .. | Davis, Bragg, Wills, Collee |
| | early Jan .. .. .. | Collee |
| | *For trial* | |
| | late Nov–Dec .. .. | Flegler |
| | *Raingrown* .. .. .. | not recommended |
| **Near South-west** | | |
| Balonne Shire .. .. .. .. .. | *Irrigated* | |
| | Nov–early Jan .. .. | Davis, Wills, Semstar |
| | *For trial* | |
| | Nov–early Jan .. .. | Flegler |
| | *Raingrown* .. .. .. | not recommended |

## SUMMARY OF SOYBEAN VARIETAL CHARACTERISTICS

| Characteristics | Davis | Bragg | Wills | Semstar | Collee | Flegler | Hill | Ross | Improved Pelican | Daintree | Gilbert |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Maturity rating | 6 | 6 | 8 | 7 | 5 | 7 | 5 | 9 | 9 | 9 | 9 |
| Growth habit | Erect | Erect | Erect | Erect | Erect | Erect | Erect | Erect | Erect | Erect | Erect |
| Resistance to lodging | Good | V. Good | Fair | Poor | V. Good | Good | Good | Good | Fair | Good | Good |
| Average height (cm) | 75 | 75 | 85 | 90 | 70 | 75 | 70 | 70 | 100 | 70 | 70 |
| Average height to lowest pods (cm) | 12 | 10 | 16 | 13 | 8 | 12 | 10 | 10 | 12 | 10 | 10 |
| Flower colour | White | White | Purple | White | Purple | Purple | White | Purple | Purple | Purple | Purple |
| Pod hairs | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No. | Yes | Yes |
| Pod hair colour | Grey | Tawny | Tawny | Grey | Tawny | Tawny | Tawny | Tawny | Grey | Tawny | Grey |
| Resistance to bacterial pustule | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes |
| Seed colour | Straw Yellow | Yellow | Yellow | Straw Yellow | Straw Yellow | Dark Yellow | Straw Yellow | Mottled Yellow | Light Yellow | Mottled Yellow | Mottled Yellow |
| Hila colour | Buff | Black | Black | Buff | Black | Black | Brown | Brown | Brown | Black and Brown | Brown |
| Plant growth habit (*) | D | D | D | ID | D | D | D | D | ID | D | D |
| Pod shattering | Yes | No | No | No | No | No | Yes | No | Yes | No | No |
| Approximate number of seeds per kg | 5 500 | 5 200 | 6 100 | 5 900 | 5 700 | 5 200 | 6 000 | 10 000 | 8 300 | 10 000 | 10 000 |

*D = Determinate ID = Indeterminate

Varietal descriptions relate to the district of recommendation.

# The bearded heaths of south-eastern Queensland

**IN 1810, Robert Brown, the British botanist who accompanied Flinders to Australia, described more than 40 different species of plants as belonging to the one genus, *Leucopogon*.**

This is in the same family as *Epacris*. The name is derived from two Greek words, *leucos* meaning white and *pogon* which means a beard. It describes the inner surfaces of the corolla lobes. These have a dense covering of erect, fine, white hairs. The common name, bearded heaths, also comes from this feature.

Bearded heaths are usually woody shrubs, although a few species attain the stature of small trees. The leaves are alternate and in most species are not as firm in texture nor as pungent pointed as those of *Epacris*. They are also more widely spaced on the stems.

In many species, the flowers are less than 1 cm long and are shaped like wide, short bells. They are either solitary and in the axils of the leaves, in spikes of two or three flowers, or in terminal or axillary many-flowered racemes or spikes.

Like *Epacris*, the flowers consist of five free sepals, five petals which are united into a tube, five stamens joined to the corolla tube, and an ovary containing two to five cells. They differ from *Epacris* in the shape of the corolla, but more particularly in the densely-bearded corolla lobes.

The flowers are either sessile or shortly pedunculate within a subtending bract. Two bracteoles are close under the calyx or are a short distance from it.

The corolla tube is either shorter or longer than the sepals and the free corolla lobes can spread at the end of the tube like a five-pointed star, or they may be distinctly recurved. Five anthers can be seen at the end of the tube alternating with the corolla lobes and partially or wholly enclosed in the tube.

*by Beryl A. Lebler, Botany Branch.*



34—64078

The fruit resembles a very tiny stone fruit, with some species having a thin outer fleshy layer surrounding the stone and others with the outer covering being thin, brittle and hard.

In Victoria and Western Australia, some species have pale-pink flowers. There are even a few in Western Australia with red flowers. The flowers of Queensland's bearded heaths are always white.

Although most bearded heaths are found only in Australia, a few species grow in New Zealand and on some islands of the Malayan Archipelago and the South Pacific.

Sixteen bearded heaths are common in south-eastern Queensland: *Leucopogon biflorus, L. juniperinus, L. lanceolatus, L. pimeleoides, L. deformis, L. recurvisepalus, L. virgatus, L. melaleucoides, L. ericoides, L. margarodes, L. leptospermoides, L. muticus, L. parviflorus, L. pedicellatus, L. neoanglicus, L. rupicola.*

### *Leucopogon biflorus*
### Twin-flowered bearded heath

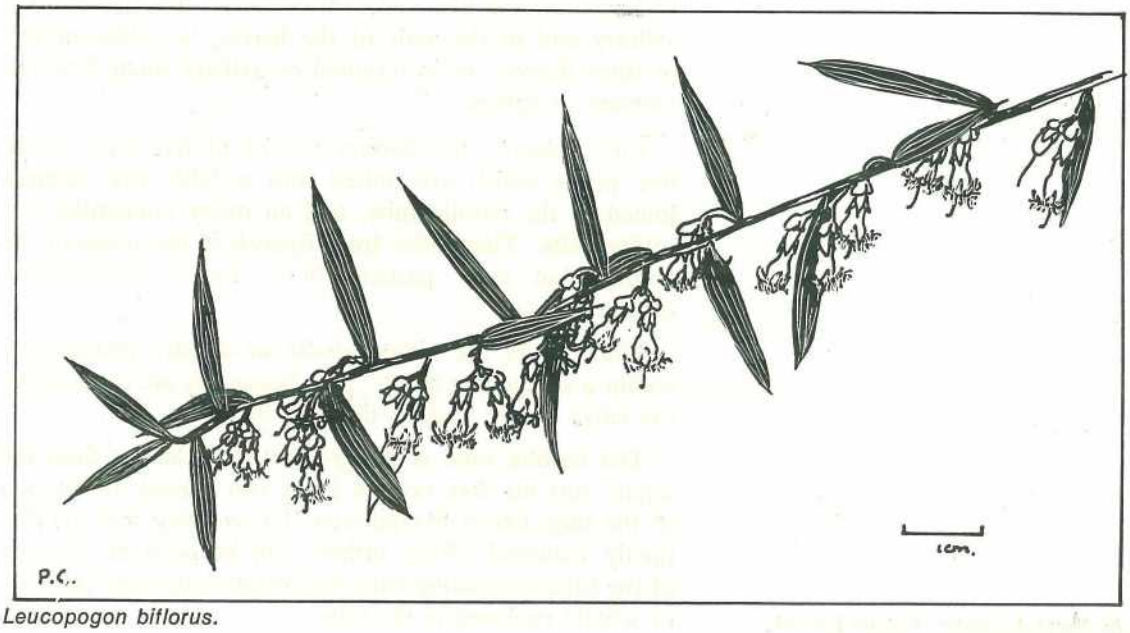
A Latin word meaning having two flowers is the specific epithet for this plant.

- DESCRIPTION. This is an intricately-branched shrub growing to a height of 1·5 m. The lateral branches spread from the main stem, and the leaves spread widely from the stems. They are sessile, up to 1·3 cm long and 0·3 cm wide, and are oblong, with the tip narrowed abruptly to a clear, rigid, needle-like point. No veins are visible in the bright-green upper surface, but on the lower surface a network of anastomosing veins can be seen.

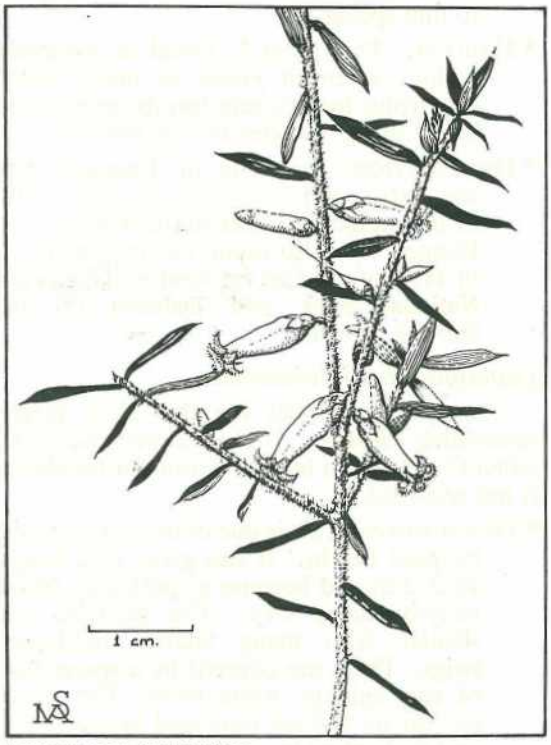
  Usually, two pendulous flowers hang on very short stalks from the leaf axils, with the two flowers almost at the same level. They are up to 0·7 cm long. The corolla forms a tube which is slightly swollen above the middle. The free corolla lobes are long and pointed and are rolled back for half their length. The slender, white style protrudes slightly from the flower. When the corolla falls, the long, white ovary is left surrounded by the overlapping, white, pointed sepals surrounded by short, rounded bracteoles at the base.

- FLOWERING TIME. Winter to spring.

- HABITAT. It is found in mixed, open eucalyptus forest, in sandy soil, on rocky hillsides or on sandstone ridges or slopes.




*Leucopogon biflorus.*




*Leucopogon juniperinus.*

- DISTRIBUTION. It is confined to the eastern mainland States to as far north as the Blackdown Tableland, the Carnarvon Range and Isla Gorge, and as far west on the Darling Downs as Chinchilla.

- GENERAL REMARKS. This is one of the most attractive bearded heaths because of its conspicuous, pendulous flowers hanging from the spreading, lateral branches. It is very prolific in bloom and the flowers have been reported to be strongly perfumed.

## *Leucopogon juniperinus*

### Prickly bearded heath

The Latin generic name for the juniper tree is *Juniperus*. This is an evergreen with branchlets spreading in all directions and with spiny-pointed linear or linear-lanceolate leaves. This specific epithet was chosen, as this bearded heath has a superficial resemblance to the juniper.

- DESCRIPTION. This is an intricately-branched shrub which grows up to a height of 1 m, with twiggy branches covered by a very short fuzz of fine hairs. The leaves spread widely from the stem. They are linear or linear-lanceolate in shape, 1 cm long and are broadest just beneath the tip. This is narrowed abruptly to a fine, rigid point about 0·1 cm long. These points make the plant very prickly to touch. The upper surfaces of the leaves are glossy green and they are paler beneath.

  Usually there is only one flower in the axils of the leaves but occasionally there are two. The flowers are up to 1·2 cm long, and slightly exceed the leaves. The sepals are pale-green, 0·3 cm long, overlapping at the base and ending in pointed tips. The petals are joined for most of their length to form a slender tube which ends in lobes up to 0·3 cm long. Initially, these spread at the end of the tube to form a star. As the flowers age, the lobes recurve slightly. The slender, green style is as long as the corolla.


*Leucopogon lanceolatus.*

- FLOWERING TIME. It blooms mainly in autumn and winter.
- HABITAT. It is common in mixed, eucalyptus forest and on shallow, stony slopes and ridges. In the border ranges, it grows in rock crevices, on the mountain peaks, or on heath lands.
- DISTRIBUTION. It is found only in the eastern mainland States to as far north in Queensland as the Blackall Range and Buderim Mountain. It is the commonest bearded heath in the Brisbane area.

### *Leucopogon lanceolatus*
### Lance bearded heath

The Latin adjective *lanceolatus* means spear-shaped, or with a narrow shape and curved sides tapering to a point. It describes the shape of the leaves of this plant.

- DESCRIPTION. This bearded heath is usually a shrub up to 1·5 m high with glabrous stems and slender, twiggy branches. The leaves are sessile and spread from the branches. They are lanceolate in shape, widest at the middle and taper gradually to both ends. Their size is variable, ranging from 2 to 7 cm in length and 0·4 to 1 cm in width. The upper surface is dark-green and the leaves are paler beneath. Usually three parallel veins, sometimes five, can be seen as paler green lines on the upper surface and, with magnification, a network of veins can be seen on the lower surface as darker green lines.

  The dainty flowers are in graceful spikes. These are either in the axils of the upper leaves or at the ends of the twigs. The spikes contain as many as 20 widely-spaced flowers and can be 4 cm long, but usually do not exceed the leaves.

  The flowers are shaped like wide, little bells—about 0·2 cm long. Two green bracteoles are at the base of the calyx and the flower is subtended by a short bract.

  The calyx is twice as long as the bracteoles and about as long as the corolla tube. The free corolla lobes are as long as the corolla tube and end in long, fine points. The fruit is succulent and red.
- FLOWERING TIME. It blooms from late winter to mid spring.
- HABITAT. This plant is found in mountain regions where it grows in open, mixed eucalyptus forests, rain-forests, or on creek banks in the margins of rain-forests.
- DISTRIBUTION. It grows in Tasmania and the eastern mainland States to as far north as the mountain peaks in the MacPherson Range. It is also found on the hills north of Helidon and as far west as Girraween National Park and Dalveen on the Darling Downs.

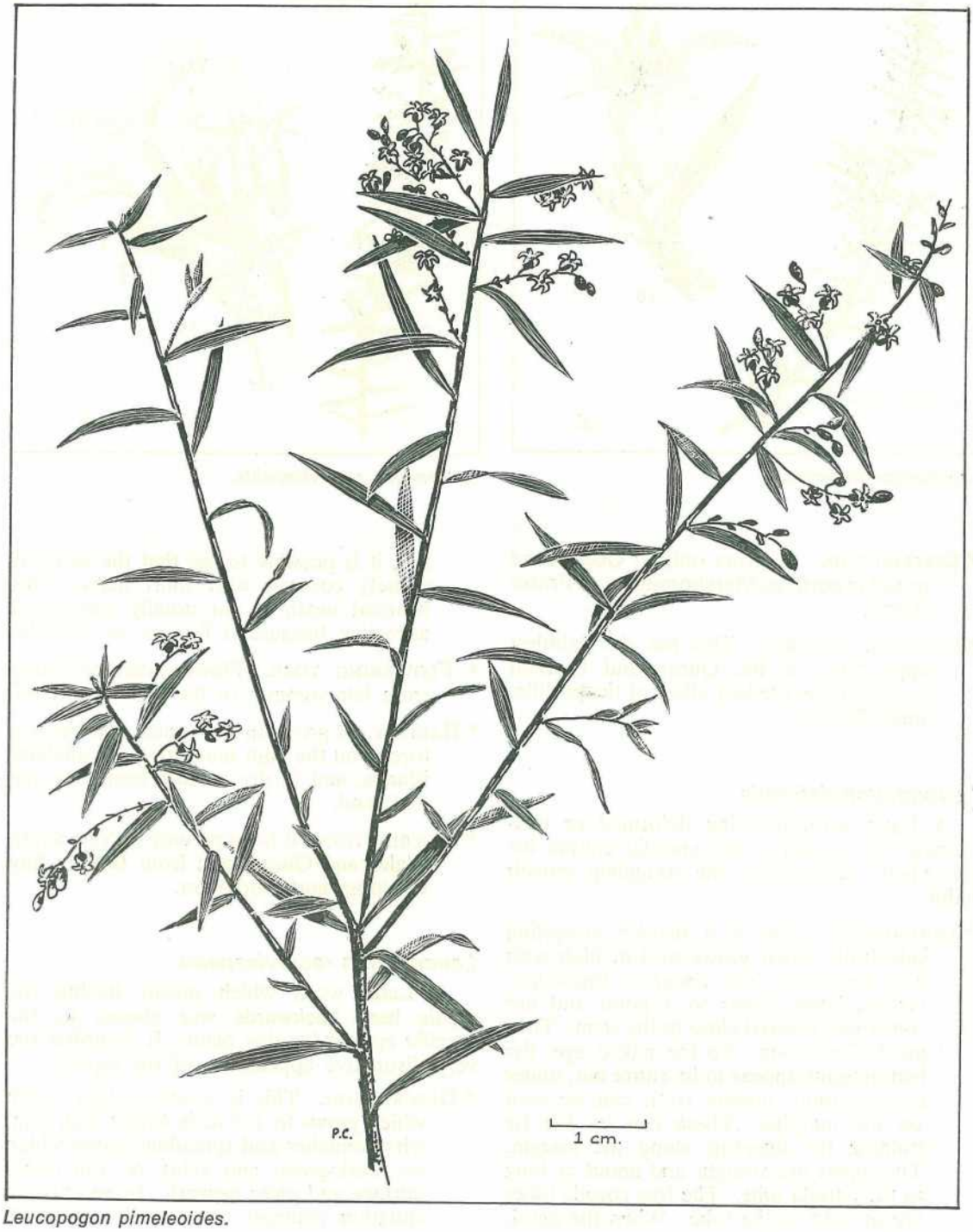
### *Leucopogon pimeleoides*

The specific epithet for this plant means resembling *Pimelea*. The name was chosen by Allan Cunningham but the reason for his choice is not recorded.

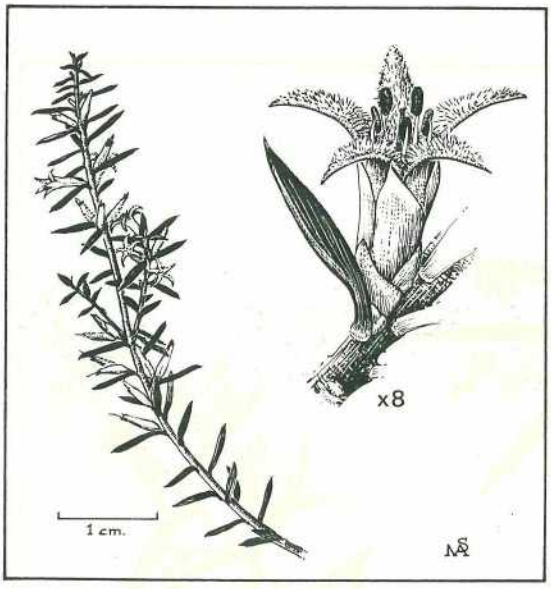
- DESCRIPTION. This is one of the largest of the bearded heaths. It can grow to a height of 3·5 m and become a spreading, intricately-branched tree. The branches are slender with many lateral, red-brown twigs. These are covered by a sparse fuzz of very minute, white hairs. The leaves are up to 1·8 cm long and between 0·1 and 0·2 cm wide. They taper to the base and end in a fine point. A network of fine veins can be seen with magnification, particularly on the lower surface, as darker green lines.

  The flower spikes are in the axils of the leaves towards the ends of the twigs. The individual flowers are 0·2 cm long and are shaped like broad bells. The corolla tube ends in pointed lobes which are rolled back and under. The pointed sepals are white and papery and reach to the end of the corolla tube.

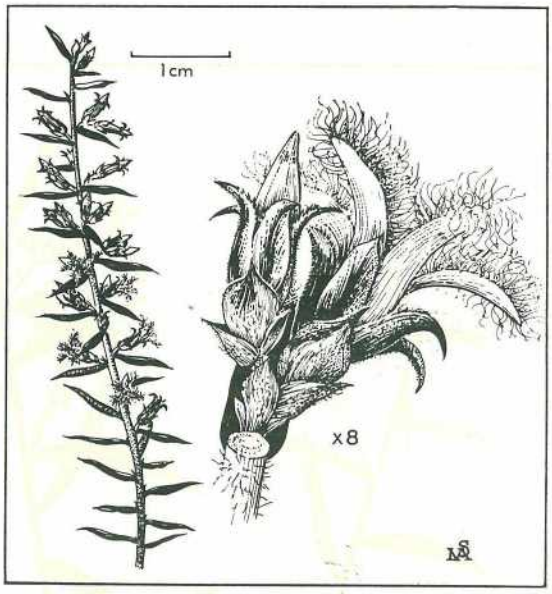
  The spikes consist of about 12 flowers and can be 0·3 cm long. This bearded heath flowers so prolifically that the leaves are almost hidden. The fruits are globose, 0·3 cm in diameter, and orange-red in colour when ripe.
- FLOWERING TIME. It flowers from autumn to early spring.
- HABITAT. It flourishes in the sandy soil of the coastal lowlands as an understorey plant in eucalyptus-banksia forest or in deep sand on high, forested dunes.




*Leucopogon pimeleoides.*




*Leucopogon deformis.*




*Leucopogon recurvisepalus.*

- DISTRIBUTION. It grows only in Queensland to as far north as Maryborough and Fraser Island.
- GENERAL REMARKS. This has the daintiest appearance of the Queensland bearded heaths due to the lacy effect of the prolific, small flowers.

### *Leucopogon deformis*

A Latin word meaning deformed or misshapen was chosen as the specific epithet for this plant. It describes the straggling growth habit.

- DESCRIPTION. This is a slender, straggling sub-shrub which grows to 1 m high with wiry branches. The linear or linear-lanceolate leaves taper to a point and are sometimes pressed close to the stem. They are 0·5 cm long. To the naked eye, the leaf margins appear to be entire but, under magnification, minute teeth can be seen on the margins. These can be felt by running the fingertip along the margin. The sepals are straight and about as long as the corolla tube. The free corolla lobes are as long as the tube. When the petals fall, it is possible to see that the ovary is densely covered with short hairs. This bearded heath is not usually considered attractive because it flowers so sparsely.
- FLOWERING TIME. Flowers can be found from late summer to the end of autumn.
- HABITAT. It grows in eucalyptus and banksia forests on the high sand dunes on offshore islands, and in dry wallum heaths on the mainland.
- DISTRIBUTION. It is found only in New South Wales and Queensland from Botany Bay to Noosa and Caloundra.

### *Leucopogon recurvisepalus*

A Latin word which means having the sepals bent backwards was chosen as the specific epithet for this plant. It describes the very distinctive appearance of the sepals.

- DESCRIPTION. This is a very twiggy shrub which grows to 1·5 m in height with thin, wiry branches and spreading leaves which are dark-green and shiny on the upper surface and paler beneath. In an exposed situation amongst other low shrubs, this

forms a compact shrub to 1 m high with firm, woody branches. When growing as an understorey plant in low-open forest on hillsides, it becomes a straggling, diffuse shrub to 1·5 m with twiggy branches. Short, spreading, white hairs cover the young twigs. The leaves are linear, 0·5 to 1·5 cm long and 0·1 cm wide and taper gradually to a pungent point. They are firm in texture but not rigid and are arranged in a close spiral. The margins are slightly recurved.

The flowers are in the axils of the terminal leaves and are solitary, in pairs or rarely in threes. They form leafy racemes at the tips of the twigs and on short, axillary branches.

From a distance, the flowering branches have an overall pink appearance. This is caused by a deep rose flush in the bracts, bracteoles, and over most of the sepals. By the time the buds have opened, the colour has almost completely faded from the sepals.

The most conspicuous feature, which is clearly seen in the buds, is the strongly recurved sepals. The corolla is 0·5 cm long and the corolla tube is slightly more than half that length. The free lobes spread between the sepals and are not as recurved.

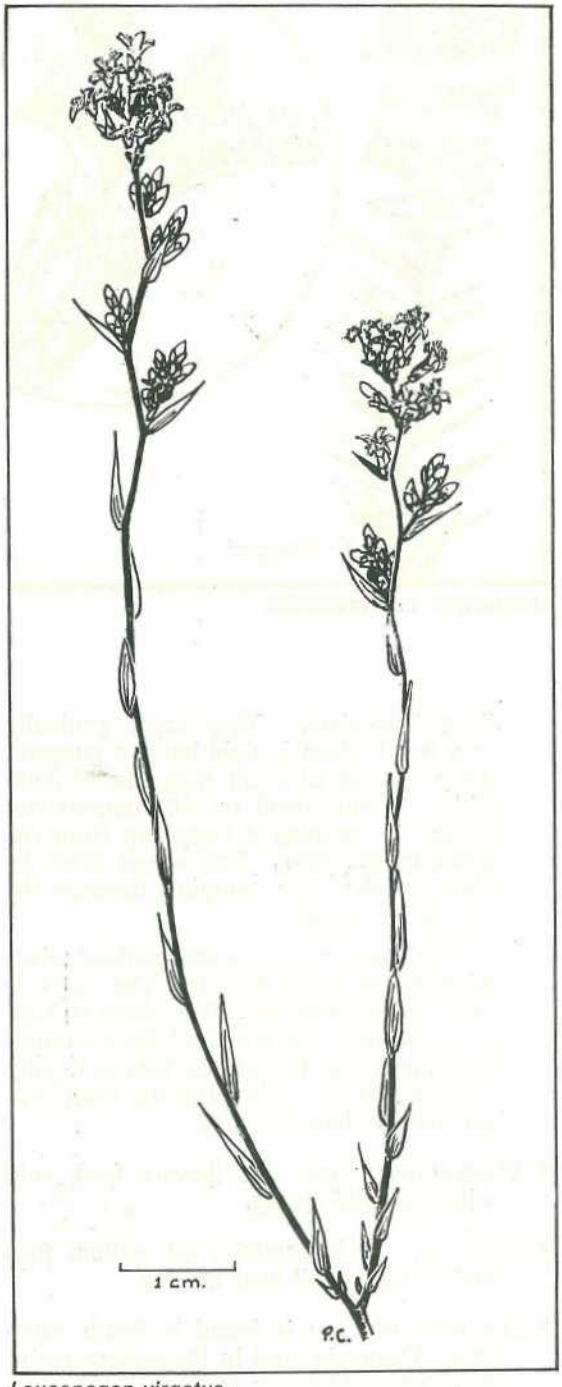
- FLOWERING TIME. It appears to have flushes of flowers in late autumn and at the end of winter.
- HABITAT. It has been found on sandstone ridges and among rocky outcrops on mountain slopes.
- DISTRIBUTION. It grows only in Queensland and has a very restricted distribution. It occurs on two of the peaks in the Glasshouse Mountains and on the sandstone hills of Plunkett, north of the upper reaches of the Albert River.

### *Leucopogon virgatus*

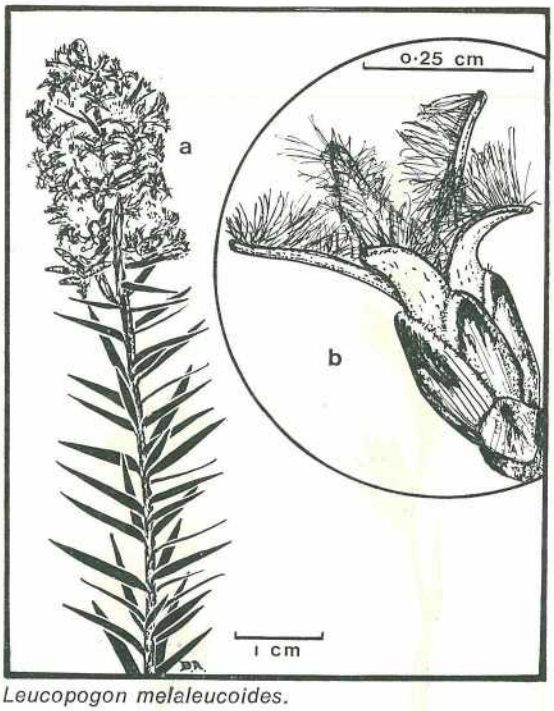
### Common bearded heath

The Latin adjective for twiggy is *virgatus*. It was chosen because of the wiry branches of this bearded heath.

- DESCRIPTION. This is a diffuse, sprawling shrub with thin, wiry, ascending or erect branches. The leaves are dark-green and



*Leucopogon virgatus.*



*Leucopogon melaleucoides.*

linear-lanceolate. They taper gradually to a point which is rigid but not pungent. They are up to 2 cm long and 0·2 cm wide. Minute teeth on the margins can be felt by running a finger tip from the point to the base. The leaves often lie close to the stem pointing towards the tips of the twigs.

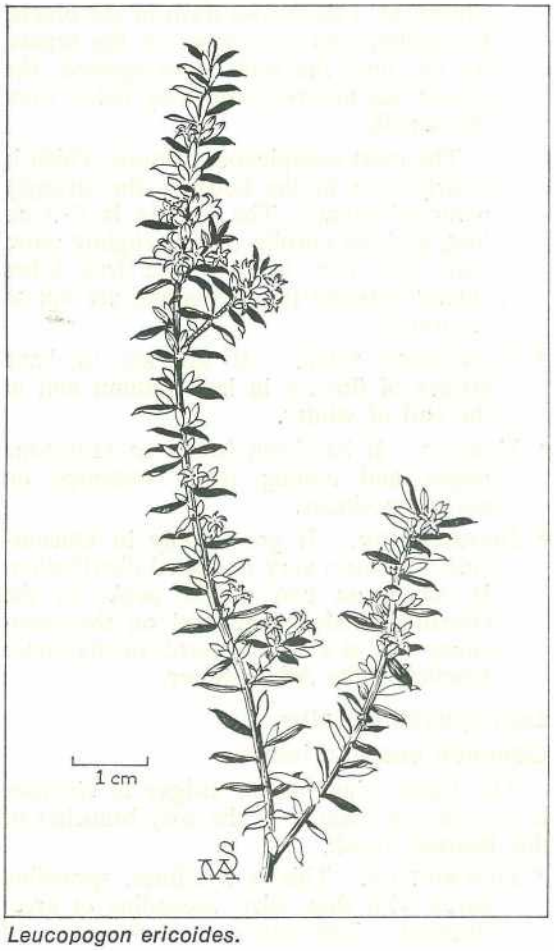
The flowers are in dense, axillary spikes of three to seven flowers. The calyx is often tinged with red. It is about 0·3 cm long and twice the length of the surrounding bracteoles. The corolla tube is slightly shorter than the calyx and the free lobes are longer than the tube.

- FLOWERING TIME. It flowers from mid winter to mid spring.
- HABITAT. It is common on wallum flats and in sandy soil near the sea.
- DISTRIBUTION. It is found in South Australia, Tasmania, and in the eastern mainland States to as far north as Bundaberg.

### *Leucopogon melaleucoides*

The Greek suffix *oides* indicates resemblance. Allan Cunningham apparently thought this bearded heath resembled a *Melaleuca* when he named it.

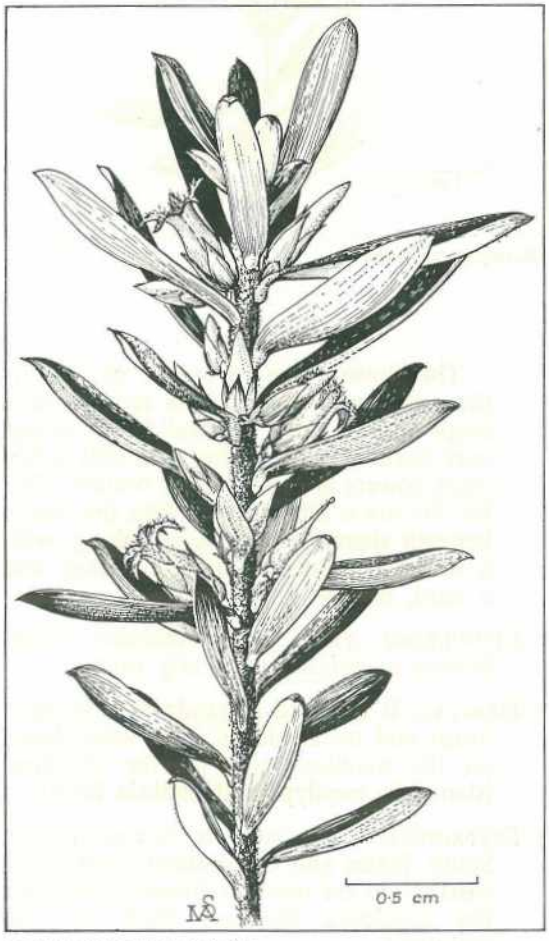
- DESCRIPTION. This is an erect, intricately-branched shrub with a spreading habit which can grow to a height of 2 m. The leaves are narrow and stiff, dark-green and slightly glossy. They are crowded along the stems, and usually spread widely. No veins are evident to the naked eye. The leaves taper to a pungent point and can be up to 2 cm long and just over 0·1 cm wide, but are usually shorter.



*Leucopogon ericoides.*

The flowers are crowded into dense spikes, up to 3 cm long at the ends of the branches. About six flowers can sometimes be found at the tip, each in the axil of a small bract. Beneath these, in the axils of reduced leaves, are very short axillary inflorescences less than 1 cm long each consisting of up to seven flowers.

In the bud stage, the bracteoles are dark-red, giving a pink colour to the inflorescence. The overlapping sepals are the same colour. Very minute, white hairs are scattered over the stems and form a fringe on the bracts and sepals. Magnification is necessary to see these. The calyx is 0·5 cm long and the corolla tube is shorter than the sepals and ends in slightly longer lobes which spread widely and become recurved as they age. The fruit is globose, slightly succulent and red in colour.



*Leucopogon margarodes.*

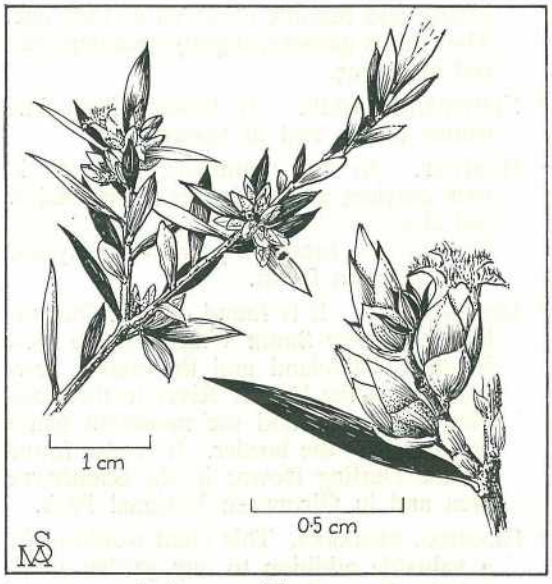
- FLOWERING TIME. It flowers from late winter to the end of spring.
- HABITAT. In the mountains, it grows in rock crevices and on ledges or in shallow soil close to cliff edges. On the Darling Downs, it is found in granitic, sandy soil often in open forest.
- DISTRIBUTION. It is found only in Queensland and New South Wales, on the New England Tableland and the coastal lowlands from the Hunter River to the MacPherson Range and the mountain peaks just north of the border. It is also found on the Darling Downs in the Stanthorpe area and in Girraween National Park.
- GENERAL REMARKS. This plant would make a valuable addition to any garden particularly if regularly pruned.

### *Leucopogon ericoides*
### Pink bearded heath

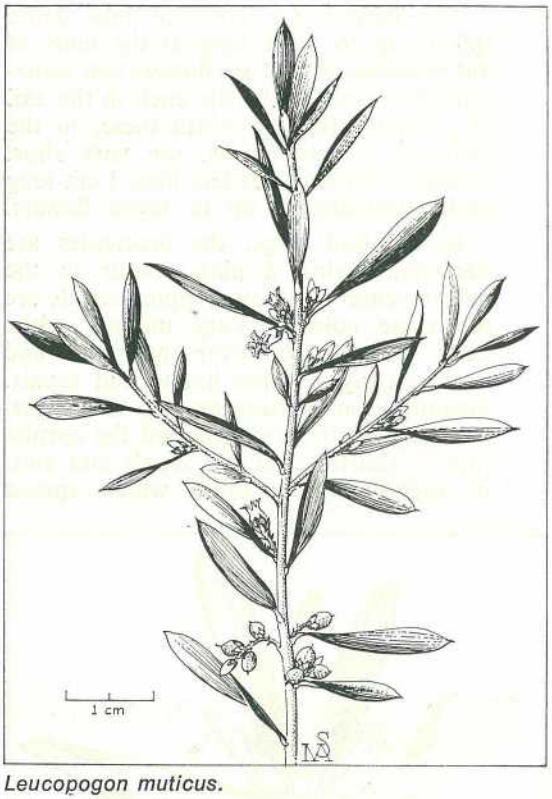
The specific epithet for this bearded heath means resembling *Erica*. When Robert Brown named it, he did not indicate why he considered it to be like Erica.

- DESCRIPTION. This is a diffuse shrub up to 1 m high with many thin, wiry branches. The dark-green leaves are oblong-linear and their margins are always strongly recurved. They spread widely from the stems and are about 0·5 cm long and end in a short, mucronate point.

  The flowers are axillary on the upper portions of the branches. Often they are solitary, but sometimes a few are together in a close cluster or spike. This is slightly longer than the leaf. The bracteoles are half the length of the sepals. The corolla is variable in size, up to 0·4 cm long. The corolla tube is usually longer than the sepals. The corolla lobes are slightly longer than the tube. At first sight, the flowers appear to be pink. Closer examination reveals a red flush on the bracteoles, sepals, and often on the backs of the petals. They are also sometimes very sweetly perfumed.
- FLOWERING TIME. It flowers from autumn to spring.




*Leucopogon leptospermoides.*




*Leucopogon muticus.*

- HABITAT. It is common in wallum heath in sandy soil, and on mountains on sandstone in dry sclerophyll forest.
- DISTRIBUTION. It grows in Tasmania, South Australia and in all the eastern States to as far north as Caloundra.

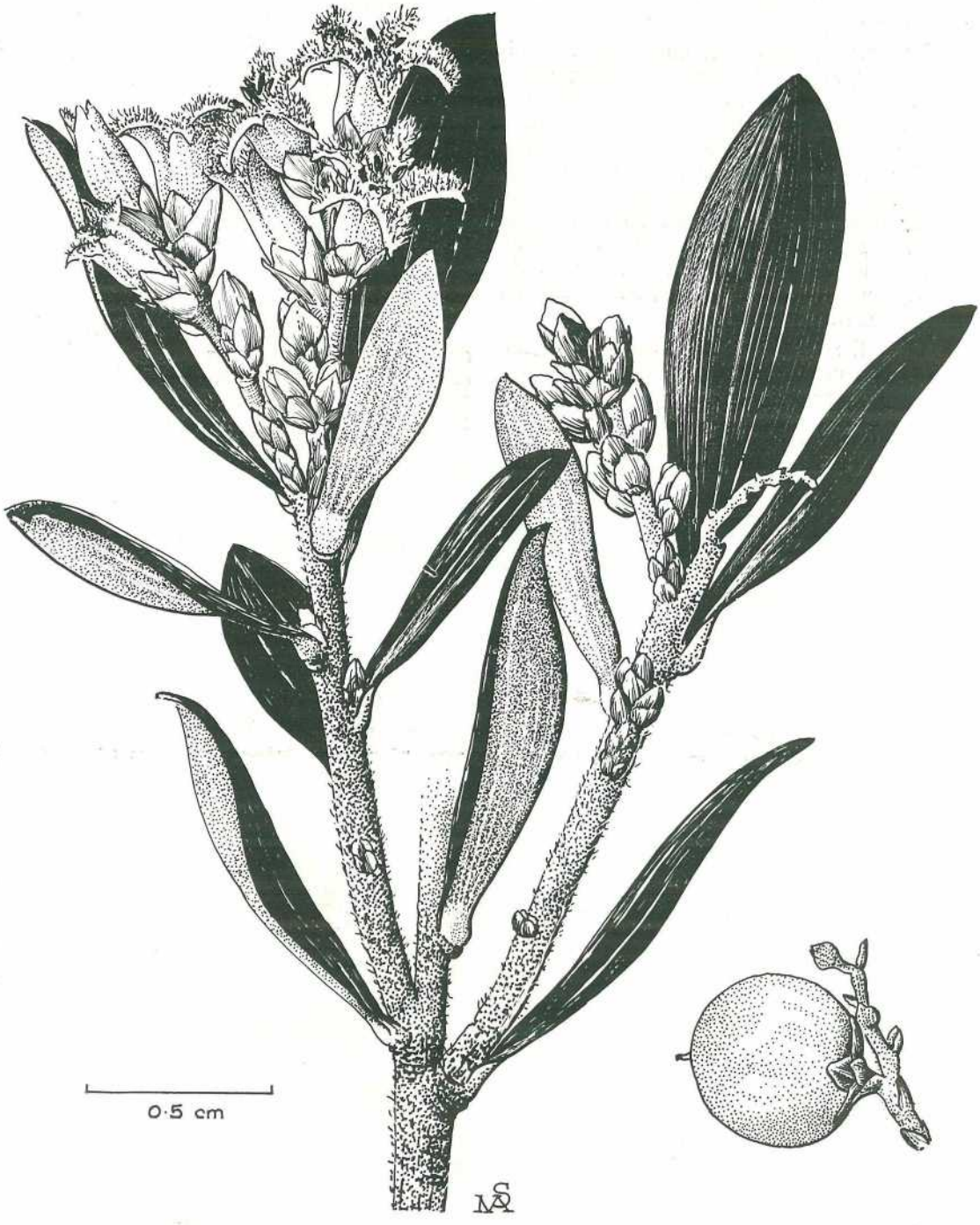
### *Leucopogon margarodes*

The specific epithet for this bearded heath is a Greek word meaning pearl-like. Possibly it was chosen because the fruits resemble small pearls.

- DESCRIPTION. This bearded heath can grow to a height of 4 m but is more often found as a much smaller shrub, sometimes weak and straggling. Short, spreading white hairs cover the young branches. The leaves are green, oblong-linear or oblanceolate and are usually less than 1 cm long. They are widest just below the tip. This is blunt and curves downward. The margins are recurved, more so at the base than in the upper part of the leaf giving it a characteristic appearance. The flowers are in the axils of the leaves near the tips of the branches.

The flowers are in spikes of two or three flowers but sometimes reduced to a single flower. This bearded heath is not very floriferous and sometimes only a few open flowers are found on a branch. The flowers are a little shorter than the leaves beneath them. The fruit is oblong, with a white, translucent, succulent base and a hard, narrow tip.

- FLOWERING TIME. This bearded heath flowers in autumn and early winter.
- HABITAT. It is found in sandy soils in open forest and on stabilized, high sand dunes on the mainland and on the off-shore islands in eucalypt and banksia forest.
- DISTRIBUTION. It is confined to coastal New South Wales and Queensland from Newcastle to as far north as Fraser Island and the Cooloola National Park on the mainland.




*Leucopogon parviflorus.*

### *Leucopogon leptospermoides*

The Greek suffix *oides* indicates resemblance of this plant to a *Leptospermum*.

- DESCRIPTION. This is a fairly dense shrub which grows to 2 m high, with intricately-branched, thin, woody stems. Minute, white hairs cover the young stems. These can be seen only under magnification. The leaves are sessile and 1·5 cm long, five times as long as broad, and practically the same width from the base until the leaf narrows abruptly to a slightly pungent point. They are flat, or nearly so, and are the same colour green on both surfaces.

  In the axils of the upper leaves are spikes, usually shorter than the leaves. They consist of three to five flowers. Sometimes, some of the flowers abort or do not develop fully. Individual flowers are 0·5 cm long. The green sepals end in a blunt tip and are more than half the length of the flower and longer than the corolla tube. The fruit is oblong with a succulent, translucent white base and a hard, conical top.

- FLOWERING TIME. It appears to have a flush of flowers in autumn and another in spring.

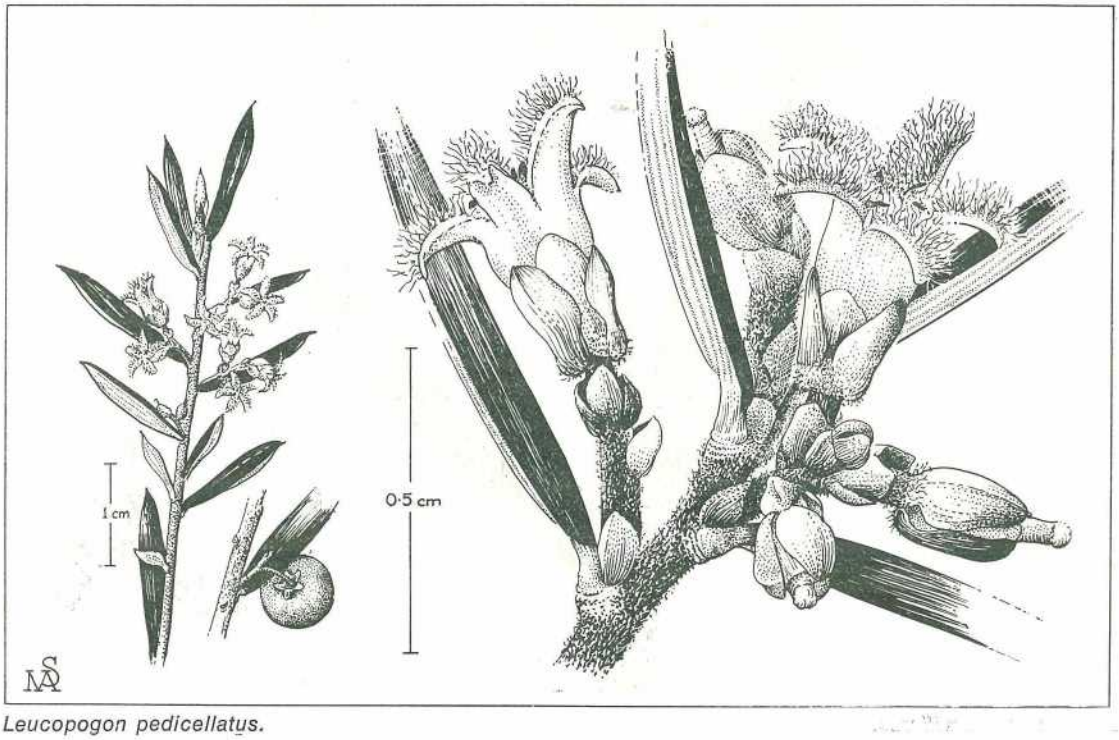
- HABITAT. It is very common in poor, sandy soil in the coastal lowlands, on the edges of swamps and sand dunes, in wallum scrub, and in low, open forest or high dunes.

- DISTRIBUTION. It grows only in Queensland to as far north as Hinchinbrook Island and on the mainland to as far north as Bundaberg.

### *Leucopogon muticus*

The Latin adjective *muticus* means blunt or without a point. This plant was first discovered in New South Wales in the Blue Mountains. Unlike the plants of this species found in Queensland, the leaves of the plants in New South Wales are either obtuse or end in a usually thickened, blunt point.

- DESCRIPTION. This is a rather sparse, open, branching shrub which can grow to 2 m in height. Magnification shows that the stems are covered with very short, white




*Leucopogon pedicellatus.*

hairs. The leaves are oblanceolate, light-green in colour, rather thin in texture, up to 2·5 cm long and 0·4 cm wide. The plant has a distinctive appearance, as the leaves have a slight spiral twist just above the petioles. They are narrowed abruptly at the tip to a long mucro which is not stiff or rigid.

The flowers are in axillary spikes of up to six flowers. These are 0·3 cm long. The sepals are green, and up to 0·2 cm long and the spreading corolla lobes only 0·1 cm. Just below the base of the corolla lobes the tube is slightly swollen. The pointed tips of the lobes spread outwards. When the corolla falls, the green ovary ending in a short style can be seen. Magnification shows that it is hairy.

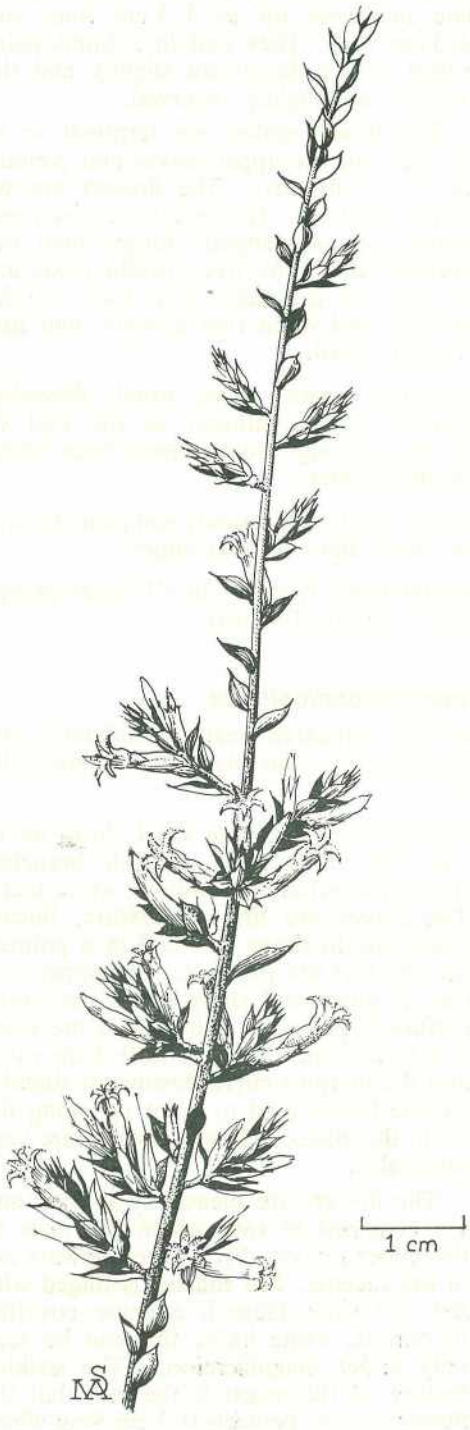
Since this plant does not flower profusely and it is not a compact shrub, it is not a particularly striking or attractive plant.

- FLOWERING TIME. It appears to produce two flushes of flowers, one in late summer, the other in spring time.
- HABITAT. It is always found on sandstone or granite hills and ridges and grows in open eucalyptus forest.
- DISTRIBUTION. It occurs only in Queensland and New South Wales, to as far south as the Blue Mountains. In Queensland, it has a patchy distribution—at Plunkett and Crow's Nest in the south and on the Blackdown Tableland in central Queensland.

### *Leucopogon parviflorus*
### Coast bearded heath

The specific epithet for this plant is a Latin adjective which means 'small flowers'. Although the flowers of this plant are no smaller than those of many other bearded heaths, when this plant was first found and described it was thought to belong to the genus *Styphelia* which has long, slender flowers.

- DESCRIPTION. The habit of this plant varies from a stunted, spreading shrub to a tall, intricately-branched shrub or small tree. The branches are either glabrous or have a sparse covering of minute, white hairs. The leaves are greenish-blue




*Leucopogon neoanglicus.*

in colour and the upper surface is darker than the lower. They are oblong-lanceolate in shape up to 1·5 cm long and 0·3 cm wide. They end in a blunt point which curves downward slightly and the margins are slightly recurved.

The flower spikes are terminal or in the axils of the upper leaves and contain up to six flowers. The flowers are up to 0·5 cm long. The sepals are green and obtuse and are slightly longer than the corolla tube. The free corolla lobes are as long as the tube. The fruit is subglobose and when ripe is white and like a small pearl.

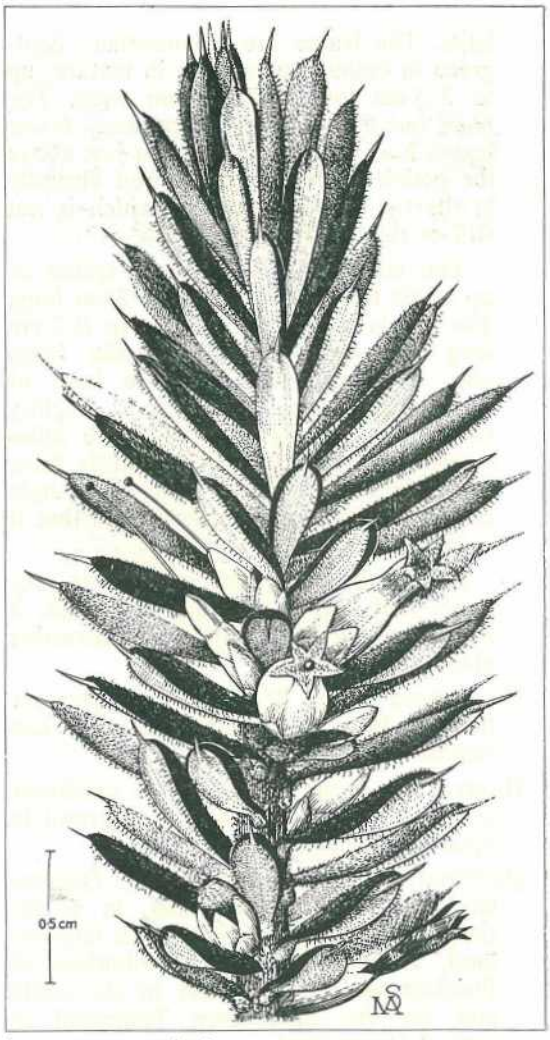
- FLOWERING TIME. The usual flowering period is late autumn to the end of winter, although flowers have been found in midsummer.
- HABITAT. It grows in sandy soil near the sea, on heath flats or sand dunes.
- DISTRIBUTION. It grows in all States except the Northern Territory.

### *Leucopogon pedicellatus*

The Latin adjective meaning 'stalked' is the specific epithet for this plant. It describes the flowers.

- DESCRIPTION. This is an erect shrub up to 1 m high with rigid, reddish branches sparsely covered with minute, white hairs. The leaves are firm in texture, linear-lanceolate in shape and end in a pointed tip which is not pungent. The upper surface is green and shiny, while the lower surface is glaucous. The leaves are from 1·5 to 2·5 cm long, 0·2 to 0·3 cm wide, and the margins curve downward slightly. As the leaves tend to point up along the stem, the glaucous lower surfaces are very noticeable.

  The flowers are pleasantly scented and are arranged in racemes in the axils of the upper leaves. Five to ten flowers are in the raceme. The rhachis is tinged with red, but since there is a dense covering of minute, white hairs, this can be seen only under magnification. The striking feature of this plant is the fact that the flowers are on pedicels 0·2 cm long which are noticeably red.




*Leucopogon rupicola.*

  The base of the pedicel is cupped by a bract and two bracteoles. The flower at the top of the pedicel is shaped like a narrow bell and has obtuse sepals 0·2 cm long. The petals are 0·4 cm long with the free lobes as long as the tube. The fleshy fruits are bright red, almost globular, and are flattened on the upper and lower surfaces.
- FLOWERING TIME. It flowers in late winter and spring.
- HABITAT. It is common in banksia scrubs, on the edges of peat swamps, on wallum flats and in open eucalyptus forest on rocky hillslopes.

- DISTRIBUTION. It grows only in New South Wales and Queensland, from as far south as Grafton to as far north as Fraser Island.

- GENERAL REMARKS This very attractive and floriferous plant was first discovered in 1928 on rocky hillsides at Chermside, a northern suburb of Brisbane. Unfortunately, residential development has almost completely replaced the native vegetation.

### *Leucopogon neoanglicus*

This bearded heath was first found in the New England Tableland in New South Wales and this is the reason for the choice of this specific epithet.

- DESCRIPTION. This is an intricately-branched sub-shrub with many thin, woody-brown stems. The habit of the plant varies greatly. On the mountains of the border ranges, it has been found forming compact cushions up to 60 cm across. In other places, it is an erect plant up to 60 cm with many short, lateral branches.

  The leaves are arranged in a close spiral, spreading widely from the stem on the older parts and imbricate and appressed at the tips of the young branches. They are concave, oblong or lanceolate in shape, firm in texture, glabrous, dark-green and shiny. They end in a long, rigid point and are up to 1·4 cm long including the point.

  The flowers are mainly solitary in the axils at the terminal leaves. Occasionally, the inflorescence contains two or three flowers. The slender corolla can be almost 1·2 cm long and the pointed, white sepals half that length. The pointed corolla lobes are 0·3 cm long and are spreading and reflexed. The style and stigma are dark-red and can be seen protruding beyond the petals.

- FLOWERING TIME. Autumn and winter.

- HABITAT. In Queensland, it grows in crevices on slopes with exposed granite slabs and on the rocky slopes of the mountain peaks in the MacPherson Range.

- DISTRIBUTION. It is found only in New South Wales and Queensland. South of the border, it grows on the New England Tableland, in the Gibraltar Range National Park and in the Whian Whian State Forest. In Queensland, it is found as far north as Crow's Nest and also on the Darling Downs at Stanthorpe, and in the Girraween National Park.

### *Leucopogon rupicola*

The Latin word meaning growing on rocks is the specific epithet for this bearded heath. This plant was first collected in 1931 at an altitude of about 2 000 feet on the rocky hillslopes of Biggenden Bluff which is now the Mt. Walsh National Park.

- DESCRIPTION. This is a dense, somewhat rounded shrub up to 1·5 m in height with rigid branches. The slender, terete twigs have a dense covering of minute, spreading, white hairs. These also cover both surfaces of the leaves. The leaves are crowded on the stems and spread widely from them except at the tips where they lie closer to the stems. They are 1 to 1·4 cm long and about 0·2 cm wide, linear-lanceolate in shape and end in a strong, pungent point 0·1 to 0·2 cm long. This is not a simple point formed at the end of the lamina but is combined with the midrib which is extended on the lower surface from just below the leaf tip.

  The upper surface is dirty green in colour and the lower is whitish. The margins are strongly recurved. The flowers are solitary and axillary, less than 1 cm long and shaped like a long urn with a narrow neck. The corolla tube is about 0·3 cm long and the pointed lobes spread slightly at the tips to form a star 0·3 cm wide. When the corolla falls, the calyx which is tinged with green can be seen in the leaf axils. It is one-third of the length of the flower and has overlapping, pointed sepals.

- FLOWERING TIME. It flowers from late winter to the middle of spring.

- HABITAT. It always grows in rock crevices or in rocky places on the summits of mountains.

- DISTRIBUTION. It is not a common plant and has been found only in Queensland in two widely seperated localities—on Mt. Beerwah in the Glasshouse Mountains and Biggenden Bluff.

## Field key to the bearded heaths in south-eastern Queensland

1. Flowers more than 10, in slender, interrupted axillary spikes about 3 cm long — 2
   Flowers less than 10 (sometimes only 1) in axillary or terminal spikes less than 2 cm long — 3

2. Branches glabrous, leaves up to 7 cm long and 1 cm wide — *Leucopogon lanceolatus*
   Branches more or less pubescent; leaves less than 2 cm long and 0·5 cm wide — *Leucopogon pimeleoides*

3. Leaves tapering gradually from the base to a point — 4
   Leaves contracted abruptly to a pungent point, or obtuse, or ending in a mucro — 7

4. Leaves linear, up to 1·5 cm long — 5
   Leaves oblong-linear or linear-lanceolate, usually more than 1·5 cm long — 6

5. Sepals straight; flowers sparse and usually solitary — *Leucopogon deformis*
   Sepals recurved, ending in a long, narrow point; flowers prolific, solitary or in 2 to 3 flowered spikes. Overall appearance of flowers—pink. — *Leucopogon recurvisepalus*

6. Decumbent or diffuse shrub; leaves linear-lanceolate; flowers in dense axillary spikes less than 1 cm long — *Leucopogon virgatus*
   Erect, intricately-branched shrub; leaves oblong-linear; flowers in dense, terminal spikes more than 1 cm long. Young inflorescences with an overall pink appearance — *Leucopogon melaleucoides*

7. Leaves obtuse or ending in a mucro — 8
   Leaves ending in a pungent point — 13

8. Leaves green — 9
   Leaves glaucous on one or both surfaces — 12

9. Leaves 1 cm long or less — 10
   Leaves more than 1 cm long — 11

10. Leaves mucronate, oblong-linear, always with strongly recurved or revolute margins. Flowers axillary, solitary or in clusters or spikes. Overall appearance of flowers pink — *Leucopogon ericoides*
    Leaves not mucronate, obtuse, oblong-linear or oblanceolate; margins recurved, more so at the base than the top — *Leucopogon margarodes*

11. Leaves flat and sessile; spikes with 3 to 5 flowers; corolla 0·5 cm long — *Leucopogon leptospermoides*
    Leaves with a distinct twist above the petioles; spikes with up to 6 flowers; corolla 0·3 cm long — *Leucopogon muticus*

12. Leaves up to 1·5 cm long, oblong-lanceolate, spikes with up to 6 flowers — *Leucopogon parviflorus*
    Leaves up to 2·5 cm long, linear-lanceolate; racemes with 5 to 10 flowers — *Leucopogon pedicellatus*

13. Leaves flat, not crowded, spreading widely from the stem — 14
    Leaves concave or with strongly recurved margins; crowded and appressed at branch tips — 15

14. Flowers pendulous, 0·7 cm long, usually 2 in the leaf axil — *Leucopogon biflorus*
    Flowers erect, 1 cm long, usually solitary — *Leucopogon juniperinus*

15. Leaves glabrous and concave, inflorescences axillary of 1 to 3 flowers — *Leucopogon neoanglicus*
    Leaves hairy on both surfaces; margins strongly recurved; flowers solitary and axillary — *Leucopogon rupicola*

# The macadamia felted coccid

*by D. A. Ironside, Entomology Branch.*

THE macadamia felted coccid (*Eriococcus ironsidei* Williams) is an important native pest of cultivated macadamia in Queensland.

Its only known host plants are *Macadamia integrifolia* and *M. tetraphylla* both of which occur wild and as cultivated varieties.

## Damage

The insect infests all above-ground parts of trees. It distorts and stunts new growth and causes yellow spotting on older leaves. Severe infestations can cause dieback and young seedlings and grafted trees may be killed. On bearing trees, nut yields are reduced and a delay is caused in the fall of mature nuts.

## Dispersal

Dispersal over long distances is mainly by passive transport of infestations on propogative material such as budwood, scion wood, cuttings, and potted nursery trees. Plantations derived from uninfested nursery trees have been observed to remain free of the insect for many years provided infested material is not brought into contact with the trees. It is thus worthwhile to disinfest propagative material to prevent the spread of the insect.

Newly-hatched crawlers may also be spread on the bodies of birds and insects or on the clothing of farm workers. Limited dispersal occurs as the crawlers actively wander to different parts of the tree or to other trees in contact.

## Life history and habits

The female passes through an egg and two crawler stages before becoming an immobile adult. The male, before becoming a winged adult, also has a pupal stage.

- EGGS—The oval-shaped eggs are laid in large numbers within the felted sac of the female. They are 0·2 x 0·1 mm in size, translucent in appearance with a pale pink or purplish tinge.
- CRAWLERS—On hatching, the lemon-coloured crawlers leave the parent, insert their slender stylet or sucking tube into the plant tissue and begin to feed on the sap. After the first moult, the insects which are then about 0·4 x 0·2 mm in size locate new feeding sites.

The females prefer sheltered sites such as in leaf folds, at leaf axils, between developing flower buds, in bark crevices, and alongside the mid vein under the leaf. They are instrumental in causing the distortion and stunting of the tender new growth.

The males settle anywhere on the under surface of leaves or on shaded parts of the trunk and branches and cause yellow spotting of the foliage.

- MALE PUPA AND ADULT—Prior to the second moult the male crawlers become enclosed in their felted coverings. This covering is elongate, about 0·8 x 0·4 mm in size and white in colour with three longitudinal ridges. The male crawlers moult to form the pupae within their coverings and the winged orange-coloured adults emerge.

# The macadamia

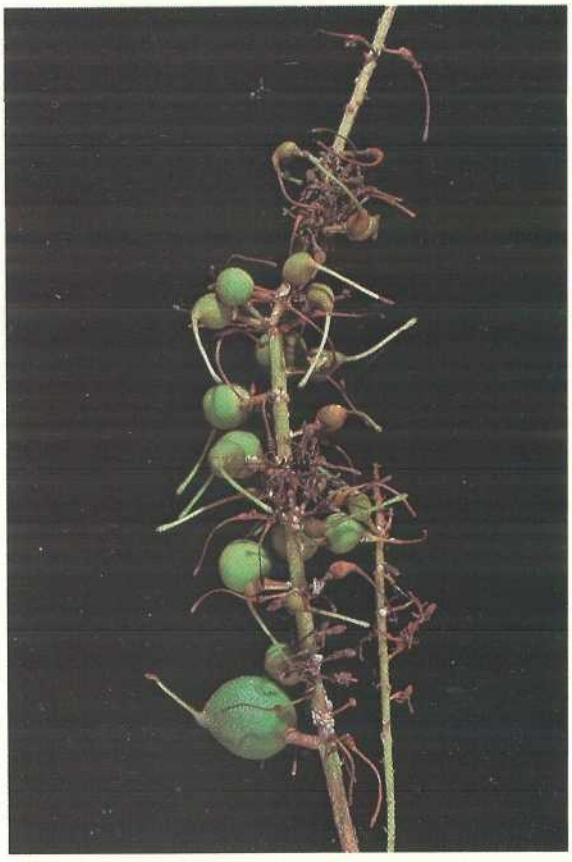
*Macadamia felted coccid on the underside of a macadamia leaf with the adult females along the mid vein and the male pupae and crawlers on the leaf blade. The female scale is about 1 mm long and the male about 0·8 mm long.*

*A heavy infestation of the macadamia felted coccid on a macadamia twig.*

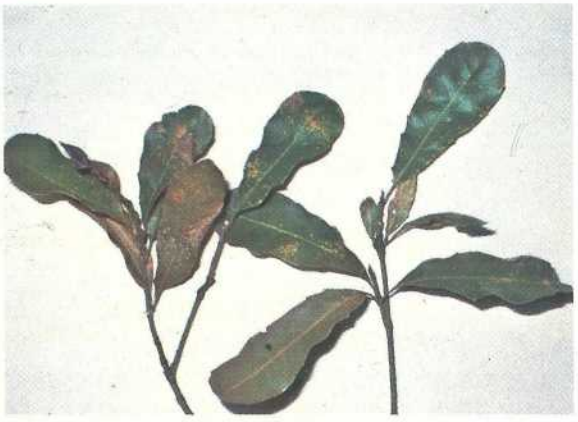
*Parasitized adult females showing the parasite emergence hole and an adult male with wings protruding from the felted covering. The female scale to the upper right of the picture has been turned upside down to show hatched and unhatched eggs within the felted covering.*

*Macadamia flower racemes showing distortion, stunting and death of flower buds caused by the feeding of the macadamia felted coccid. Portion of an undamaged raceme on the right.*

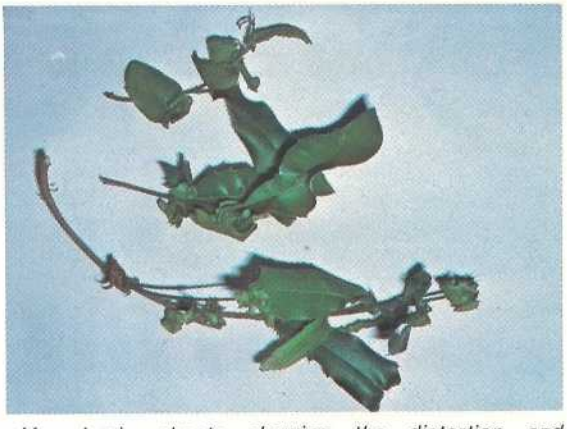
# felted coccid



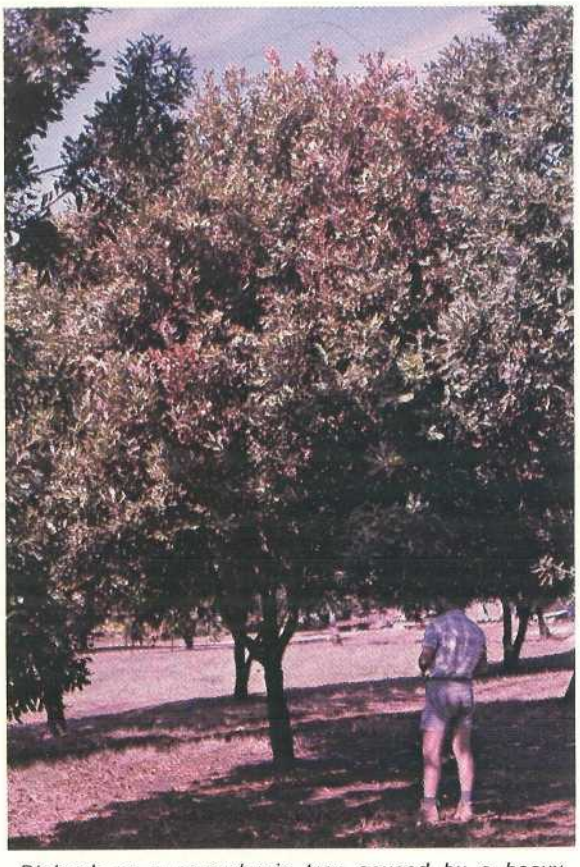
*Macadamia felted coccid damage to young macadamia nuts. Note the distortion and death of the nuts.*



*Yellow spotting and death of mature leaves caused by the macadamia felted coccid.*



*Macadamia shoots showing the distortion and stunting of leaves caused by feeding of the macadamia felted coccid on lush growth.*



*Dieback on a macadamia tree caused by a heavy infestation of the macadamia felted coccid.*

- FEMALE ADULT—The second stage crawler moults to become the immobile adult. Mating is then necessary before it can develop its felted sac covering. This is white to yellow-brown in colour and averages 0·7 x 1·0 mm in size with a tiny opening at the anal end.

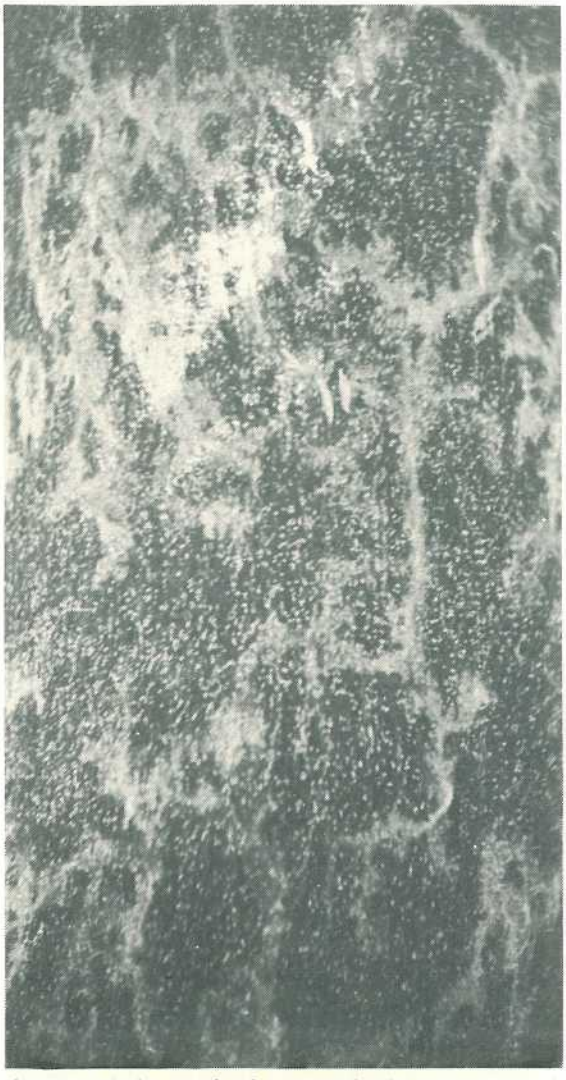
- DURATION OF THE LIFE CYCLE—This decreases with increasing temperature. The results in table 1 were obtained in an insectary during March-April with mean temperatures of 20°C minimum and 31°C maximum.

In this study, the minimum duration for the complete life cycle was 42 days. The females began to lay eggs about 4 to 5 days after forming the felted covering. As eggs are laid over an extended period there is considerable overlapping of the generations and about six generations are possible in a year.

## Natural enemies

The macadamia felted coccid has numerous natural enemies. The more important of these include ladybird bettles and their larvae (*Midus pygmaeus* Blkb., *Rhizobius ventralis* Er., *Serangium maculigerum* Blkb.), larvae of a predatory moth (*Batrachedra arenosella* Walk.), and the tiny parasitic wasps (*Aspidiotiphagus* sp.? *citrinus* Crawford and *Metaphycus* sp.). It is also attacked by lacewing and gall midge larvae and a number of predatory mites.

At times, natural enemies maintain adequate control. When the insect is introduced to new localities, however, its numbers usually increase and cause severe damage before its enemies can effect control and insecticide sprays are then necessary.



*Section of the trunk of a macadamia tree showing a heavy infestation of the macadamia felted coccid with the webbed larval tunnels and pupal cocoons of the predatory moth* Batrachedra arenosella.

TABLE 1
THE DURATION IN DAYS OF STAGES IN THE LIFE CYCLE OF *E. IRONSIDEI*

| Insect | Egg | Crawler | | Pupa | Maturing adult* | Life cycle range |
|---|---|---|---|---|---|---|
| | | stage 1 | stage 2 | | | |
| Female .. .. .. | .. | .. | 9 | .. | 11·5 | 42–59** |
| Male and female .. .. | 11·5 | 10 | .. | .. | .. | .. |
| Male .. .. .. | .. | .. | 8 | 6–7 | .. | 33–41 |

* The adult female from stage 2 to the formation of the felt covering.
** At 59 days 84% of the adult females had begun to lay eggs.

# Pastures in coastal south-east Queensland

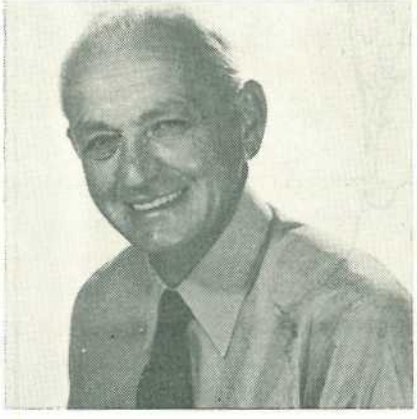
*by H. Ostrowski, Agriculture Branch.*

THE coastal strip of south-east Queensland is the most densely populated part of the State with a consequent high demand for agricultural products.

It also has a high rainfall which can give high production per hectare. The better soil areas around Brisbane city and the main towns are mainly used for horticulture. Sugar-cane is also grown in suitable areas. The remaining areas are mostly occupied by dairy farms which supply large quantities of fresh milk for urban consumers. In the last decade, however, many dairy farmers have changed to beef production.

The environmental conditions with rather mild temperatures are well suited for pastures provided the generally poor fertility of the soils is improved. However, the current recession in dairy and beef enterprises combined with the high costs of pasture establishment and maintenance has strongly undercut the pasture development programmes which were initiated in the previous decade.

The area to be dealt with in this article extends from the border of New South Wales north to Tiaro and west to the Jimbroken-D'Aguilar-Conondale and Jimna Ranges (see figure 1).



*The author, Henry Ostrowski, is a Senior Agrostologist with the Department's Agriculture Branch in Brisbane.*

*Natural pasture (mainly mat grass and paspalum) on cleared rain-forest country at Mt. Mee.*

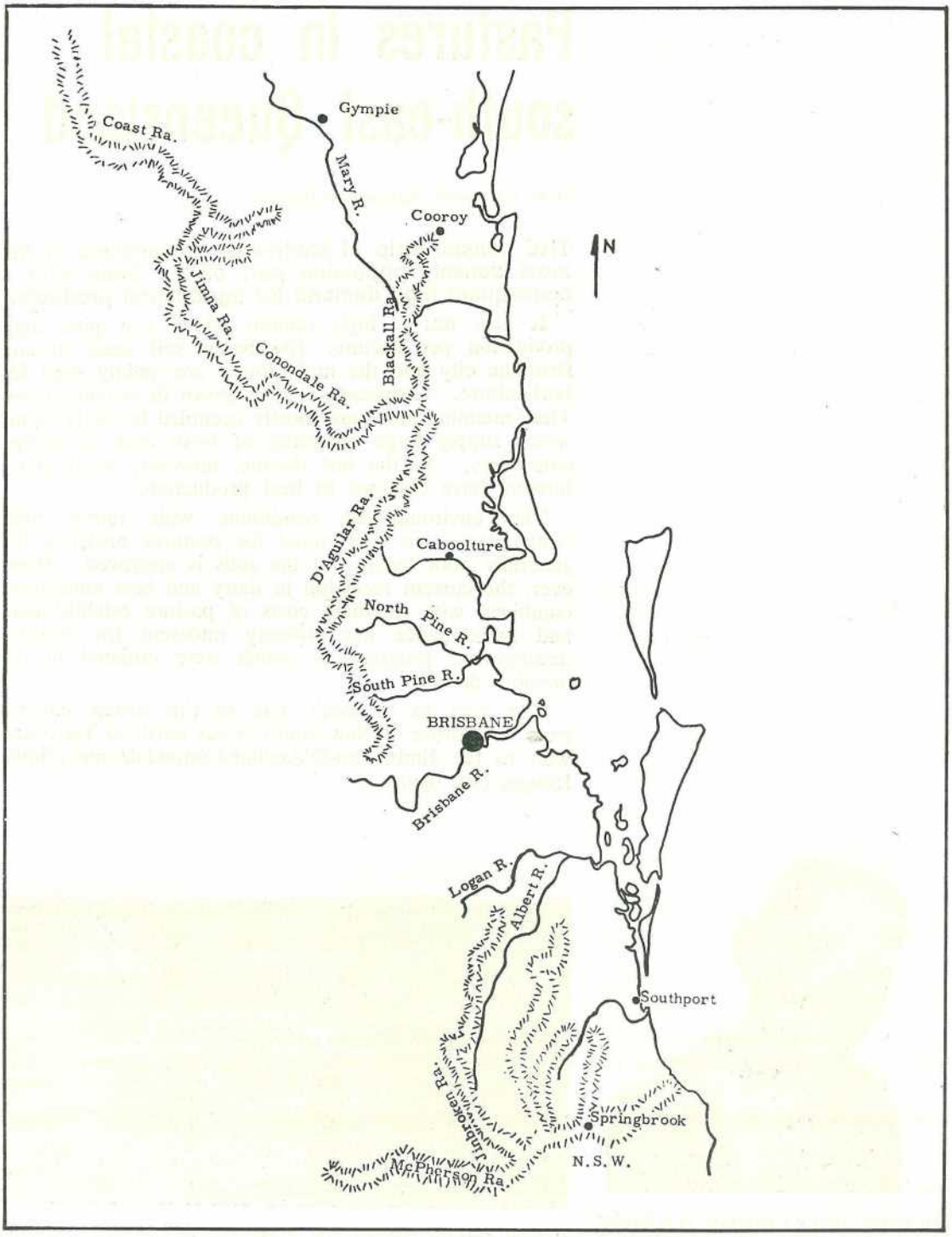



*Figure 1. The coastal south-east Queensland region.*

It consists of a narrow strip of coastal lowlands in the east, flanked by undulating to steep mountainous country in the south and west, and undulating hillsides in the north. Altitudes range from sea level to about 1 000 metres. A number of small rivers and streams drain the region.

## Climate

With the exception of elevated areas, the region has a humid sub-tropical climate. The mean annual rainfall varies from 3 060 mm at Springbrook to 1 150 mm at Gympie, with an average of 1 400 mm for the whole region. The rainfall has a predominantly summer incidence, about 60% falling in the December to March period. August is the driest month of the year, while February is the wettest. The mean seasonal and total rainfall for various centres is shown in table 1.

Rainfall, especially during the winter, is not reliable and moisture stress is possible at any time of the year.

Temperatures vary with elevation. January and February are the hottest months, July and August the coldest. A number of frosts can be expected in the June to August period, but they are relatively mild and restricted to the lower slopes, river valleys, flats and plateaux. The upper slopes of many hillsides are almost frost free.

High humidity and high evaporation are common over summer. Radiation is high enough to keep pastures growing the whole year.

## Soils

There is a great geological diversity in the region which is expressed in the lack of large, continuous areas of uniform soil types.

The major soils that occur can be grouped as follows: podzolics, red friable earths, coastal lowland, alluvial, black earths and skeletal soils (see figure 2).

### Podzolic soils

These are the most common soils in the region. They occur on flats and undulating to hilly country, and support eucalypt forest. They were formed from various acidic parent materials and are characterized by a shallow, gravelly nature, poor drainage and poor water holding capacity. Fertility is very poor with nutrients extensively leached. The physical structure is usually also poor, with little organic matter present. Properly managed, however, they can grow good pastures and substantial areas are sown.

### Red friable earth soils

These are deep, well drained soils originally supporting dense vegetation in the high rainfall areas. All plateaux in this region consist of these soils. Following clearing, the soils were fertile but this fertility has declined with time especially under cultivation.

TABLE 1

RAINFALL (mm) FOR MAJOR CENTRES IN COASTAL SOUTH-EAST QUEENSLAND (LONG TERM AVERAGES)

| Centre | Spring (Sep.–Nov.) | Summer (Dec.–Feb.) | Autumn (Mar.–May) | Winter (Jun.–Aug.) | Yearly Average |
|---|---|---|---|---|---|
| Springbrook | 478 | 1 180 | 959 | 447 | 3 060 |
| Maleny | 302 | 811 | 633 | 250 | 1 996 |
| Cooroy | 253 | 670 | 490 | 214 | 1 627 |
| Mount Tamborine | 268 | 593 | 422 | 252 | 1 536 |
| Kin-Kin | 238 | 600 | 461 | 197 | 1 498 |
| Mount Mee | 251 | 601 | 419 | 188 | 1 453 |
| Southport | 246 | 505 | 455 | 226 | 1 433 |
| Beechmont | 241 | 561 | 383 | 227 | 1 408 |
| Caboolture | 219 | 563 | 386 | 173 | 1 342 |
| Beenleigh | 211 | 461 | 359 | 192 | 1 224 |
| Kandanga | 217 | 501 | 308 | 150 | 1 182 |
| Gympie | 210 | 477 | 307 | 155 | 1 150 |
| Brisbane | 217 | 452 | 299 | 171 | 1 149 |

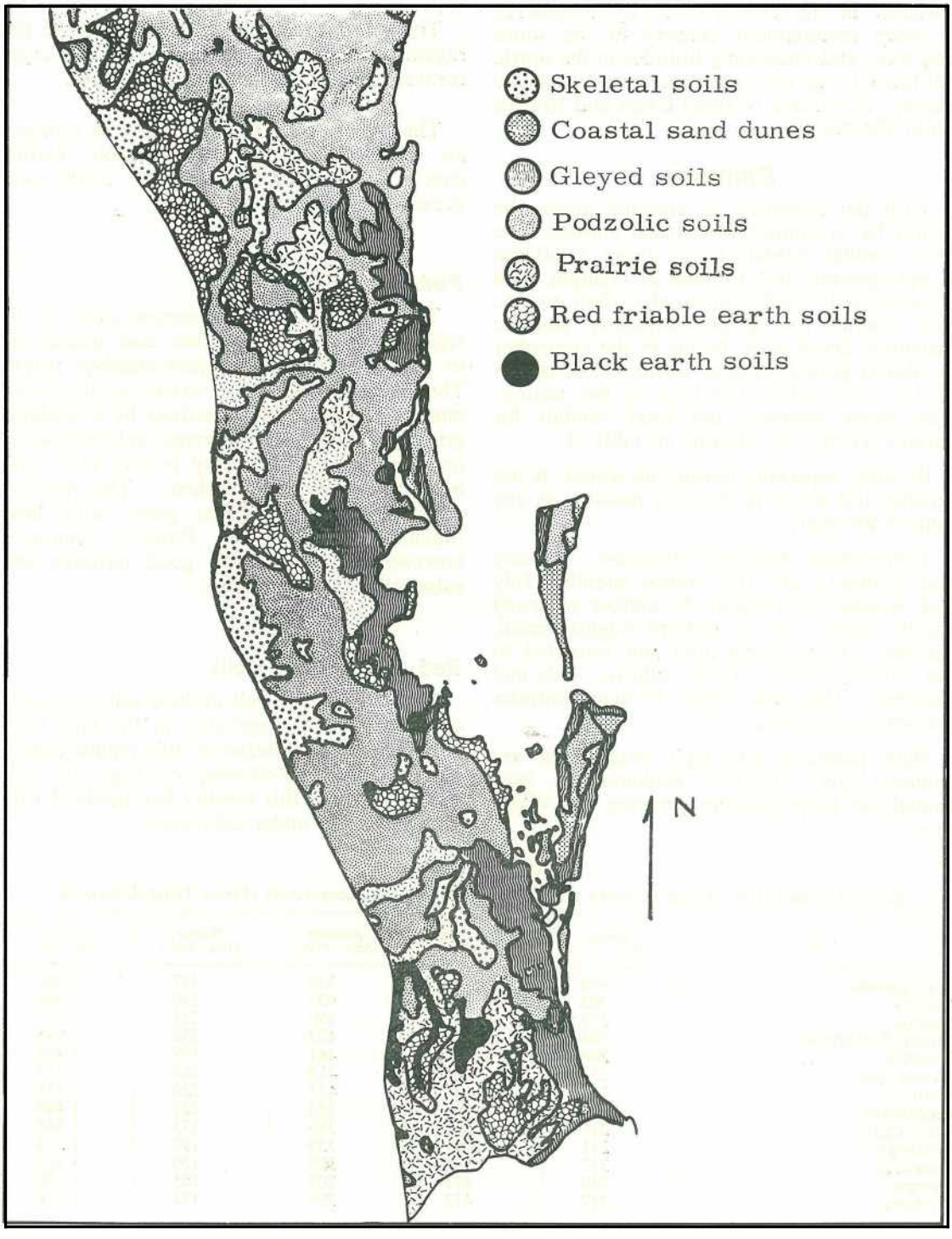



*Figure 2. Soils map (adapted from the Atlas of Australian Soils, C.S.I.R.O.).*

### Coastal lowland soils

Soils in a narrow strip along the coast line are better known as 'wallum' soils. They are often poorly drained and are subject to widely fluctuating water tables. These soils show a deep podzolic profile on higher ground, progressively changing down-slope to humic gleys on low-lying areas of impeded drainage. Swamps and peats are common. All are extremely infertile and the reaction ranges from acid to strongly acid.

### Alluvial soils

These are the most productive soils in the region. They are mainly grey to brown in colour and from light to heavy in texture, depending on parent material and distance from the headwaters. Their physical structure is usually well developed. Prairie soils of friable, loamy to clayey texture with brown to yellow-grey subsoils occur in the valley plains.

### Black earth soils

These are deep, fertile soils usually composed of heavy clay. They are not common in the region and occur only on some flood plains.

### Skeletal soils

These are shallow and stony with very poor profile development. They occur on tops of hills or on steep slopes and are best retained under timber to reduce erosion.

Most soils in coastal south-east Queensland are acid, with the common deficiencies being nitrogen, phosphorus, sulphur and molybdenum. On coastal lowlands, potassium, zinc and copper deficiencies are also frequent. Potassium is sufficient in other virgin soils but it diminishes with long periods of cultivation. Deficiencies of other nutrients may also occur in some particular soils.

## Original vegetation

The original vegetation, where not destroyed by a long period of settlement, is a good indicator of the quality of the land for agriculture. The type of vegetation is related predominantly to soil and climate factors.

The original vegetation of coastal south-east Queensland can be grouped into four types.

### Eucalypt forest

This forest covers the largest part of the region. It is typical of undulating to steep hillside country and consists of various types of eucalypt such as narrow-leaf (*Eucalyptus crebra*), silver-leaf ( *E. melanophloia*) and grey (*E. drepanophylla*) ironbark, Moreton Bay ash (*E. tessellaris*) spotted (*E. maculata*) and blue gum (*E. tereticornis*) and some species such as brush box (*Tristania conferta*) and she-oak (*Casuarina* spp.). The soil is generally poor.

Grass cover consists mainly of kangaroo grass (*Themeda australis*) with wire grasses (*Aristida* spp.) and love grasses (*Eragrostis* spp.) as minor components. On better soils, blue grasses (*Bothriochloa bladhii* and *Dichanthium* spp.) are dominant. In many situations these grasses, which do not withstand heavy grazing and burning, were progressively replaced by pitted blue grass (*Bothriochloa decipiens*), wire grasses, blady grass (*Imperata cylindrica*) and bracken fern (*Pteridium esculentum*) on settlement. The soils carrying this type of forest are poor.

### Rain-forest

Rain-forests grow on relatively small areas in the Gympie-Cooroy districts, on the Blackall Range, Mt. Mee and the McPherson Range on Queensland's southern border. The plateaux of Maleny, Tamborine, Beechmont and Springbrook were also originally covered by this forest. Rain-forest usually grows on fertile soils but occasionally may also be found on poorer soils.

Rainfall in these areas is usually high but variable and averages from 1 500 to 2 000 mm and to 3 060 at Springbrook. It consists of dense stands of tall trees in which climbing vines or lianas are abundant. Grasses cannot gain a foothold. However, on cleared land, many types of native and introduced pasture species can grow well.

### Bastard scrub

The so called 'bastard scrub' occuring in coastal south-east Queensland is a mixture of rain-forest and eucalypt forest. The canopy is not as tall as in the rain-forest, but is sufficiently dense to exclude grass. Soils are fertile, but lantana (*Lantana camara*) is a common pest.

*Dairy heifers grazing kikuyu grass at Eumundi.*

*Narok setaria is quite cold tolerant.*

### Wallum

This consists of rolling sandy ridges and flats, interspersed with peat swamps drained by slow-flowing creeks. Low-lying areas are subject to periodic flooding and waterlogging. Vegetation is a mosaic of sedges, heaths, tea-trees (*Melaleuca* spp.) and banksia (*Banksia aemula*) with eucalypts occuring on the ridges.

## Native pastures

Originally most of the country was dominated by kangaroo grass with love grasses and wire grasses as minor components. On more fertile soils, such as those derived from basalt, forest blue grass (*Bothriochloa bladhii*) or Queensland blue grass (*Dichanthium sericeum*) were dominant. Clearing of timber, intensive grazing and annual burning have led to a progressive replacement of these grasses by less palatable grasses such as pitted blue grass, wire grasses, spear grass (*Heteropogon contortus*) and blady grass.

*Rodd's Bay plicatulum.*

Some of the native pastures especially those in the higher rainfall areas were replaced with more productive, introduced species such as paspalum (*Paspalum dilatatum*), kikuyu grass (*Pennisetum clandestinum*) and white clover (*Trifolium repens*). Initially, the soil fertility was sufficient to support these species. With time, under high grazing pressure and high annual rainfall, the fertility has declined to the point where these species were invaded by mat grass (*Axonopus affinis*).

Some other species such as green couch (*Cynodon dactylon*), blue couch (*Digitaria didactyla*) and Rhodes grass (*Chloris gayana*), have naturalized freely in native pastures.

At present, natural pastures, usually containing some naturalized species, cover the larger part of grazing land in the region. They are of very poor quality and are strongly deficient in phosphorus and nitrogen. Their season of growth is short and their response to fertilizer and other management treatments is small.

They are not able to maintain cattle production throughout the year without liveweight loss in some periods, and their yields fluctuate from season to season and year to year, depending on prevailing weather conditions. As these pastures are usually heavily over-grazed, deterioration in their composition is continuing.

## Improving native pastures

Sown pastures will maintain higher animal production than native pastures. However, there is a trend to improve the existing native or naturalized pasture with minimum costs rather than planting a completely new pasture. The reasons for this are the high costs of establishing a new pasture and the current low returns for animal products. Better pasture technology also makes this new approach feasible. Improving a pasture with minimum costs can be achieved by over-sowing with suitable legumes and encouraging the better grasses to spread freely.

Legumes require a high phosphate level in the soil, but in return, through their nitrogen fixing ability, they are capable of lifting the production of associated grasses.

To keep costs to a minimum, the natural pasture ideally should already contain some paspalum or kikuyu. The presence of native grasses only, which are slow to respond to improved fertility, will not produce a quick return on the capital expended.

The main factor in this programme is superphosphate (with molybdenum if necessary). This has to be supplied in the required quantity, according to the deficiency in the soil, usually at the rate of from 300 to 600 kg per hectare.

There are two legumes which are suitable for planting in such pastures with little or no soil disturbance. These are white clover and siratro (*Macroptilium atropurpureum*). White clover can be spread with superphosphate in one operation without soil disturbance, while sowing of siratro will generally need some seed-bed preparation and seed coverage. Direct sod-seeding of siratro may be successful also. Other legumes are not as suitable for this kind of operation.

White clover should be planted preferably in the autumn, at 2 to 5 kg per hectare, and siratro in the late-spring-early summer period at 4 to 8 kg per hectare. Clover seed should be inoculated and pelleted with lime if mixed with superphosphate at sowing. To improve the grass component of the pasture, small quantities of improved grasses (0·2 to 0·5 kg per hectare) can be added to siratro plantings.

Some success may be also obtained by planting legumes such as glycine (*Glycine wightii*) on better soils, Archer axillaris (*Macrotyloma axillare*), lotononis (*Lotononis bainesi*), green-leaf desmodium (*Desmodium intortum*) and stylo (*Stylosanthes guianensis*) in the ashes after burning off dry native grasses.

An improved native or naturalized pasture planted this way should be grazed leniently during the legume establishment period and should be left to seed down at the end of the legume growing season. Adequate maintenance superphosphate should be applied each year to maintain an active legume component.

## Improved pastures

Soon after settlement it was realized that the native grasses with their strong seasonal habit of growth, low yields and very low nutritional value over winter were not able to provide for the constantly increasing cattle numbers. The initial solution was supplementation with forage crops, and later, replacing the native pastures with some more reliable pasture species. Early attempts to introduce some of the old country species were only moderately successful because of completely different conditions.

Real pasture improvement in coastal south-east Queensland was not achieved until the introduction of paspalum, Rhodes grass, kikuyu grass and white clover in the early part of this century. These were planted on a large scale. Except for some white clover, they lacked legumes. They were also not fertilized, so their productivity declined with time.

It was not until the 1960s when a large number of tropical pasture species became available and fundamental studies on pasture nutrition were undertaken, that a second wave of pasture improvement commenced.

### Role of legumes

The coastal soils are very deficient in nitrogen. Since nitrogen is the main component of protein, large quantities are essential for pasture growth. Legumes, with the help of nodule bacteria (*Rhizobium* spp.) are able to fix nitrogen from the air. This nitrogen is used by the legumes themselves, but a great part of it is later transferred to the companion grasses by way of leaf-fall, root and nodule decomposition and through dung and urine from animals.

Pasture improvement in coastal Queensland is based largely on the concept of grass/legume mixtures. Productivity depends on a vigorous legume component in the sward. If reasonable nitrogen fixation occurs, the legume will maintain satisfactory grass growth on nitrogen-deficient soils and serve as a cheap alternative to costly nitrogen fertilizer.

Besides stimulating grass growth, legumes are high quality stock feed and, depending on variety and stage of growth, contain between 10 and 25% crude protein.

### Tropical pastures

Environmental conditions in coastal south-east Queensland are well suited for the growth of sub-tropical and some tropical pasture species. It is clear today that the whole development of the grazing industry in this region has to be based on these species. Furthermore, sub-tropical species (both grasses and legumes) are better adapted than temperate species to the acid and infertile soils common in this area.

Tropical pastures, however, have some limitations. Their growth is seasonal. Low temperatures during the winter and erratic rainfall during spring and early summer can severely reduce their production. Above the frost-line, tropical pastures are capable of making growth for 7 to 8 months of the year. Some of the sub-tropical species, however, possess some cold tolerance and although they are not able to make much growth during this period, they may be used as autumn-saved feed for deferred grazing later in the winter.

Some other species are able to produce substantial amounts of feed early in spring. Research is continuing and there is hope that by using these species the winter feed gap can be reduced to a very short period.

The nutritive value of tropical pastures is generally much lower than that of temperate pastures. However, while tropical pastures are not able to meet the entire production requirements of dairy cows, they can meet the requirements of beef animals nearly as well as temperate pastures (see table 2).

TABLE 2

PRODUCTIVITY OF TEMPERATE AND TROPICAL PASTURES†

| Diet | Dry matter digestibility (%) | Maximum milk production* (kg/cow/lactation) | Beef production liveweight gain (kg/day) |
|---|---|---|---|
| Tropical pasture | | | |
| 1. Young growth .. .. .. | 60–65 | 1 800–2 200 | 0.7–0.9 |
| 2. Semi-mature growth .. .. .. | 50–55 | 1 000–1 400 | 0.4–0.5 |
| Temperate pasture .. .. .. .. | 70–80 | 3 300–3 800 | 0.9–1.2 |
| Concentrate ration .. .. .. .. | 80–85 | 4 400–4 900 | 1.2–1.4 |

* Jersey cows

† From article—Milk production from tropical pastures—by T. H. Stobbs and P. A. C. Thompson, in World Animal Review No. 13 pages 27–31 (1975).

## Temperate pastures

These can grow in low temperatures, but they also require moisture—a factor seldom present in south-east Queensland during the late autumn-winter-early spring period. Summer rainfall may be more than adequate for tropical species but temperate species can suffer moisture stress during short, hot, dry periods.

Irrigation is necessary if reliable yields are to be obtained. Under natural rainfall they may be grown only at high altitudes or on wetter sites and on soils which have a high moisture holding capacity. Their persistence under dryland conditions is poor because of heavy competition from summer-growing grasses and weeds during the hot summer months.

Good temperate pastures can fill the midwinter feed gap and provide protein rich feed in the autumn, when the quality of summer pastures is often low, and in the early spring when summer pastures are commencing growth and bulk is not available.

As these pastures have a much higher nutritional requirement than tropical pastures, they should be planted only on very good soils. Otherwise a heavy application of fertilizer will be necessary.

Most of the temperate pastures grown in coastal south-east Queensland are of an annual character and are limited mainly to ryegrass (*Lolium* spp.) and white clover. Some new phalaris (*Phalaris* spp.) lines are promising for more permanent plantings.

In the last few years, so called 'high density' ryegrass pastures have become popular. In these, straight ryegrass is oversown into natural pasture at a high seeding rate, heavily fertilized with nitrogen and well irrigated. They are very costly, but can provide a heavy bulk of high quality feed throughout the cool season.

## Grass-legume and pure grass pastures

Both tropical and temperate pastures grown under natural rainfall conditions are mainly grass-legume pastures. However, some pure grass swards are used. They are generally fertilized strategically with nitrogen to promote extra growth at critical periods (for example, late spring and late autumn). Nitrogen fertilizer is very expensive and substantial yield increases are necessary to make it pay.

When adequately fertilized and watered, pure grass pastures can provide much higher total yields than grass-legume pastures. This can be very important for farms with a limited area. An irrigated, high density ryegrass pasture is a good example.

The quality of grass legume pastures is less dependent on prevailing rainfall and their protein levels are more even. Under favourable conditions and when grass-legume proportion is well balanced, they can produce comparable yields to pure grass pastures. Their establishment and maintenance costs are much lower.

*Dense stand of siratro on road cutting.*

## Pasture establishment

### Time of sowing

The main factors determining sowing time are soil temperature and moisture.

For summer species, an early to midspring planting (late September and October) when the danger of frost is over and there is sufficient moisture from early storms, is generally preferred. The young plants may suffer from hot, dry weather in late November–early December, but by this time they should be established well enough to survive.

Planted early, they respond rapidly to the January-February rains and have a full season to develop. However, where weeds especially crowsfoot grass (*Eleusine indica*) may be a problem, midsummer plantings are preferable. Sowings later than February are not recommended. An exception is kikuyu which does not withstand high temperatures well in the seedling stage. It should be planted in March or early April.

Temperate species should be planted from late March to early June when temperatures are lower and competition from summer growing grasses is minimal.

### Seedbed preparation

A well prepared seedbed will give the best pasture.

On new forest clearings, after removal of stumps and burning of timber, a cross ripping with a heavy ripper is advised. This will break up the soil and bring many roots and stones to the surface. It will also make the ground much easier to cultivate with a chisel plough or heavy offset discs. One or two further workings with a cultivator and a final harrowing should leave the seedbed in fine condition. Another light harrowing just before sowing will kill many germinating weeds and break up the surface crust for seeding. If possible, all these operations should be done across the slope to minimize erosion.

A firm but friable seedbed should be the target. This is especially important on some red volcanic soils which are very loose and settle slowly. Rolling before and after planting will help to consolidate such soils.

On soils carrying a heavy body of unwanted grasses, slashing followed by rotary hoeing of the top 5 to 8 cm will destroy many of the surface roots and make deep ploughing much easier.

In places too rough for cultivation or for partial clearing, spraying with weedicides or brushing and burning will be the only preparation possible. In such places, seed can be broadcast by hand or from the air but cannot be covered. Consequently, an extended period of showery weather is essential to ensure successful germination and establishment. In such sowings, all inoculated legume seed should be pelleted with lime (temperates) or bauxite (tropicals) to give the *Rhizobium* protection from direct sunlight.

To introduce tropical legumes into an existing kikuyu sward, severe renovation is necessary. This should be carried out in the early spring, before the grass is in its most active stage of growth. Generally, it is difficult to establish legumes in the existing pasture, and all precautions should be taken to obtain rapid germination. It is strongly recommended in such cases to use scarified seed as germination of this seed is faster and more even.

Severe renovation is also necessary for autumn over-sowing of kikuyu, paspalum or mat grass pastures with ryegrass or oats for increased winter production.

On a dense sward of grass such as kikuyu, a herbicide may be used to reduce competition from the grass during the establishment period of the legume. The grass will re-establish itself later. The chemical dalapon (2,2DPA) sold under various trade names at 5 to 10 kg of active constituent per hectare can be used for this purpose.

## Methods of planting

All legume seed should be inoculated with the appropriate *Rhizobium* culture before planting. After inoculation, allow the seed to dry away from direct sunlight. The various components of the mixture can then be combined for planting.

Drilling is the most accurate way of sowing, but fertilizer spreaders are more commonly used. Modern spreaders can spread small amounts of seed very accurately. In using the older models, the seed should be mixed thoroughly with dried, sieved hardwood sawdust to give a better flow and more even distribution.

In some plantings, seed has been mixed with fertilizer as a carrier but results generally have not been as satisfactory as with sawdust. When mixing seed with superphosphate or other acid fertilizer, care should be taken to prevent the inoculated legume seed being in direct contact with fertilizer any longer than necessary. Pelleting will protect the seed from the harmful effect of acidity.

After sowing, the ground should be lightly harrowed. Peg tooth harrows are commonly used but where only shallow seed coverage is required, a large, leafy branch dragged behind the tractor gives excellent results. Finally, if possible, the area should be rolled. For small seeds such as Greenleaf desmodium or lotononis, it is better to roll the seed into the ground without harrowing. If heavy rain falls immediately after sowing, even rolling of small seeds is not necessary. Seed should germinate in about 5 to 10 days under favourable conditions.

Direct sod-seeding of winter components such as oats (*Avena* spp.), ryegrass or vetches (*Vicia* spp.) into a very well grazed pasture of mat forming grasses is practised on some lighter soils.

## Pre-cropping

Quite often, for various reasons, preparations are finalized too late in the season for a pasture to be reliably established. Instead of taking a risk, it is better to grow a suitable crop and plant the pasture in the following season.

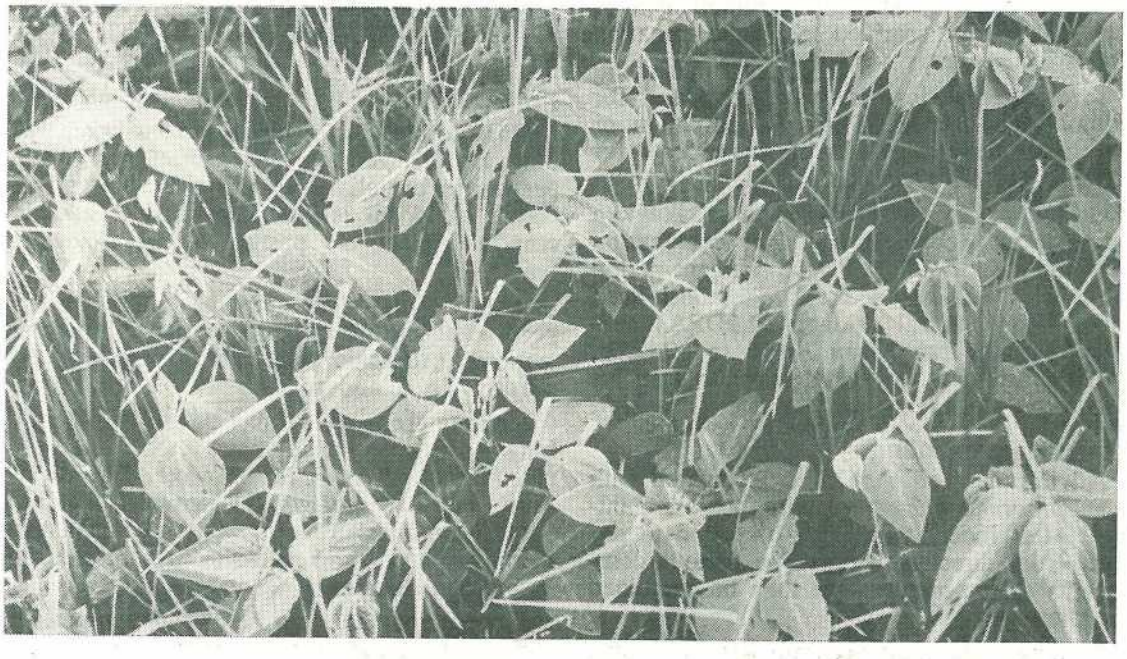
A phase of fodder cropping before sowing permanent pasture helps to get the soil in good working order, improves the available soil nitrogen level and reduces weed populations.

Grazing crops which may be grown successfully in this area include oats, vetches and field pea (*Pisum arvense*) in the winter and lablab bean (*Lablab purpureus*), cowpea (*Vigna* spp.), sorghums (*Sorghum* spp.), panicums (*Panicum* spp.) and maize (*Zea mais*) in the spring and summer.

Grazing of the crop should be completed early enough for pasture seedbed to be adequately prepared.

*ABOVE. Competitive growth of Tinaroo glycine at D'Aguilar.*

*BELOW. 3-year-old pasture of kikuyu with Greenleaf and Silverleaf desmodium at Mt. Mee.*



## Fertilizers

### For establishment

A general recommendation for the establishment of grass-legume pastures is to use at least 400 kg per hectare of molybdenized (Mo) superphosphate 24. Some poorer forest soils will need not less than 700 kg per hectare of superphosphate. If more than 400 kg per hectare is to be applied, Mo superphosphate 12 should be used. For glycine, which has a higher molybdenum requirement than other tropical legumes, Mo superphosphate 24 may be used up to 700 kg per hectare.

On soils with extreme deficiency in nitrogen, a light application (20 kg per hectare) of elemental nitrogen (N) is useful. On other soils, a sufficient amount of available nitrogen should be released by cultivation to maintain the grass component of the pasture during the establishment phase. Pure grass pastures should receive about 50 kg of N per hectare at planting.

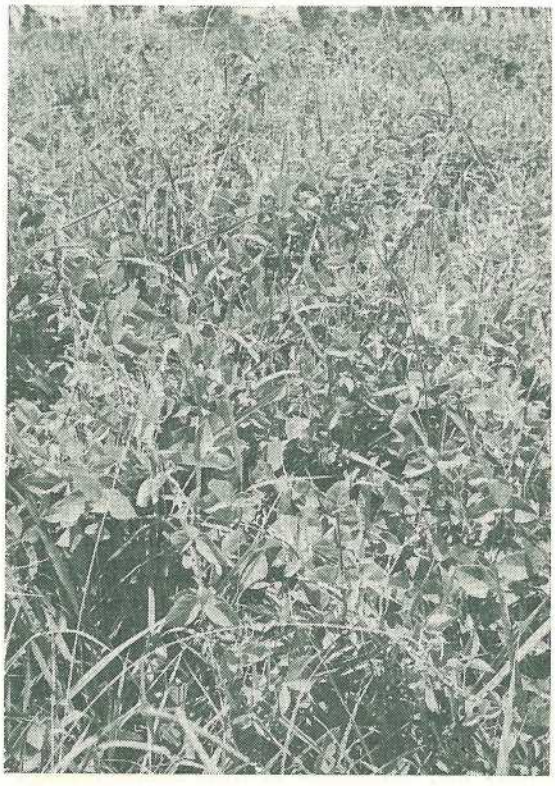
These recommendations will apply to a wide range of soils, except wallum soils. The latter are highly deficient in many elements, and application of 600 kg of agricultural limestone plus 13 kg nitrogen, 60 kg phosphorus, 60 kg potassium, 2 kg copper, 2 kg zinc and 140 g molybdenum per hectare is needed to correct the deficiencies.

The best time to apply fertilizer is about 10 days before sowing, but to reduce operating costs, seed and fertilizer may be applied together. However, separate applications of fertilizer and seed are more accurate.

### For maintenance

Maintenance fertilizer for grass-legume pastures consists mainly of superphosphate which should be applied at 200 to 400 kg per hectare annually. Every 3 to 4 years, Mo superphosphate should be used instead of straight superphosphate.

The amount of nitrogen used on pure grass rain-grown pastures will depend upon prevailing moisture conditions. Under irrigation, however, 200 to 400 kg of N per hectare should be applied annually in a number of split applications—preferably after each grazing.



*Well balanced pasture of green panic and glycine at Mt. Mee.*

Generally, the soils in south-east Queensland, with the exception of wallum soils and old cultivations, are adequately applied with potassium but after a few years under a pasture, the addition of muriate of potash at 50 to 100 kg per hectare may be necessary. Soils and leaf analyses are helpful in detecting deficiencies.

On larger areas, the aerial application of maintenance fertilizer can sometimes be more convenient and economical.

## Management

### Grazing

Particular care should be taken with the pasture in the early stages of development. It should not be grazed too early. The plants must be well established before cattle are allowed entry.

Grasses generally develop much faster than legumes and this can give a misleading impression of the maturity of the pasture. On the other hand, waiting too long before the first grazing results in the loss of valuable grazing and the suppression of the legume through shading by the grasses. The first grazing should always be light and cattle should be allowed to remove the top parts of the grasses only. Generally, after such grazing, the legumes grow much faster and keep up with the grasses.

As a rule, tropical pastures should not be grazed too closely. Leniently grazed pastures will recover more rapidly and will be ready for another grazing much sooner than heavily grazed pastures. On the other hand, pangola-lotononis, kikuyu and temperate ryegrass—white clover pastures, may be grazed much closer to the ground. Over-stocking will reduce pasture persistence, but under-stocking will lower pasture quality.

If the stand becomes too thin, it can be left ungrazed for reseeding. This generally will improve the density, especially if soil fertility is maintained at a satisfactory level. Some legumes, however, may be affected by frost before they commence to seed. Skilful management will result in a vigorous, well balanced, nutritious pasture that will provide high animal production.

### Weeds

Weeds are often a problem in young pastures. Slashing after grazing will help greatly in their control but extra care must be taken not to slash lower than 10 cm as this may damage the tropical legumes. Leaving a vigorous pasture ungrazed to overgrow and suppress weeds is also a good method of control.

Areas infested by more persistent weeds such as blackberry (*Rubus* spp.), groundsel bush (*Baccharis halimifolia*) wild tobacco (*Solanum auriculatum*) or mist flower (*Eupatorium riparium*) should be spot-sprayed with hormone type weedicides, but care should be taken because the spray will badly damage or even kill some legumes. Stylo (*Stylosanthes guianensis*) and Greenleaf desmodium are, however, fairly tolerant to weedicides. Pure grass pastures may be sprayed safely with 2,4-D to control a wide spectrum of broad-leaved weeds.

### Bloat

There is little danger of bloat in cattle grazing tropical pastures but there is a potential danger in grazing some of the temperate legumes such as clover and lucerne. The risk of bloat on such pastures may be reduced by maintaining the legume content of the pasture below 50% of the total bulk, feeding roughages to the cattle and allowing access to dry pastures before grazing. Grazing when the foliage of temperate legumes is wet should be avoided.

Various commercial anti-bloat preparations are available. These may be sprayed on the pasture, applied to the feed or drinking water or administered as a drench.

## Recommended pasture mixtures

Various pasture mixtures should be used over the whole farm to provide year-round production. Even on small properties, variations occur in soil fertility, moisture status, drainage, temperature, aspect and many other factors determining pasture growth. The degree of seed-bed preparation required will also differ. All these factors have to be considered when choosing the most suitable pasture mixture.

Each grass and legume has its own particular production pattern. The mixtures should be so arranged that they will provide grazing for as long a period as possible.

Recommended grasses and legumes in order of priority for various types are shown in table 3. Table 4 shows sowing rates.

Mixtures containing one type of grass and two or more legumes are recommended. Mixtures of components with different palatability should be avoided as this leads to selective grazing and consequent loss of more valuable species.

## Irrigation

The types, establishment and maintenance of irrigated pastures have been discussed in the other parts of this article. This section deals with irrigation practice.

TABLE 3

RECOMMENDED PASTURE SPECIES

| Situation | Grasses | Legumes |
|---|---|---|
| Wet, occasionally water-logged soils .. .. | pangola grass (runners)<br>plicatulum<br>setaria<br>para grass | lotononis<br>phasey bean<br>greater lotus |
| Lowlands .. .. .. .. .. | setaria<br>pangola grass<br>plicatulum<br>paspalum | Silverleaf desmodium<br>Greenleaf desmodium<br>lotononis<br>white clover<br>Safari white clover<br>phasey bean |
| Low fertility, forest soils .. .. .. | setaria<br>broadleaf paspalum<br>plicatulum<br>Rhodes grass<br>molasses grass | siratro<br>Greenleaf desmodium<br>Silverleaf desmodium<br>Archer axillaris<br>white clover |
| Red volcanic soils .. .. .. .. | kikuyu grass<br>setaria<br>Gatton panic<br>green panic | glycine<br>Greenleaf desmodium<br>Silverleaf desmodium<br>siratro<br>white clover<br>Safari white clover |
| Scrub soils .. .. .. .. .. | setaria<br>Gatton panic<br>green panic<br>kikuyu grass<br>paspalum | Greenleaf desmodium<br>glycine<br>siratro<br>Silverleaf desmodium<br>white clover<br>Safari white clover<br>lucerne |
| Rough, unworkable ridges .. .. .. | molasses grass<br>Kazungula setaria<br>Rhodes grass<br>signal grass<br>kikuyu | siratro<br>white clover |
| Heavy soils .. .. .. .. .. | plicatulum<br>Narok and Nandi setaria | Silverleaf desmodium<br>white clover<br>phasey bean |
| Irrigated and high altitude temperate pasture | ryegrass<br>phalaris<br>fescue<br>prairie grass<br>oats | white clover<br>lucerne |

Irrigated pastures, especially temperates, should be watered regularly, and always before wilting becomes apparent. During the spring they should be irrigated at about 10-day intervals for sandy loams and 14 days for clay loams. These intervals can be reduced to 7 and 10 days respectively in summer and increased to 14 and 21 days respectively in winter.

The soil should be wet to the bottom of the root zone. This may require from 50 to 65 mm of irrigation water for sandy loams, and about 120 mm for clay soils. The depth of the root zone, however, will vary with different plant species and soils. The depth of the root zone and penetration of water can be measured quite easily with a soil auger.

TABLE 4 RECOMMENDED SOWING RATES (KG/HA)*

TROPICAL SPECIES

| Grasses | | Legumes | |
|---|---|---|---|
| Broadleaf paspalum | 3–4 | | |
| Gatton panic | 2–3 | Archer axillaris | 2–3 |
| Green panic | 2–3 | Glycine | 4–6 |
| Kikuyu grass | 1·5–2 | Greenleaf desmodium | 1–1·5 |
| Molasses grass | 1·5–2 | Lotononis | 0·75–1·5 |
| Paspalum | 4–6 | Phasey bean | 1·5–2 |
| Plicatulum | 2–3 | Safari white clover | 3–4 |
| Rhodes grass | 3–4 | Silverleaf desmodium | 2–3 |
| Setaria: Narok and Nandi | 1·5–2 | Siratro | 3–4 |
| Kazungula | 1–1·5 | | |
| Signal grass | 3–4 | | |

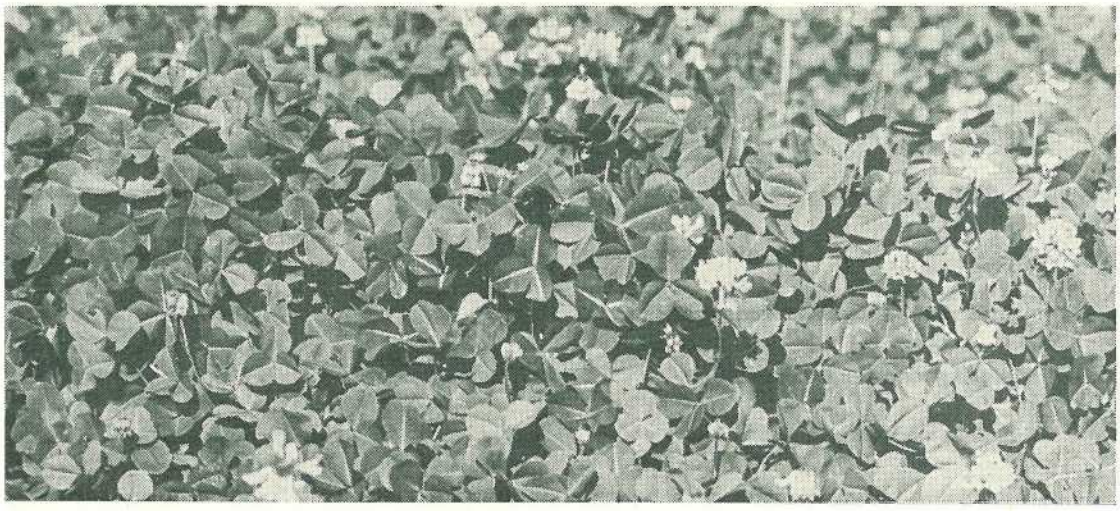
TEMPERATE SPECIES

| | | | |
|---|---|---|---|
| Fescue | 2–3 | Greater lotus | 0·5–1 |
| Ryegrass (straight grass) | 10–30† | Lucerne (pure stand) | 10–14 |
| Ryegrass (grass-legume) | 4–8 | Lucerne (grass-legume) | 4–6 |
| Phalaris | 2–3 | White clover | 2–3 |
| Prairie grass | 8–10 | | |

*These rates are for sowing mixtures containing only one grass and one legume. Where more than one grass or legume are sown, the rates should be reduced proportionally.

†The higher seeding rates are for poorly prepared seedbeds and high rates of nitrogen (for example, 'high density' ryegrass).

*Attractive mixture of pangola grass and lotononis.*



*Safari Kenya white clover.*

Preferably, every grazing should be followed by watering. Grazing immediately after watering may cause soil pugging, especially on clayey soils.

## Nutritional value and production

Nutritive value of plants depends mainly on the variety, stage of growth and the fertility of the soil. Generally, legumes are much more nutritious than grasses, and temperate species are more nutritious than their tropical counterparts. Plants, especially grasses, lose their nutritive value rapidly with maturity. For example, variations in crude protein levels in kikuyu may range from 3 to 18% depending on the stage of growth and level of soil fertility.

Digestibility depends mainly on variety and the stage of growth. Digestibility of tropical grasses is about 13% lower than that of temperate grasses. There are, however, no big differences in digestibility percentages between tropical and temperate legumes.

Milk production requires a diet rich in both protein and carbohydrate, while beef production depends mainly on high carbohydrate intake.

Under normal farm practice, considering the various grades of pastures, a dairy cow may produce from 25 to 75 kg butterfat per lactation on unimproved pastures and up to 100 kg on improved pastures. If fed on irrigated pastures, crops and grain supplements, a cow can reach a level of 200 kg of butterfat.

Carrying capacity of various types of pastures may also vary greatly. Whereas 1·6 to 3·0 hectares are needed for a dairy cow grazed on unimproved pasture, this will change to 0·8 to 1·2 hectares on improved pastures and 0·2 hectares on irrigated temperate pasture.

## Farm feed year programme

To maintain high production, good grazing should be provided to the animals all year-round. Pastures are the cheapest source of feed, and crops and purchased feed should only be considered when further improvement of pastures is limited. The most critical period of the feed year is the winter, particularly for whole milk producers. On many properties, irrigated temperate pastures or winter crops will be necessary to maintain satisfactory production. The proper integration of native, tropical and temperate pastures and crops is the key to success.

The existence of natural pastures and the need for their proper management must not be overlooked. Annual applications of superphosphate and heavy stocking at some periods are necessary to encourage clover growth. At other times, the grazing pressure should be lenient. Occasional slashing to control weeds and to remove old, unused pasture will help to keep these pastures in good condition.

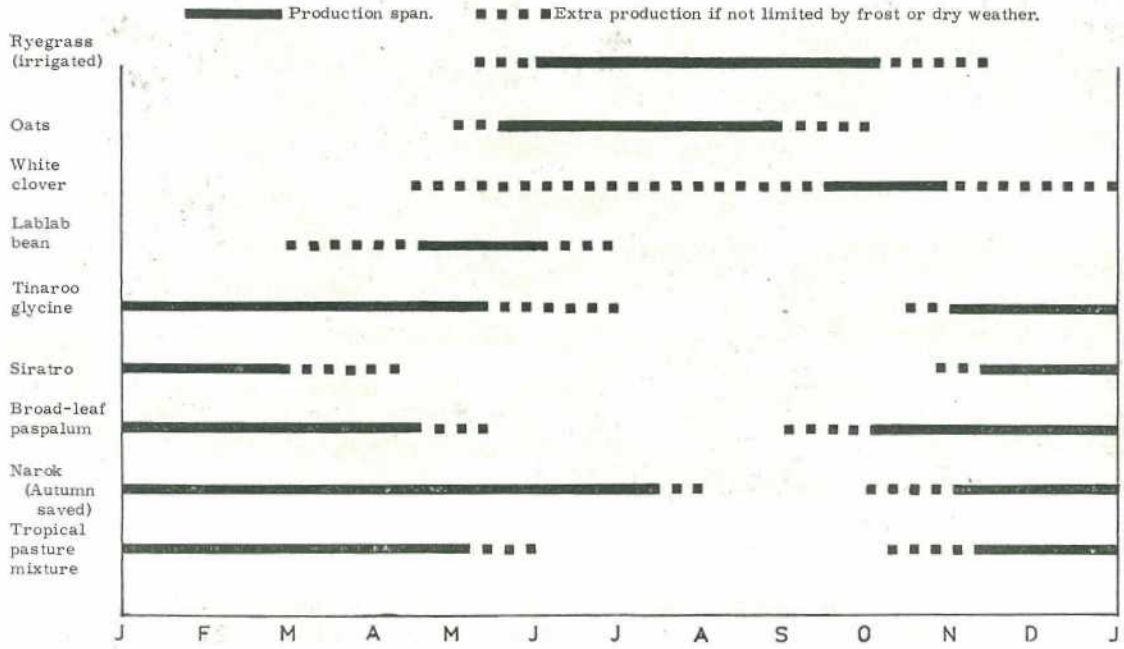



*Figure 3. The production span of pasture species in coastal south-east Queensland.*

Recent research in coastal south-eastern Queensland shows that high yields of moderate quality forage may be provided as late as the end of July from nitrogen-fertilized autumn-saved Narok setaria; kikuyu is also able to provide late autumn–early winter feed. Nitrogen-fertilized broadleaf paspalum (*Paspalum wetsteinii*) can provide substantial yields in the late September–October period when other feed is scarce. Care should be exercised not to harm the legume component of these pastures with excessive use of nitrogen.

In an average season with a pronounced wet period, tropical pastures are able to produce much more feed in the late summer than can be utilized by grazing animals. Conserving this extra feed in the form of hay or silage can help to overcome the winter shortage. In the frost-free areas, the autumn-saved tropicals may provide good grazing during the winter.

On the wetter soils, or with irrigation, sod-seeding of oats, ryegrass or vetches with fertilizer into kikuyu, pangola (*Digitaria decumbens*), paspalum or mat grass dominant pastures may help to overcome the winter feed shortage.

A summer crop of lablab bean may provide protein fodder during the autumn and, where frost incidence is low, even in early winter.

A range of species which may help to meet a year-round animal requirement is shown in figure 3.

## Description of grasses and legumes

### Tropical grasses

- SETARIA (*Setaria anceps*) is one of the best grasses for coastal south-east Queensland. It forms large tufts, stools readily and is a prolific seeder. As a result of these characteristics, it increases its density in the new pasture rapidly. It is very competitive and has a tendency to push out other grasses. It grows well from spring to late autumn, producing some growth in winter if there is no frost and enough moisture.

Where fertility and moisture are adequate, it produces heavy yields of palatable and nutritious forage. When heavily fertilized with

nitrogen, it will withstand heavy grazing pressure and maintain a pure sward. It can grow on a wide variety of soils, tolerates waterlogging and is very persistent.

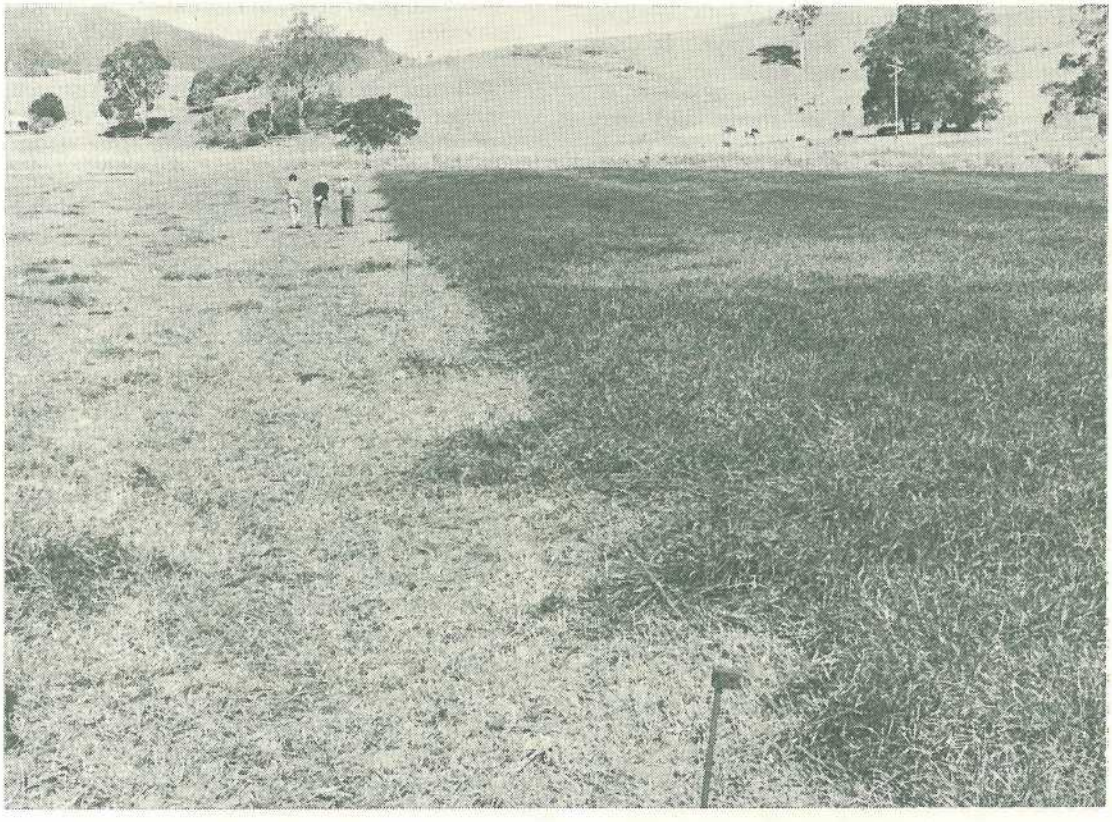
Of the three commercial cultivars, Narok is the most frost tolerant and may be used as autumn-saved forage for winter grazing. It is also more nutritious and more palatable than other varieties. Kazungula is a very coarse and stemmy cultivar, but is the most drought tolerant. Nandi is not as coarse as Kazungula and more leafy, but requires better soils and better moisture conditions.

All three varieties have a higher oxalate content than most other grasses. Very high concentration of oxalate in plants may cause some disorder in animals, especially in sheep and horses. Horses grazed on setaria may develop 'big head' disease. To prevent this, it is better to keep them away from setaria pastures.

- KIKUYU GRASS (*Pennisetum clandestinum*). This is a good grass for areas with higher rainfall and more fertile soils. It should not be planted on its own if these two requirements are not met.

On good scrub or red volcanic soils such as those on most plateaux, kikuyu grass will spread rapidly making a dense mat-like cover. Under these conditions, it produces high quality fodder and will grow right through until late autumn.

Two seeding cultivars, Whittet and Breakwell, are now available. The latter is mainly used as a lawn grass while the former is now widely grown as a pasture grass on suitable soils. Small quantities of seed of Whittet are frequently added to other grass-legume mixtures planted on poorer soils. The aim is to have this grass present in the pasture for further spread once the fertility of the soil improves through the action of the legumes. Like common kikuyu, both Whittet and Breakwell can be readily established from cuttings.



*Irrigated high density ryegrass pasture (on the right) at Dayboro.*

Kikuyu grows quite well with both white clover and tropical legumes such as Safari Kenya clover, glycine and desmodium, but it is very difficult to establish these legumes in an existing sward.

- GATTON PANIC (*Panicum maximum*). This grass resembles green panic and is very popular along the coastal area. It requires rather more moisture than green panic. Under these conditions, it will establish more readily, make better ground cover and outyield green panic. It appears to utilize soil nitrogen better and has a longer growing season.

- PETRIE GREEN PANIC (*Panicum maximum* var. *trichoglume*). Petrie forms medium-sized tufts and grows very rapidly giving a quick cover. This fast initial growth competes effectively with re-establishing weeds. Green panic is not greatly affected by drought provided it is well established before dry weather comes. It responds very quickly to rain, making lush growth within a few days. It does not like poorly-drained situations.

Petrie will grow well in shade and may be seen growing under trees and among dense shrubby weeds such as lantana. It combines well with both vigorous twining and low-growing legumes. It prefers fertile soils rich in nitrogen but may be sown on poorer soils if legumes are included. Green panic may appear rather yellow initially but improves considerably after a few seasons if the legume is effective.

- PASPALUM (*Paspalum dilatatum*). Paspalum is widely naturalized along the coastal belt of Queensland. While it is not widely planted in new sowings, owing to shortcomings such as rankness, a long period of seeding and infection of seed-heads with ergot (*Claviceps paspali*), it will persist in unimproved pastures for many years to come. The best method to restore its productivity in run-down pastures is to renovate and over-sow with white clover and superphosphate.

Heavy grazing and topping after grazing help to control ergot and keep the grass fresh.

- PANGOLA GRASS (*Digitaria decumbens*). Pangola grass does not produce fertile seed and has to be propogated vegetatively. However, it spreads rapidly and competes aggressively with other grasses. It grows on a wide range of soils, including wet, occasionally waterlogged areas but is extremely responsive to nitrogenous fertilizer. This grass is susceptible to frosting and low temperatures but regeneration is rapid in the spring. Its compatibility with vigorous tropical legumes is poor but it mixes fairly well with lotononis and white clover.

Pangola is palatable and nutritious and tolerates heavy grazing well. Under irrigation and heavy supplies of nitrogen, pure stands of pangola are able to produce very high yields of good quality fodder.

- PLICATULUM (*Paspalum plicatulum*). The quality of this grass is somewhat lower than other improved grasses but it has certain advantages such as the ability to grow on poor soils, tolerate dry conditions, flooding and waterlogging. It will grow in many situations where other grasses will not grow satisfactorily. Persistence under grazing is good. Seedheads are produced in April and are free from ergot.

Two cultivars of this grass are available commercially. They are Rodd's Bay and Bryan. Bryan is more compatible with legumes, more palatable and more drought tolerant than Rodd's Bay. A third cultivar, Hartley, has disappeared from the commercial trade.

- BROADLEAF PASPALUM (*Paspalum wettsteinii*). As yet, this grass is little used in Queensland although it possesses some favourable characteristics. It is a tufted and stoloniferous grass that originated in South America. It can grow on a variety of soils and, because of its relatively low nitrogen requirement, has the ability to compete with poorer grasses such as mat grass.

Broadleaf paspalum is quite drought-resistant, yet it can tolerate poor drainage. It is very susceptible to frost but it comes away very early in the spring while other tropical grasses are still quite dormant.

In newly-planted pastures, early growth of broadleaf paspalum may be slow but once the plants become well established rapid growth can be expected. The grass is very competitive with other grasses but combines well with legumes.

During an abundance of other feed, broadleaf paspalum is not relished by cattle but it is well eaten when the feed supply is scarce. Seed-heads of this grass appear only once during late summer and, unlike the common paspalum, are not infected by ergot.

- RHODES GRASS (*Chloris gayana*). This grass is adapted to a large part of Queensland but has not attained prominence in the coastal area as other grasses are better suited to high rainfall. Nevertheless, Rhodes grass is known as a good pioneer grass on new clearings and rough country. It may be grown on a wide range of soils and is tolerant of high soil salinity. The palatability declines rapidly once it seeds in summer.

The old, naturalized material is known as Pioneer. The newer cultivar, Callide is more vigorous and colonizes even better than Pioneer. Unlike Pioneer, it is a very late seeder which remains green until late summer. It is also much more palatable even when mature.

Katambora, which is widely used in Gympie area, has fine leaves and stems and a very dense root system.

Samford is less drought tolerant than other cultivars. Seed is not available.

- MOLASSES GRASS (*Melinis minutiflora*) is a good pioneer grass for new clearings and rough ridges which are difficult to cultivate. Molasses grass should not be grazed heavily. There are two hazards with this grass; it can be thinned out or killed by frost, or completely lost through fire.

*Grasslands Tama ryegrass.*

*Clover in tropical pasture.*

- SIGNAL GRASS (*Brachiaria decumbens*) cultivar Basilisk is well known in North Queensland. It is a vigorous and nutritious grass but very susceptible to frost. In coastal south-east Queensland it may be planted on warmer, frost-free ridges and on steep hillsides where good seedbed preparation is difficult and where the danger of weed invasion is serious. It is also good for planting on old banana and pineapple plantations where quick and dense cover is needed to suppress weeds.

## Temperate grasses

- RYEGRASSES (*Lolium* spp.). Ryegrasses are the most popular temperate grasses in this region. They can produce abundant yields of high quality forage especially during the cooler part of the year. A number of cultivars are available commercially.

Kangaroo Valley (perennial ryegrass) is rather slow in early winter, but produces well in the spring. It is more persistent, resistant to rust and tolerant of hot weather than other ryegrasses.

Two Italian ryegrasses (Grasslands Paroa and Grasslands Tama) grow as annuals, producing well during the winter, but are susceptible to rust.

Grasslands Manawa (known also as H1 ryegrass) is very popular in coastal areas for its easy establishment, high and evenly distributed yields, good recovery after grazing, rust resistance and some perenniality.

Wimmera annual ryegrass is a quick germinating and fast growing cultivar that produces a large bulk of early feed, but it can complete its life cycle as early as August. It has only moderate rust resistance, tolerates flooding and has a high degree of salt tolerance.

*Summer crop of lablab bean for autumn grazing.*

Glasslands Ariki is still in the evaluation stage. It shows slow initial growth, high yields in the spring, good persistence and fair rust tolerance.

- PHALARIS (*Phalaris aquatica*). Phalaris is cold tolerant but also survives hot, dry summers. Under rain-grown conditions, it is the most persistent of temperate grasses. Cultivar Australian was exclusively used in the past but a number of newer cultivars now show more promise.

- PRAIRIE GRASS (*Bromus unioloides*). Priebe perennial prairie, a local Queensland selection, needs well-drained soils and ample irrigation. It is susceptible to overgrazing.

- FESCUE (*Festuca arundinacea*). Fescue is a strongly-rooted perennial which may persist better than other temperate grasses in harsh situations. Summer-autumn production is better than winter production.

## Tropical legumes

- GREENLEAF DESMODIUM (*Desmodium intortum*) is one of the most important legumes in the area. It is a robust grower, roots down readily, stands up to grazing very well, and recovers rapidly. Greenleaf grows on a variety of soils, even poor soils if superphosphate is added, but prefers light, sandy loams. It is a winter-hardy legume and will withstand light frost. It is moisture demanding and best suited to areas with an annual rainfall of 1 000 mm or more.

Greenleaf is slow to establish and should be grazed leniently during the establishment period to enable the long runners to root at the nodes. It is late in maturity and in south-east Queensland the seed is frequently damaged by frost.

This legume produces a heavy bulk of palatable feed, especially in spring and autumn. Older stands are sometimes damaged by *Amnemus* weevil.

- SILVERLEAF DESMODIUM (*Desmodium uncinatum*) is similar in growth habit to Greenleaf, but usually produces lower yields except in the elevated areas where it is better suited than most tropical legumes. It can grow on heavier soils than Greenleaf. If drainage is reasonable, it will grow well on low-lying flats. It has the ability to establish well among large, tropical weeds and when unchecked will grow over the top of them.

In midsummer, Silverleaf can suffer from hot, dry weather. It seeds heavily in June. The seeds adhere to clothes and animals and are easily transferred from one place to another.

Silverleaf desmodium can be affected by *Amnemus* weevil and 'little-leaf' virus.

- SIRATRO (*Macroptilium atropurpureum*). This legume is very valuable, especially for poorer soils and areas with medium rainfall, and where frost is less severe.

Siratro likes hot weather and is most productive in midsummer. For the same reason, it begins to grow rather late in the spring compared with other legumes. It is very drought tolerant but susceptible to frost from which, however, it generally recovers well in spring.

This legume is an excellent nitrogen fixer and can enable poor forest soils to produce well-balanced pastures even in two seasons. It is easier to establish than other tropical legumes and consequently may be sown on roughly-prepared seedbeds. It combines well with other grasses and legumes and is very palatable.

Siratro, unlike most other legumes, is resistant to nematodes but seedlings can be attacked by bean fly (*Melanagromyza phaseoli*), especially if sown after December. It is also susceptible to halo blight during prolonged wet and humid periods.

- GLYCINE (*Glycine wightii*) is a very good legume but its use is restricted to situations of high rainfall and higher fertility soils.

It has a twining habit of growth and will climb on all other species, covering them completely with dense foliage. To obtain maximum yields, glycine should be grown in association with tall-growing grasses. For good establishment it requires good soil, for example scrub or red volcanic soils, and well-prepared seedbeds. Grown in such places it is hard to find a better legume.

Initial growth of glycine is slow and sometimes it will not establish well until the second season. Once established, it is very hardy, resistant to frost and, to some degree, to drought. Generally, it produces best in autumn when good grazing is most needed. There are four cultivars of glycine available.

Tinaroo is a late-maturing cultivar which grows strongly to late autumn. Clarence is an early-maturing type and it is the first to come away in the spring. Cooper, a midseason cultivar is hardy and can withstand drought and poor drainage. Malawi is a new cultivar which has yet to be evaluated for south-east Queensland conditions.

- MILES LOTONONIS (*Lotononis bainesii*). Lotononis is a smaller plant than other tropical legumes.

It has a creeping habit of growth, rooting at every node. It spreads rapidly, producing a large bulk of succulent and palatable feed. It has good frost tolerance and is also very drought tolerant. It will grow on very poor soils, but prefers sandy, well-drained ones. It can grow also under moist, even occasionally waterlogged conditions, but it is sometimes short-lived in these situations. It will tolerate fairly acid soils and thrives on some wallum soils, particularly the better-drained eucalypt ridges.

Seed of lotononis must be inoculated with a specific type of *Rhizobium*. It can be sown in the spring or in early autumn, provided the seedbed is moist and sufficient rain is received for early development. It prefers a rather firm seedbed. Seed is very small and should be covered only lightly if at all. A little rolling after planting is ideal.

Lotononis is susceptible to little-leaf virus and fungal diseases, especially during humid summer weather, if allowed to bulk up.

Lotononis makes a good mixture with pangola grass and also combines well with other grasses such as green panic, setaria and paspalum. It withstands heavy grazing pressure better than the viny tropical legumes.

- ARCHER AXILLARIS (*Macrotyloma axillare*). This twining legume possesses remarkable drought tolerance. This characteristic combined with the ability to grow on very shallow, poor soils, makes it a very valuable pasture component. It does require good drainage.

Being able to grow in relatively dry soils, it begins to grow very early in the spring before the usual spring storms occur. It grows actively in cool weather but will not withstand heavy frost. On frost-free hillsides and ridges it will grow all year-round.

- SAFARI KENYA WHITE CLOVER (*Trifolium semipilosum*). Safari is less frost tolerant but more heat and drought-resistant than common white clover and is better adapted to climates with low winter and high summer rainfall such as in south-east Queensland.

Establishment of this clover is usually slow and can take up to 2 or even 3 years. New plantings are severely affected by a bacterium-like organism associated with rugose leaf curl disease; once the stand recovers, however, re-infestation is confined to new seedlings only. Safari is hardier and more productive than white clover. Because of its ascending stems it combines better with the taller-growing

tropical grasses. The peak production period is usually during summer. It spreads well and withstands heavy grazing. Safari needs a very specific *Rhizobium* for successful nodulation.

- PHASEY BEAN (*Macroptilium lathyroides*) is a self-regenerating annual which is susceptible to bean fly and nematode infestations. It finds a place on heavier and badly-drained soils. It is good as a pioneer legume and as such can be included in perennial pastures, particularly where earlier grazing is required. Seed supply is low and erratic.

### Temperate legumes

- WHITE CLOVER (*Triolium repens*). White clover is widely naturalized in coastal south-east Queensland. Its palatability, high nutritive value and ability to improve the yield and quality of associated grasses are well known. Under irrigation, it is highly productive with a long growing season. Under rain-grown conditions, its growth is erratic and mainly confined to spring.

White clover combines very well with the temperate grasses, and reasonably well with most of the tropical grasses such as green panic, setaria and pangola. For many years to come, it will probably be the main legume in kikuyu, paspalum and mat grass pastures.

The cultivar Ladino is widely used in irrigated and rain-grown pastures. It recovers faster after long, dry periods than other cultivars.

Louisiana is more productive in winter than most other cultivars but less productive than Ladino in summer. Its recovery after summer drought is good and it seeds freely.

Grasslands Huia, known better as New Zealand white clover, has high spring production and persistence under grazing but yields less in winter than Louisiana and less in summer than Ladino.

Haifa, a new cultivar, is more stoloniferous and dense in growth than Ladino, has good seeding ability and better growth in autumn and winter.

- RED CLOVER (*Trifolium pratense* cv. Grasslands Hamua) does not persist beyond the second year. It provides limited feed over the critical winter period but is highly productive over spring and summer. It is very susceptible to regose leaf curl disease.

- STRAWBERRY CLOVER (*Trifolium fragiferum* cv. Palestine) is tolerant of repeated flooding and is used in wet, acid, sandy soils and low-lying areas where other clovers will not persist.

- LUCERNE (*Medicago sativa*). Lucerne is an excellent legume but in coastal areas suffers from waterlogging, acid soils and high humidity in summer. Consequently its use is very restricted.

- GREATER LOTUS (*Lotus uliginosus*) is used to some extent on shallow soils with poor internal drainage. It has fair frost tolerance and grows well on soils too acid for white clover.

## Conclusions

There is already a wide range of pasture species on offer for this region and commercial seed is in good supply. Further research, however, is continuing to find other more adapted species (especially legumes) for various situations. Research on cold-tolerant tropical species should result in narrowing the existing feed gap to the winter months only. Deferred grazing in winter of selected autumn-saved pastures and the inclusion of tropical species with early spring growth should be incorporated into the farm feeding system. On most farms, however, the integration of temperate species or forage oats is necessary to overcome the cool period feed shortage.

# Easy mustering goes with home-made bells

*by A. J. Boorman, Beef Cattle Husbandry Branch.*

MIKE Bredillet of Bald Hill Station, Cooktown has an unusual mustering problem but he has solved it with an old-fashioned remedy.

His problem is a property that has many patches of tropical rainforest. Mike's cattle like to shelter and feed in these patches of scrub so they can be difficult to find and get together when he is mustering.

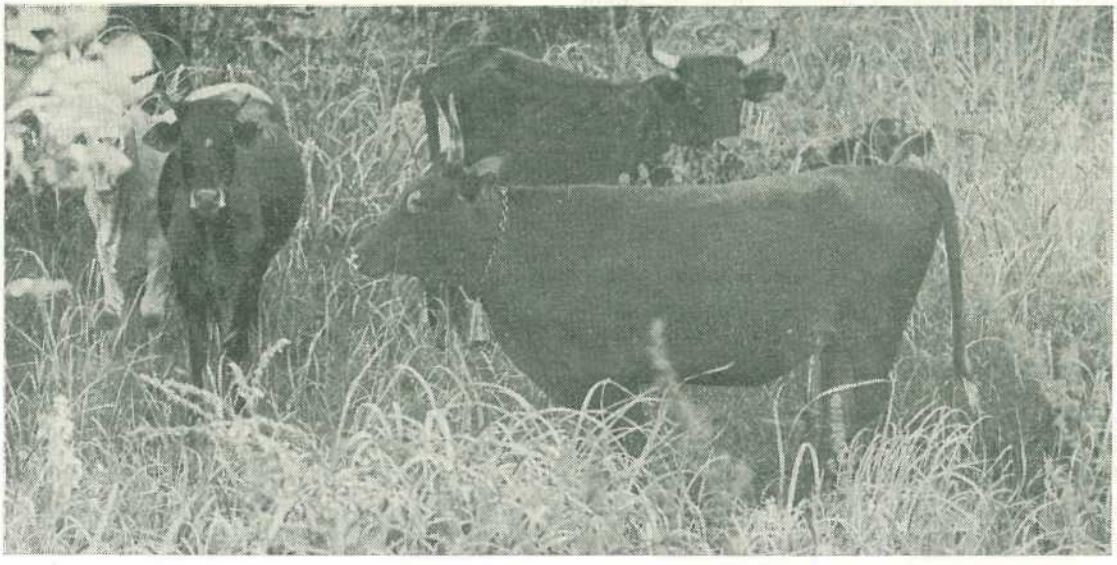
Mike's remedy for the problem is old, but simple, effective and cheap. He makes bells and puts them on some of the cattle.

The bells help him to locate cattle, help with mustering the cattle and prevent mistakes.

Stockmen riding through the property listen for the bells and once they hear them they follow the sound to the cattle.

*Plate 1. Mike Bredillet testing a home-made bell. A good bell makes the crown of the hat vibrate strongly.*

*Plate 2. Bell animals should be mature and quiet.*



Once a belled animal is driven, the others come to see why it is moving. They are then put into the mob by the stockmen.

Mistakes are avoided when cattle are feeding in the edge of the scrub. The stockmen do not suddenly ride on to the cattle and frighten them. Instead, they know where the cattle are without even seeing them and can pull back and wait for them to come out of the scrub before taking them in hand. Without the bells, the frightened cattle would race off into the scrub and that would be the last anyone would see of them that day.

## Making the bell

The bell Mike makes is patterned on a horse bell. He has made a template from flat, galvanized iron as it will last a long time. Cardboard could be used just as easily for the template, but it is less permanent.

The template is made by measuring the original bell and drawing the pattern in pencil (see plates 3 and 4). When measuring the bell, remember to allow for the overlap of the sides where they are brazed.

Bells can be made from a variety of steel objects. Mike has used the ends of light 200 *l* fuel drums, hand saws, circular saw blades and even the petrol tank guard from a Land Rover. However, saws make the best bells.

Once the template is cut out, place it on the steel to be used and run a piece of chalk around the outline. Cut the bell out with an oxy torch or a cold chisel (see plates 5 and 6).

If the bell is cut from a fuel drum (PARTICULARLY A PETROL DRUM) with an oxy torch, the drum MUST be filled with water before cutting begins. Petrol drums remain dangerous for a very long time after use.

When the bell is cut out, mark the lines which will be at the top and side corners.

Heat the metal where the top corners will be and crease it. These bends must be started first as they cannot be started successfully once the side bends are begun. Later, when the bell is shaped, all the bends can be finished quite easily by hand. They will follow the original creases.

Select the material for the keeper at the top of the bell and for the tongue. This can be a 150 mm nail or 7 mm or 10 mm mild steel rod.

The rod for the keeper on Mike's bell was a 150 mm nail.

Drill the holes for the keeper and the tongue in the top of the bell. The keeper should be about two-thirds of the length of the top of the bell and placed in the centre. The hole for the tongue should be in the centre of the top (see plate 7).

Select a drill which will allow the keeper and chain link for the tongue to fit neatly. If they are loose, brazing is difficult.

Heat and bend the rod so that it will fit into the keeper holes. The keeper should have legs about 35 mm long. Braze it into position.

Mark where the sides of the bell will bend. These lines run at right angles to the top of the bell (see plate 8).

The bend for the sides is made so that the corner is rounded. This is done by starting the bend in front of the line and finishing behind the line.

Use a light hammer to make the bends for the sides. This is important—if the hammer is too heavy the bends will not be rounded.

Once the four corner bends are begun, the final shaping of the bell is done by hand.

The gussets at the top are left and turned down later.

Clamp one side into position with a small G-clamp (see plate 9).

Heat the bottom side along the overlap. It should expand to close with the top side. If it does not, heat the top side and tap it into position with a light cross pein hammer.

Now the gussets at the top can be bent into position.

Braze the seam along the outside. Finish by putting a spot of braze on the inside of the seam at the bottom.

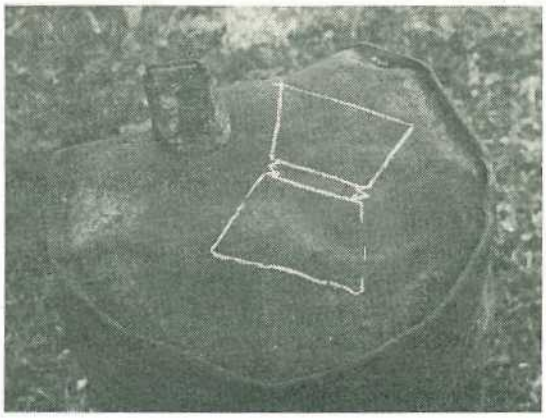
Repeat the process with the seam on the other side of the bell.

The tongue of the bell hangs from a swivel made from two chain links. One link is cut to go through the top of the bell and the other is left uncut.

The cuts are made in the cut link at the point where the straight begins to curve on one side and in the centre of the straight on the other side.

*Plate 3. A template for the bells can be made by measuring any horse bell. Remember, the sides of the bell overlap.*

*Plate 4. If the template is made from flat, galvanized iron it will last a long time. Holding one handle of the tinsnips in a vice makes cutting easier.*



*LEFT. Plate 5. Bells can be cut from the top or the side of drums.*

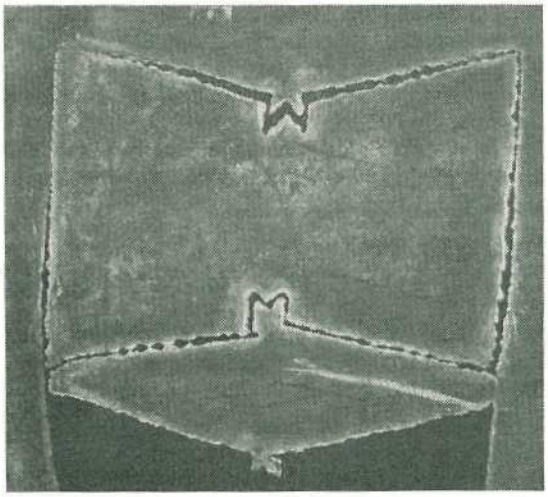


*Plate 6. This bell was cut from the side of a drum with an oxy torch. Mike has used a cold chisel to cut his bells out on occasions.*

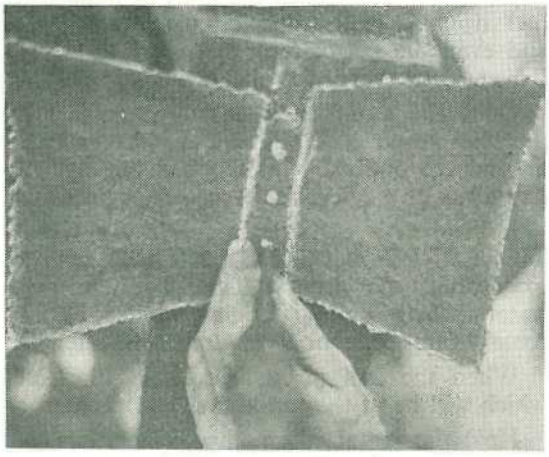


*Plate 7. The holes for the keeper and tongue should be marked with a centre punch and drilled before any bends are made.*

# a bell

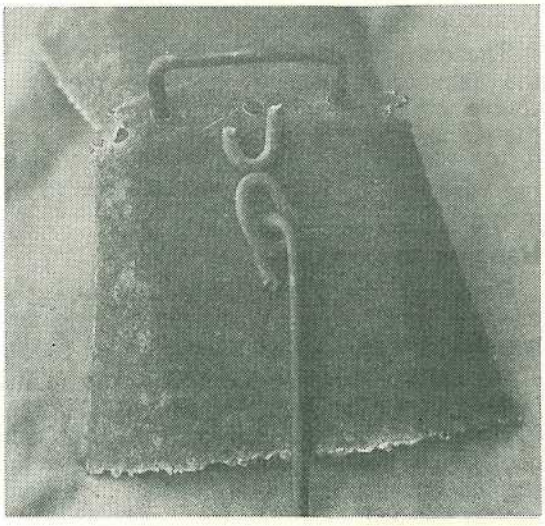


Plate 8. Mike starts the bends at the top of the bell first and then he starts the bends for the sides. He uses a light hammer to start these bends. Next, Mike brazes the keeper and tongue into position. The tongue swivels on two chain links, one of which is cut.

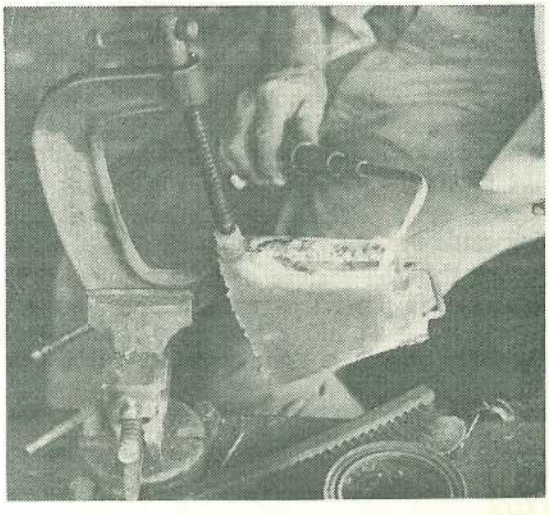


Plate 9. The bends at the top and sides of the bell are finished by hand and then the sides are held in a G-clamp while the seam is brazed.

RIGHT. Plate 12. Turn the bottom edge of the bell out to apply the tension necessary to give the bell tone.

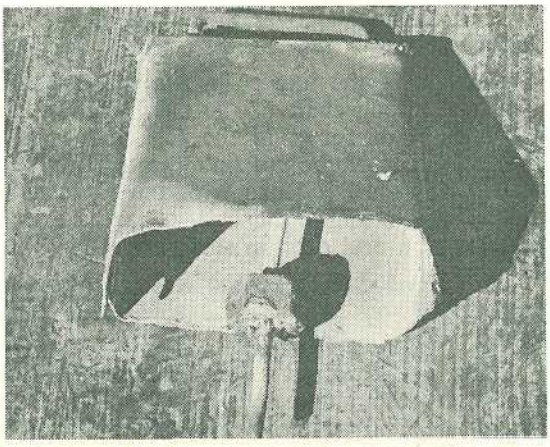


Plate 10. A heavy nut makes a good hammer. The hammer is in the correct position when its bottom edge is 2 to 3 mm below the bottom edge of the bell.

Plate 11. Dip the bell open end first into water to check that there are no holes in it. Holes must be filled with braze.

Bend the tongue over the uncut chain link and braze it.

Next, hang the uncut link on the cut link and fit the long shaft of the cut link through the hole made for it in the top of the bell. Pull the shaft of the cut link through the top of the bell until it stops with the short side against the inside of the bell. Braze the link into position and cut the shaft off.

The swivel action of the links allows the tongue to work against the sides and ends of the bell.

Select a 15 mm nut or similar heavy object to use for the hammer (see plate 10). The hammer should be too heavy rather than too light. Braze the hammer to the tongue and cut off the excess tongue.

The hammer is in the correct position when its bottom edge is 2 to 3 mm below the bottom edge of the bell.

Dip the bell (open end first) into water and watch for rising air bubbles (see plate 11). Bubbles indicate holes which must be filled with braze.

Trim the bottom edge of the bell with a grinder or a file to make it neat.

Place the bell on the anvil with the bottom edge of the bell 6 mm over the edge of the anvil. Tap the edge of the bell out with a light hammer (see plate 12). This puts tension on the edge and gives tone to the bell.

Varying the amount of tension on the edge of the bell varies the tone of the bell. The tone of the bell may also be improved by running a bead of braze about 15 mm wide around the bell about 10 mm from the bottom edge. However, this is only necessary when the bell is made from light metal.

Finally, feel the tap of the bell through the crown of your hat held upside down in the palm of your hand. A good bell will really make the hat vibrate indicating that an experienced stockman will be able to feel the bell tap over a long distance.

Mike says that by the time a man has made his fifth or sixth bell he should be turning out good ones.

The only problem he has with his bells is the hammer falling off the tongue after a couple of years. The constant working of the hammer causes metal fatigue in the braze holding it to the tongue. However, it does not take long to braze a new hammer to the tongue.

### Hanging the bell

Push paper into the bell before putting it on the animal. This will stop the bell frightening the animal when it rings.

Put the chain around the neck of the animal making sure that it is not twisted and that it is loose. Put the bell on the chain and use a split link to join the chain. Cut the surplus chain off so that it does not hang against the bell.

Remove the paper from the bell and let the animal out.

### Avoiding mistakes

The chain must not be twisted. A twisted chain may cut into the animal's neck.

The chain must be loose around the animal's neck but not so loose that it will flop up and down as the animal raises and lowers its head.

Horned cattle should be used as bell animals according to Mike. A polled animal could choke if the chain slipped forward over the poll while its head was down.

Use quiet cattle as bell animals. Galloping cattle are not suitable.

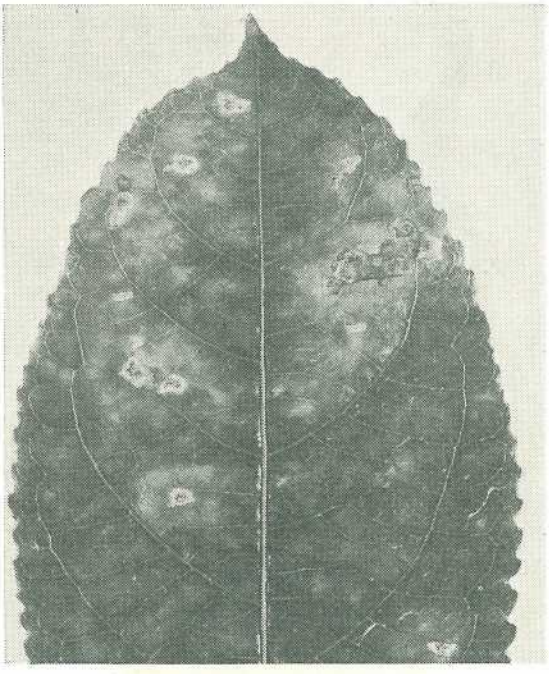
Put bells on mature or near mature cattle. If a bell is put on a young animal and it is not seen for 12 months or more it may grow so much than the chain becomes tight.

# Passionfruit diseases

*by A. J. Inch, Plant Pathology Branch.*

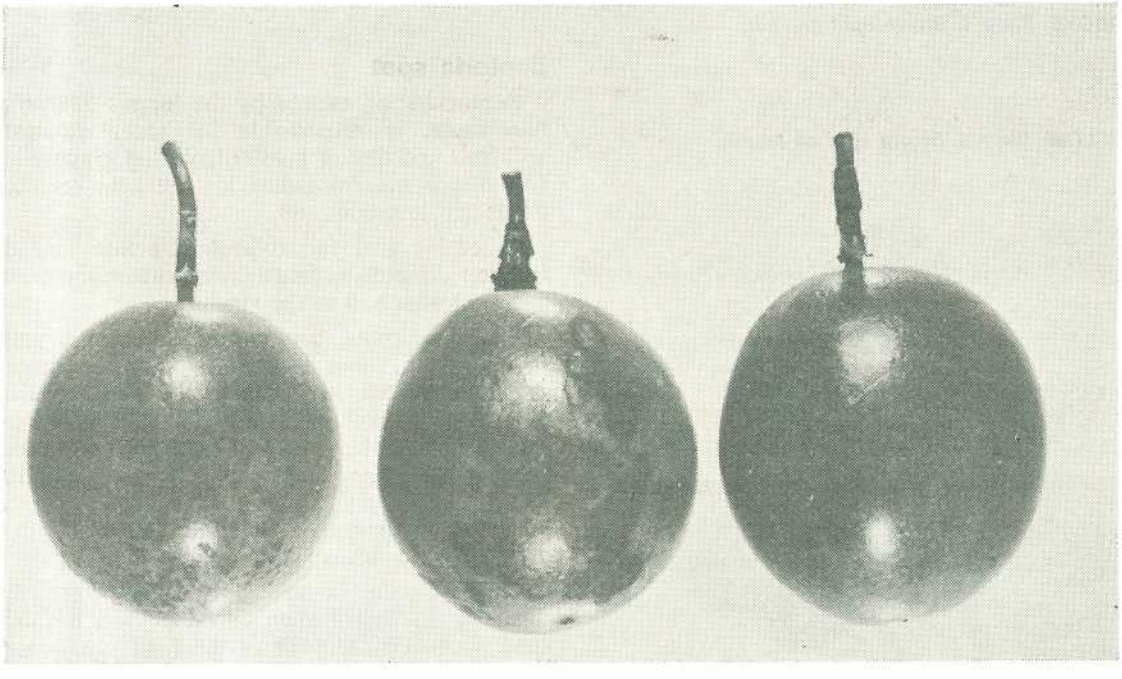
IN Queensland, the main diseases of passionfruit are Septoria spot, brown spot, Phytophthora blight, Fusarium wilt, base rot, damping off and woodiness.

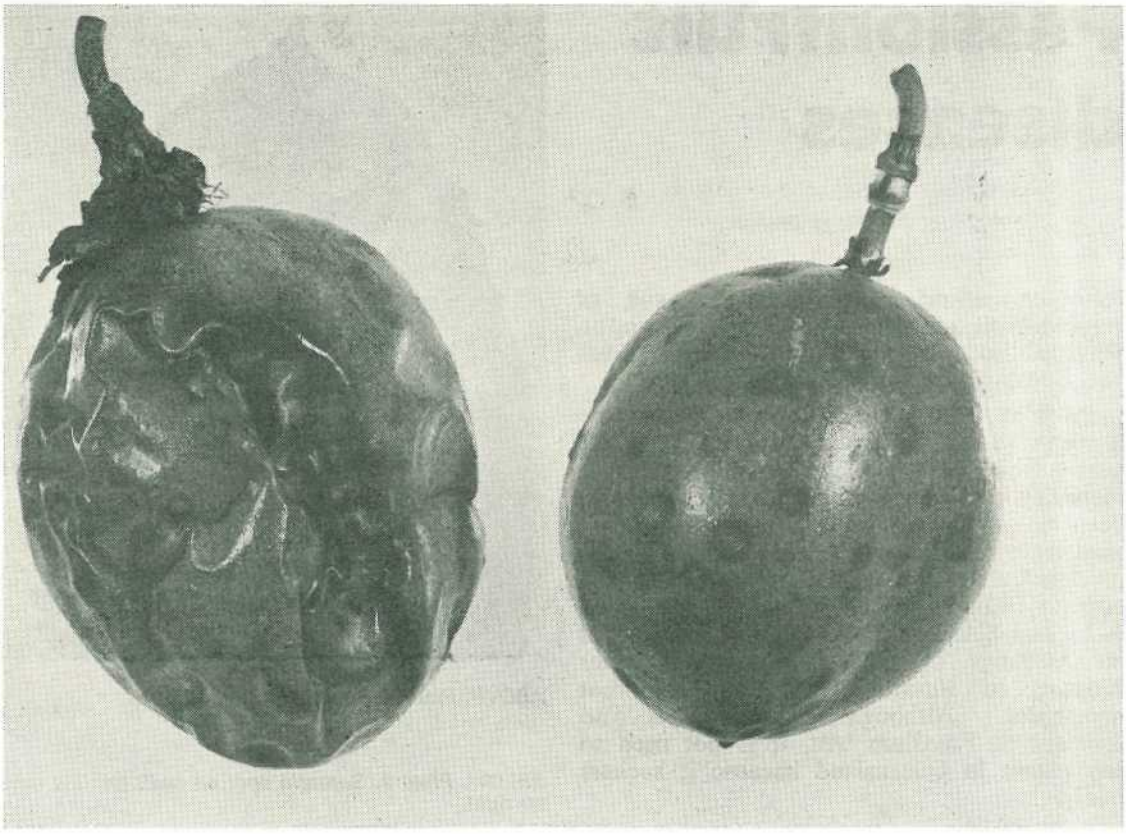
Prior to 1950 when Fusarium wilt became a very serious problem, only the purple passionfruit (*Passiflora edulis*) was grown commercially in Queensland. This species has now been almost entirely replaced, except in home gardens, by hybrids of *P. edulis* and the golden passion fruit (*P. edulis* f. *flavicarpa*) the most popular being Redlands Triangular (Selection 3–1) and Selection E–23. These are grafted on seedlings of golden passionfruit vines resistant to Fusarium wilt and root-knot nematodes. Although *P. caerulea* is also resistant to Fusarium wilt, it is not used to any extent in Queensland because it suckers freely.



*ABOVE. Plate 1. Septoria spot on leaves.*

*BELOW. Plate 2. Septoria spot on fruit. Healthy fruit on right.*





*ABOVE. Plate 4. Brown spot on fruit.*

*BELOW. Plate 3. Brown spot on leaves.*

## Septoria spot

Septoria spot, caused by the fungus *Septoria passiflorae,* is responsible for extensive leaf and fruit spotting of passionfruit and granadilla (*Passiflora quadrangularis*). Lesions on the stems are less common.

Extensive leaf fall follows infection and it is often difficult to find leaves with more than one spot attached to the vine.

Septoria spots are more numerous and smaller than those of brown spot, the other common fungal leaf disease of passionfruit. If individual spots are examined, fruiting bodies (pycnidia) of the fungus can be seen with the naked eye (see plate 1). These contain spores which are spread by rain, dew and overhead irrigation. Pycnidia are not produced by the brown spot fungus.

Fruit infection occurs at any stage of growth resulting in light-brown blotches which may coalesce to cover much of the fruit (see plate 2). Affected fruit ripen unevenly and are acceptable only for processing.

## Brown spot

Brown spot, caused by the fungus *Alternaria passiflorae,* affects the passionfruit, granadilla and some species of wild passion flowers especially the white passion flower (*Passiflora alba*).

The disease is recognized by the characteristic brown spots which appear on all parts of the vine. On leaves they are up to 10 mm in diameter, at first chestnut brown in colour and later drying out in the centre to lighter shades of brown (see plate 3). Laterals are usually attacked near the leaf axils where brown lesions up to 30 mm long are formed. The lesions develop slowly to eventually cincture the stem. This causes wilting and death of long sections of vines.

Fruit spots are light-brown in colour, circular and sunken (see plate 4). As they enlarge, the spots become sunken and wrinkled. They can cover up to half the fruit.

Brown spot is favoured by warm, wet weather and, like Septoria spot, is more severe in summer and early autumn. The disease is spread by spores produced on the leaf, fruit and stem lesions.

## Phytophthora blight

This disease caused by the fungus *Phytophthora nicotianae* var. *parasitica* is marked by a blight of the shoot tips, stem lesions and fruit rot in periods of prolonged, wet weather in late summer and autumn. Young tip growth blackens and dies. Mature leaves at first become translucent then light-brown and readily fall (see plate 5). The main stem may be girdled above the graft by a purple and later brown lesion. This causes wilting and death of vines. Large, grey-green, watersoaked spots appear on infected fruit which soon fall (see plate 6). If wet weather continues, the affected fruit becomes covered with white fungal growth.

In the nursery, *P. nicotianae* var. *parasitica* causes defoliation of young plants.

The infective spores (zoospores) of *P. nicotianae* var. *parasitica* are found in the soil where they swim in the water film around the soil particles. They are produced during warm, wet weather and are splashed from the soil to the lower parts of the vines. Spores produced on the vines are spread by wind-driven rain.

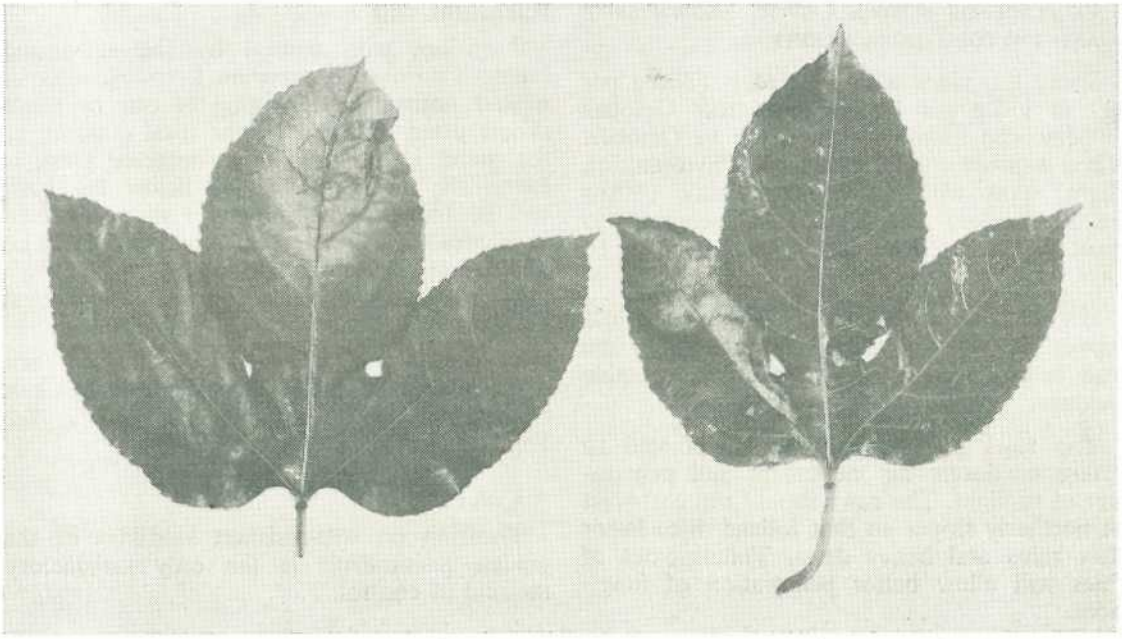


*Plate 5. Phytophthora blight on leaves.*

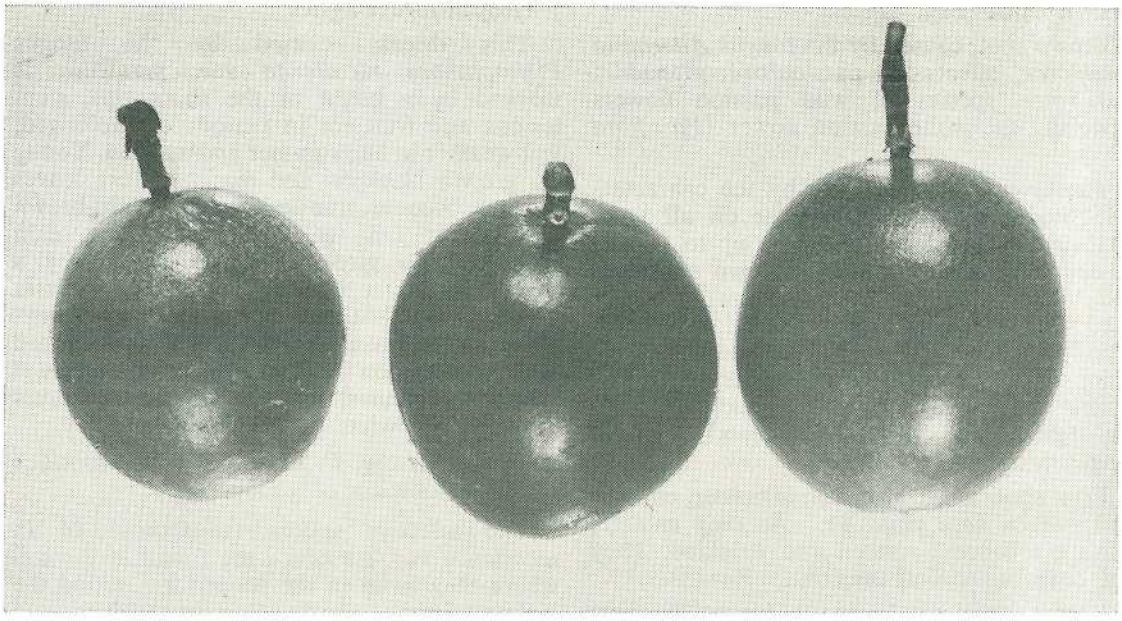


*Plate 6. Phytophthora blight on fruit. Healthy fruit on right. Large, grey-green watersoaked spots appear on infected fruit.*

• CONTROL OF SEPTORIA SPOT, BROWN SPOT AND PHYTOPHTHORA BLIGHT

Spray the vines with mancozeb (800 g per kg) at 1·5 g per *l* fortnightly from October to May and monthly from May to October. When weather conditions favour Phytophthora blight, spray with copper oxychloride (500 g per kg copper) at 2 g per *l* in preference to mancozeb and reduce the interval to 7 to 10 days.

Higher concentrations of mancozeb and copper oxychloride should be avoided when fruit is maturing as they leave unacceptable residues.

The rows of vines should be planted to ensure maximum air movement and penetration of sunlight. The rows should run east-west on northerly slopes so that foliage dries faster after rains and heavy dews. Thinning-out of vines will allow better penetration of fungicides.

The establishment of a mown sward between the rows reduces the severity of Phytophthora blight by reducing splash of zoospores from the soil during heavy rain.

## Fusarium wilt

Fusarium wilt, caused by the soil-borne fungus *Fusarium oxysporum* f. sp. *passiflorae*, is first noticed as a wilting of one or more shoots often followed by the total collapse of the plant. If the stem of an affected plant is examined, the woody tissue below the bark will be found to be brown or reddish-brown in contrast to the normal white colour. The absence of girdling or surface rot at the crown distinguishes Fusarium wilt from other fungal wilts.

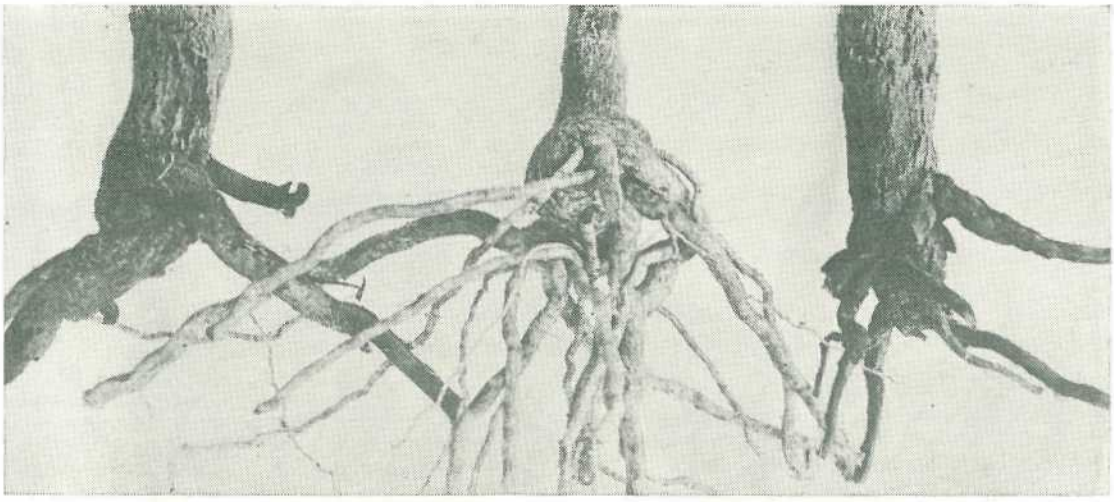
*F. oxysporum* f. sp. *passiflorae* does not affect plants other than passionfruit but can survive for many years in the soil in the absence of the host.

• CONTROL

Grafting on wilt-resistant seedlings of the golden passionfruit is the only satisfactory method of control.

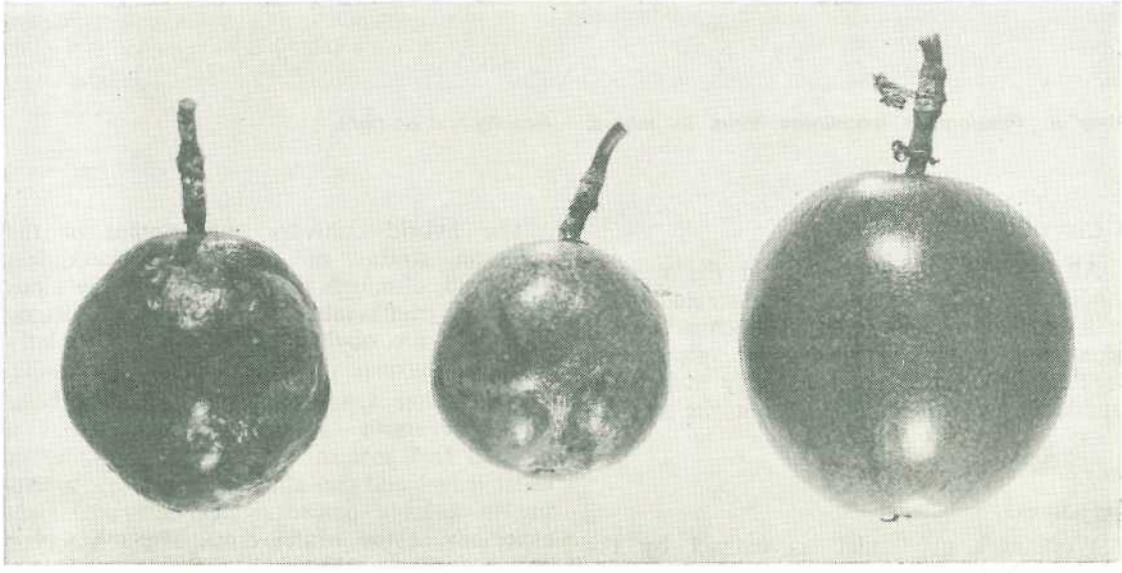
## Base rot

Base rot is marked by a soft decay at the base of the stem and upper parts of the main roots.



*ABOVE. Plate 7. Base rot. The plant in the centre is healthy.*

*BELOW. Plate 8. Passionfruit woodiness virus in fruit. Healthy fruit on right.*



Plants may show symptoms of rot for some time before a slow decline of the vine is apparent. When the vine is growing vigorously, new tissue may be formed on the outside of the stem as fast as the internal tissue is destroyed so that the stem becomes a hollow structure several times the normal diameter (see plate 7). Weak vines often die.

Although the cause of the disorder has not been established, there is some evidence to indicate that it may be due to water moulds (*Pythium* spp.) entering the crown through injuries.

• CONTROL

Avoid injuring the crown of the vine when cultivating or fertilizing. Do not plant in poorly-drained soil.

## Damping off

This problem is caused by soil-borne fungi—the most important of which are *Rhizoctonia solani* and *Pythium* spp. The seed germinates but young seedlings up to 3 to 4 cm high wilt and die. The disease spreads rapidly through seedbeds.

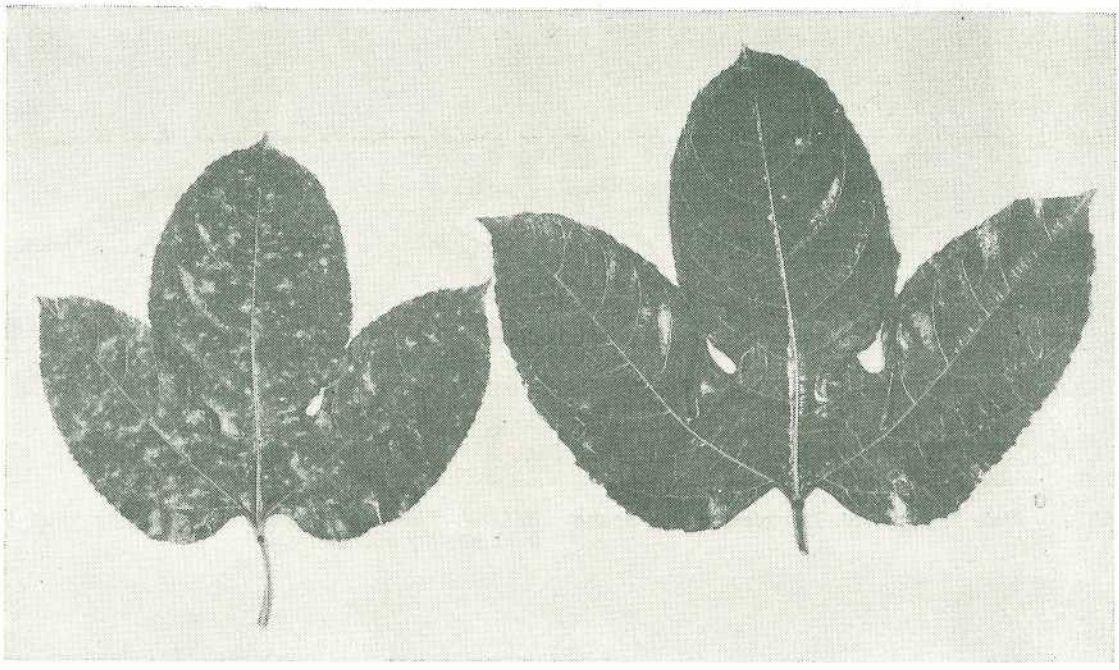


*Plate 9. Passionfruit woodiness virus in leaves. Healthy leaf on right.*

• CONTROL

All potting mixtures used in the nursery should be treated with steam, aerated-steam or a broad spectrum fumigant such as methyl bromide. Containers should be placed on benches where they are less likely to be contaminated by soil splashed from the nursery floor.

**Woodiness**

Woodiness or 'bullet' is caused by the passionfruit woodiness virus. Fruit on affected vines is small and misshapen (see plate 8) with an abnormally thick rind and small pulp cavity. Leaves have a mosaic pattern of light and dark-green and are often puckered (see plate 9). Woodiness also affects wild passion flowers.

Most purple passionfruit vines contract the disease at some stage and are very susceptible to the fruit-deforming symptom. Affected vines are usually worthless and will not recover.

The hybrid cultivars are tolerant of the common strains of passionfruit woodiness virus and, although usually infected, the vines produce marketable fruit. Leaf mosaic symptoms are obvious on hybrids particularly on poorly-grown vines in the winter months.

Two other types of woodiness have been found in south Queensland. One causes a mottled leaf pattern with yellow speckling of older leaves and can affect hybrid vines, resulting in a large percentage of deformed fruit especially in the winter crop. The other type occurs in the corky passion flower (*P. suberosa*) and causes tip blight and severe fruit symptoms on purple passionfruit and hybrids.

The passionfruit woodiness virus is transmitted from diseased to healthy vines by migrating aphids and on pruning implements.

• CONTROL

The use of tolerant hybrids on golden passionfruit root stock has provided adequate control of woodiness for many years.

When grafting, select only healthy tips from young plants.

# South Queensland grain sorghum planting guide 1978-79 season

GRAIN sorghum hybrids recommended for planting in south Queensland in the 1978–79 season are listed below.

In the tables, the hybrids have not been ranked in order of preference.

There could be in excess of 50 hybrid lines offered for sale this season. Many have not been tested in Departmental trials and others have only been tested for a limited period—these cannot be included in the planting guide until further testing has been completed.

The hybrids listed 'for trial' should be sown in smaller areas for evaluation under your conditions. It would be appreciated if farmers would advise their Agricultural Extension Officer of trial plantings as this will enable a wider evaluation of the performance of these hybrids to be made.

Some hybrids appear to be closely related and are therefore interchangeable (for example, Texas 626 and Yates 212, and Goldfinger and Yates 233).

*by Officers of Agriculture and Plant Pathology Branches*

Some hybrids have a reaction to the insecticide monocrotophos; the severity of the reaction may vary with the growth stage of the plant. The hybrid, Pioneer 846, and the open-pollinated variety Alpha show a marked reaction to the insecticide.

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

## Planting rates

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

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

Grain sorghum seed sold by major seed companies is of high quality and is required to have a laboratory germination of 70% or higher.

Seed size varies with hybrids but is generally in a range of 20 000 to 40 000 seeds per kilogram.

APPROXIMATE PLANTING RATE FOR GIVEN PLANT POPULATIONS

| Plants/ha | Planting Rate kg/ha |
|---|---|
| 50 000 | 2·5 —3·0 |
| 75 000 | 3·75—4·0 |
| 100 000 | 5·0 —5·5 |
| 150 000 | 7·5 —8·0 |

Adjustments must be made for higher or lower populations and seed size. The efficiency of most planting machinery is also variable.

## Lodging

Lodging is a major problem in many grain sorghum producing areas in Queensland. The most prevalent type of lodging in Queensland is that which follows moisture stress during the grain filling period. Under such conditions, all known grain sorghum hybrids will lodge. Lodging can also be associated with conditions other than moisture stress and hybrids relatively resistant to one form of lodging may be more susceptible to other forms.

Nevertheless, trial data and farmer experience have enabled classification of some hybrids as to their lodging resistance.

Because of the importance of lodging, only lodging-resistant hybrids are recommended for areas where lodging is known to be a problem. Other hybrid characteristics, particularly grain yield and disease resistance, determine the recommendations for areas where lodging is usually not important.

Lodging is not usually of importance in fully-irrigated crops but can occur in well-grown irrigated crops which experience moisture stress during grain filling.

## Crop maturity

In the guide, the hybrids have been given maturity ratings. However, hybrid sorghum maturity is governed largely by temperature and to a lesser extent by day length. Hybrids when sown in October in south Queensland could flower in 60 to 65 days, but the same hybrids could be expected to flower in a much shorter period (50 to 55 days) when sown in December.

The slow and medium-slow hybrids may therefore react as midseason types when sown later in the season.

## Head smut

Head smut, an important soil-borne disease, is favoured by cool soil conditions. It is common in early plantings in south Queensland.

A 12% head smut incidence, which is common on highly susceptible hybrids, represents a 12% yield loss.

Avoid sowing highly susceptible (HS) hybrids early in areas where this disease is known to have occurred.

## Sugarcane mosaic virus (SCMV)

Most grain sorghum hybrids grown in Queensland are susceptible to the Johnson grass strain of sugarcane mosaic virus.

Three types of symptoms occur; these depend on hybrids and environmental conditions. The mosaic (M) symptom is shown by most of the recommended hybrids. Under field conditions, the grain yield of mosaic reactors is little affected.

Red stripe (R.S.) reactors show a conspicuous red striping when infected. Early infection results in severe stunting and consequently a substantial yield loss.

When cool conditions follow infection, the mosaic symptoms change to red spots, streaks and areas of dead tissue; this is the red leaf symptom (R.L.). If severe red leaf disease occurs, substantial yield loss will result.

## Rust

Sorghum rust occurs in most districts throughout the State; it is more prevalent in late sown crops.

Severe rust infection in highly susceptible (HS) hybrids has been associated with pinched grain and yield reduction. Premature plant death may also occur predisposing the plant to lodging.

# South Queensland Grain Sorghum Planting Guide 1978–1979 Season

| Region and Shires | Planting Time | Recommended Hybrids |
|---|---|---|
| **Burnett** | | |
| Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, part Biggenden, part Tiaro, Woocoo, Hervey Bay Shires | Sept.–Jan. | S: F64a<br>MS: E57, Yates 266<br>*For trial:*<br>MS: Dorado<br>MQ: Goldrush |
| Monto, Eidsvold, Gayndah, Mundubbera, part Biggenden Shires | Nov.–Jan. | S: F64a<br>MS: E57, Yates 266, Q5161, Sunlover I, Dorado, Golden Acres Y101, Leader<br>M: Texas 610SR, Yates 212, Texas 626<br>MQ: Yates 233, Goldfinger, Goldrush, Dorado E. |
| **South Burnett** | | *Dark alluvial soils* |
| Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires | mid Nov.–Dec. | S: Big Red<br>MS: Yates 266, Dorado, Golden Acres Y101, E55e, Leader<br>M: Pride<br>MQ: Yates 233, Goldfinger, Dorado E.<br>*Other soils*<br>MS: E57, Q5161, Sunlover I, Leader<br>M: Pride<br>MQ: Goldrush |
| **Near North Coast** | | |
| Noosa, Widgee, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires | mid Nov.–end Jan. | MS: E57, Q5161, Sunlover I, Dorado, Golden Acres Y101, Leader<br>M: Pride<br>MQ: Yates 233, Goldfinger<br>*For trial:*<br>S: Big Red |
| **East Moreton** | | *Irrigated and rain-grown* |
| Caboolture, Pine Rivers, Redlands, Albert, Beaudesert Shires | Sept.–mid Jan. | MS: E57, Dorado<br>M: Texas 610SR, Yates 212, Texas 626<br>MQ: Yates 233, Goldfinger, Dorado E. |
| **West Moreton** | | *Irrigated and rain-grown* |
| Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires | Aug.–mid Jan. (Aug.–Sept. planting preferred) | MS: E57, Dorado<br>M: Texas 610SR, Yates 212, Texas 626, Dorado A<br>MQ: Yates 233, Goldfinger, Dorado E. |
| **Darling Downs** | | *Lodging soils* |
| Wambo, Chinchilla Shires .. .. .. | Oct.–Jan. | MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E.<br>*Other soils*<br>MS: Yates 266, Dorado, Golden Acres Y101<br>M: Texas 610SR, Yates 212, Texas 626, Pride<br>MQ: Yates 233, Goldfinger, Dorado E. |
| Pittsworth, Millmerran (east of Condamine River), Jondaryan, Crows Nest, part Rosalie Shires | Oct.–early Nov. | MS: Dorado, Golden Acres Y101<br>M: Texas 610SR, Yates 212, Texas 626, Pride<br>MQ: Yates 233, Goldfinger, Dorado E. |
| Millmerran Shire (west of Condamine River) | Oct.–early Nov. | *Brigalow soil*<br>MS: E57, Q5161, Sunlover I, Dorado, Golden Acres Y101<br>M: Pride<br>MQ: Goldrush |

| Region and Shires | Planting Time | Recommended Hybrids |
|---|---|---|
| **Darling Downs**—*continued* | | |
| Clifton, Allora, Rosenthal, Glengallan, Cambooya Shires | Oct.–mid Nov. | MS: E57, Yates 266, Dorado, Golden Acres Y101, Leader<br>M: Texas 610SR, Yates 212, Texas 626, Pride<br>MQ: Yates 233, Goldfinger, Dorado E. |
| Stanthorpe Shire .. .. .. .. | Nov.–mid Dec. | MS: E57, Q5161, Sunlover I, Dorado, Golden Acres Y101<br>MQ: Goldrush |
| Inglewood Shire .. .. .. .. | Sept.–Oct. | S: F64a<br>MS: E57, Q5161, Sunlover I, Dorado, Golden Acres Y101<br>MQ: Goldrush |
| Irrigated all Shires .. .. .. .. | Oct.–early Nov. | S: F64a<br>MS: Texas 671, E55e, Yates 275, Yates 266, Dorado, Golden Acres Y101, Big Red<br>M: Texas 610SR, Yates 212, Texas 626, Pride<br>MQ: Yates 233, Goldfinger, Dorado E.<br>*For trial*<br>S: Tropic |
| **Near South West** | | |
| Waggamba Shire .. .. .. .. | Sept.–Oct. | MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |
| | late Dec.–Jan. | MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |
| | | *Rain-grown* |
| Balonne Shire .. .. .. .. | late Dec.–Jan. | MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |
| | late Dec.–Jan. | *Irrigated*<br>MS: Texas 671, E57, Yates 275, Dorado, Golden Acres Y101, E55e<br>M: Texas 610SR, Yates 212, Texas 626 |
| Murilla, Tara, Taroom Shires .. .. | late Sept.–Oct. | S: F64a<br>MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |
| | late Dec.–Jan. | S: F64a<br>MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |
| Bungil, Bendemere, Warroo, Booringa Shires | late Dec.–Jan. | MS: E57, Q5161, Sunlover I<br>M: Pride<br>MQ: Goldrush, Dorado E. |

**KEY:**

S = Slow maturity; MS = Medium slow maturity; M = Medium maturity; MQ = Medium quick maturity; Q = Quick maturity.

For further information on hybrid performance in your own district, consult your agricultural extension officer.

# Guide to Grain Sorghum Characteristics

| Seed Company | Hybrid | Time of Flowering | Height | Head | Grain Colour | Reaction to | | | | Standability or Resistance to Lodging | Mean Yield as a % of TEXAS 610SR up to and including 1976–77 Trials | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Head Smut Race 1 | S.C.M. Virus | Rust (*Puccinia purpurea*) | leaf blight (*Drechslera turcica*) | | Darling Downs | | South Burnett | |
| | | | | | | | | | | | Yield % | No. of Trials | Yield % | No. of Trials |
| Asgrow .. .. | Dorado E | MQ | MS | Semi-compact | Bronze | R | Red Stripe | R | S | *** | 98 | 10 | 100 | 3 |
| | Dorado A | M | M | Semi-open | Bronze | R | M | S | S | * | 107 | 11 | 112 | 3 |
| | Rico | M | M | Compact | Red | R | M | HS | R | *** | 98 | 13 | 96 | 4 |
| | Dorado TX | MS | MT | Open | Yellow | R | NA | NA | NA | NA | NA | — | NA | — |
| | Dorado | MS | MS | Open | Bronze | R | M | S | R | *** | 105 | 12 | 106 | 5 |
| DeKalb .. .. | B17 | Q | M | Semi-open | Brown-Red | HS | M | HS | S | * | 79 | 9 | NA | — |
| | C42t | M | M | Semi-compact | Bronze | R | M | HS | HS | *** | 92 | 15 | 92 | 5 |
| | C43 | MS | M | Open | Bronze | R | M | NA | S | ** | NA | — | NA | — |
| | E55e | MS | M | Semi-compact | Red | R | M | S | S | *** | 94 | 13 | 95 | 5 |
| | E57 | MS | M | Open | Bronze | R | M | S | S | **** | 94 | 21 | 100 | 9 |
| | F64a | S | T | Open | Bronze | R | M | R | R | **** | 94 | 9 | 90 | 4 |
| | FS1a | NA | VT | Semi-compact | NA | R | M | NA | NA | * | NA | — | NA | — |
| Northrup King .. | NK006 | MQ | M | NA | NA | R | M | NA | S | | NA | | NA | |
| | NK111 | MQ | M | NA | NA | R | M | | S | | NA | | NA | |
| | NK150 | MQ | M | NA | NA | R | M | NA | HR | | NA | | NA | |
| | NK180 | MQ | MS | NA | NA | R | NA | NA | HR | | NA | | NA | |
| | NK280 | | | NA | NA | R | NA | NA | NA | | NA | | NA | |
| | NK333 | M | M | NA | NA | R | NA | NA | S | | NA | | NA | |
| Pacific Seeds .. .. | Pac 001 | Q | S | Semi-open | Red | S | M | HS | S | ** | 82 | 9 | NA | — |
| | Nugget | Q | S | Semi-open | Red | NA | M | NA | S | NA | NA | — | NA | — |
| | Goldfinger | MQ | M | Semi-open | Bronze | R | M | S | R | ** | 96 | 13 | 100 | 5 |
| | Goldrush | MQ | M | Semi-open | Red | S | M | HR | S | **** | 95 | 9 | 99 | 4 |
| | Sovereign | M | M | Semi-open | Red | NA | M | NA | S | NA | NA | — | NA | — |
| | Pac 710 | M | M | Compact | Red | R | M | R | HR | ** | NA | — | NA | — |
| | Pac 303 | S | T | Semi-compact | Red | R | Red Stripe | S | S | NA | NA | — | NA | — |
| | Tropic | S | T | Open | Bronze | R | Red Leaf | S | S | ** | NA | — | NA | — |
| | Monsoon | S | T | Semi-open | Red | NA | M | NA | NA | NA | NA | — | NA | — |
| | Sundowner | MS | MS | Open | Bronze | NA | NA | NA | NA | NA | NA | — | NA | — |
| | Golden Acres Y101 | MS | MS | Open | Bronze | R | M | S | R | *** | 105 | 9 | 91 | 4 |
| Pioneer .. .. | Gem | NA | NA | NA | NA | NA | NA | HS | S | NA | NA | — | NA | — |
| | Pride | M | MS | Semi-compact | Bronze | R | M | S | S | *** | 105 | 9 | 100 | 5 |
| | Leader | MS | MS | Open | Bronze | HS | M | R | S | *** | 101 | 12 | 107 | 6 |
| | Big Red | S | M | Semi-compact | Red | S | M | S | S | ** | 106 | 7 | 102 | 4 |
| | P846 | MS | M | Semi-compact | Red | R | M | HS | HS | ** | 94 | 30 | 99 | 10 |
| | Solo | | | Open | NA | NA | R | NA | S | NA | NA | — | NA | — |
| | Sunlover 1 | MS | MS | Semi-compact | Bronze | HS | Red Leaf | R | R | **** | 97 | 12 | 100 | 6 |

| Seed Company | Hybrid (experimental designation) | Time of Flowering | Height | Head | Grain Colour | Reaction to | | | | Standability or Resistance to Lodging | Mean Yield as a % of TEXAS 610SR up to and including 1976–77 Trials | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Head Smut Race 1 | S.C.M. Virus | Rust (*Puccinia purpurea*) | leaf blight (*Drechslera turcica*) | | Darling Downs | | South Burnett | |
| | | | | | | | | | | | Yield % | No. of Trials | Yield % | No. of Trials |
| Yates .. .. .. | Yates 147 | Q | MS | Semi-compact | Red | R | M | HS | S | * | 80 | 8 | NA | — |
| | Yates 207 | M | MS | Semi-compact | Red | HS | M | HS | HS | ** | 88 | 8 | NA | — |
| | Yates 212 | M | M | Compact | Red | R | M | S | S | ** | 98 | 27 | 92 | 13 |
| | Yates 220Y | M | MS | Semi-open | Bronze | R | Red Stripe | S | S | ** | 91 | 14 | NA | — |
| | Yates 233 | MQ | M | Semi-compact | Bronze | R | M | S | S | ** | 91 | 10 | NA | — |
| | Yates 266 | MS | MT | Semi-open | Bronze | R | M | S | R | ** | 96 | 16 | 99 | 1 |
| | Yates 275 | MS | M | Compact | Red | R | M | S | HS | ** | 99 | 6 | NA | — |
| | SM 5 | MS | M | Open to Semi-open | Bronze | R | M | S | R | ** | NA | — | NA | — |
| | SM 8 | M | M | Semi-open | Bronze | S | M | S | R | *** | NA | — | NA | — |
| | SM 9 | M | M | Open | Bronze | R | Red Leaf | NA | R | ** | NA | — | NA | — |
| | SM 10 | S | M | Semi-open | Bronze | HS | M | R | S | ** | NA | — | NA | — |
| Miscellaneous Open pedigree hybrids produced by Hylan, Panorama, Selected Seeds | Texas 610SR | M | M | Compact | Red | R | M | S | S | ** | — | — | — | — |
| | Texas 626 | M | M | Compact | Red | R | M | S | S | ** | 96 | 34 | 95 | 10 |
| | Texas 671 | S | MT | Compact | Red | R | M | S | S | ** | 96 | 20 | 102 | 5 |
| | Q5161 | MS | M | Compact | Bronze | HS | Red Leaf | R | HR | **** | 98 | 20 | 102 | 10 |
| Open pollinated variety | Alpha | S | MS | Semi-compact | Red | S | M | HS | R | **** | 71 | 46 | 84 | 8 |

**KEY:**

Time to Flowering: Q = Quick; MQ = Medium Quick; M = Medium; MS = Medium Slow; S = Slow.

Lodging behaviour ratings: * = Below average; ** = Average; *** = Above average; **** = Very good standability.

Height: VT = Very Tall; T = Tall; MT = Medium Tall; M = Medium; MS = Medium Short; S = Short.

Head: Open, semi-open, semi-compact, compact. Compact heads dry less rapidly and are more susceptible to head caterpillars.

Head Smut: R = Resistant; S = Susceptible; HS = Highly susceptible.

Leaf Rust: HS = Highly susceptible; S = Susceptible; R = Resistant; HR = Highly Resistant. These classes are relative to each other, the dividing line being somewhat arbitrary.

Sugarcane Mosaic Virus Reaction: M = Mosaic; Red Stripe; Red Leaf.

NA: = Information not available or the variety has not been tested in Departmental trials. In the yield comparison columns, the 'number of trials' shows the number of trials in which both Texas 610 SR and the particular hybrid both appeared. The greater the number of trials used to calculate the average, the greater reliability can be placed on it.

# Seed vigour testing . . . what is its role?

FOR many years, high quality seed has been judged on the results of purity analyses and germination tests.

Today, many seed characteristics are under close scrutiny. One of these—seed vigour—is receiving particular attention by seed testing bodies.

## Seed vigour

Germinable seeds are those that produce normal seedlings when tested under optimum conditions of temperature, moisture and light. However, in the field where conditions are somewhat less than ideal, the number of normal seedlings that emerge may be far less than would be expected on a basis of seed germination data. It has been found that two samples which perform similarly in a laboratory germination test may behave very differently when sown in the field. This is the classical example of vigour difference between lines of seed.

Nevertheless, despite this type of evidence it is difficult to define vigour in a meaningful way. However, it is generally agreed that vigorous seed will—

- Germinate rapidly and uniformly.
- Perform satisfactorily over a wide range of planting conditions.

There are many reports in which these advantages from sowing vigorous seeds have been carried through the life of the crop and have resulted in higher yields.

*by J. E. Butler, Standards Branch.*

Rapid and uniform germination is needed for precision-planted crops and for crops with a once-only harvest with very little opportunity to delay the harvest (for example, beans for processing). The ability to establish adequately under unfavourable conditions can mean the difference between a commercial crop and no crop at all in areas with uncertain climatic conditions.

The absence of a suitable definition of seed vigour has made it difficult to develop widely acceptable vigour tests. There are many well-documented reports in which particular types of vigour tests have been very useful in predicting field performance under local conditions. However, it must be stressed that these are applicable only to local conditions. Seed which germinates well under fairly dry, hot conditions need not do so under waterlogged, cold conditions. It is on this difficulty that attempts to derive a single, universal vigour test have floundered.

If seed is sown under very good conditions, the simple germination test is as good an indicator of probable field performance as any test. However, the worse the planting conditions, the less reliable a germination test becomes and the more important a vigour test is.

## Types of vigour tests

There are three basic types of vigour tests involving:

- Speed of germination
- Germination under stress
- Biochemical/physiological measurements

### Speed of germination

Speed of germination is considered an extremely important aspect of vigour. Consequently, some agriculturalists regard the germination percentage at the 'first count' more highly than the final percentage.

Various mathematical formulae have been derived to provide an index of vigour based on rate of germination.

In a similar vein, seedling growth rates are frequently used to assess seedling vigour.

## Stress conditions

One method of evaluating vigour is to subject the seed to one or more of the environmental stresses it might encounter under soil conditions and then measure its response in terms of rate of germination, survival, rate of growth, and presence of structural abnormalities.

The main types of stresses used are:

- Temperature
- Soil moisture and oxygen
- Osmotic stress
- Physical properties of soil
- TEMPERATURE. For many species, the optimum temperature for laboratory germination is above that normally encountered in the field. Low temperature has at least two adverse effects on germinating seeds:
- It may cause direct low-temperature injury.
- It may slow germination so that the seeds remain in a soil environment favouring competition and attack by micro-organisms for a much longer period.

The best-documented and most widely used stress test is the cold test for maize. This test involves exposure of seeds in soil to a temperature of 10°C for 5 to 7 days followed by germination at 30°C. Critical factors in this test are the presence of fungi, particularly Pythium (which is introduced through the use of non-sterile soil or sometimes by the addition of ground seeds which previously failed to germinate) and moisture content of the medium (which must be relatively high). Such a test has proved exceedingly difficult to standardize.

High temperature during germination is also a stress condition, and its use has been investigated for peas.

- SOIL MOISTURE AND OXYGEN. A limited supply of soil moisture is probably the most common stress encountered by seeds in the field. An excess of soil water also incorporates a stress due to the restriction of oxygen supply to the germinating seedling. Oxygen and water supply can be influenced not only by the actual quantities of air and water in the soil, but also by the geometry of the seed and soil particles and the intimacy of the seed-soil contact.
- OSMOTIC STRESS. Osmotic stress has been utilized by many workers in an attempt to select genetic strains that will withstand drought. Similar techniques have related seed vigour to osmotic stress. Carbowax polyethylene glycol—6 000, manitol, and sodium chloride have been used as osmotic agents and a relationship between osmotic sensitivity and a vigour rating based on the tetrazolium test has been determined.
- PHYSICAL PROPERTIES OF SOIL. Soil compaction in the form of normally poor soil structure, crusting (especially in irrigated soils), and mechanical pressure from machine wheels are common sources of stress in the field. One of the early attempts to evaluate seedling vigour was to cover the seeds with a layer of brick dust (more properly—brick sand) and count the number of seeds with sufficient vigour to emerge from this covering. A more recent modification has been to place seeds on a layer of wet sand and cover them with a layer of filter paper and then another layer of wet sand; good correlation with soil emergence was found.

## Rapid vigour tests

Although the germination-type tests have been developed, occasions do arise when these are too slow. For such instances, rapid vigour tests have been determined as a substitute. However, their validity depends on the level of correlation with establishment.

The two most important of these rapid vigour tests are:

- Conductivity test
- Tetrazolium test

- CONDUCTIVITY TEST. This is the vigour test which has come into prominence in recent years. In this test, the amount of material leached from seeds soaked in water is measured by conductivity; the greater the amount of leaching the lower the vigour.
- TETRAZOLIUM TEST. Although the tetrazolium test is primarily used to assess viability, it can be used in some cases to evaluate vigour in terms of death or damage to specific tissues within the seed. This test requires considerable expertise.

## Conclusion

If a region is experiencing establishment problems due to seed of low vigour, a vigour test should be developed which is applicable to that region. Despite the many tests available, the best approach is to devise a test that mimics the sort of field factors that restrict establishment. Thus, if seed is being sown under cool, very moist conditions, a vigour test should be based on such conditions. Research is presently in progress to determine the most appropriate one for beans. A test for sorghum is also high on the list of priorities.

However, it must be stressed that the first remedy to establishment problems is to improve cultural practices and planting conditions. If, after this, difficulties still occur, vigour testing becomes relevant. The sowing of highly vigorous seed should not be seen as a substitute for good farming methods.

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# Bovine Brucellosis Accredited-free Herd Scheme

Below is a list of recent additions to the bovine brucellosis accredited-free herds registered in Queensland as at 31–7–78.

| | |
|---|---|
| J. L. and S. E. Abraham, 'Kaho' Stud Farms, M.S. 892, Meringanden. | AIS, JS, SM |
| R. N. Alexander, 'Trefoil Pk.', Warra. | HF |
| E. Bassingthwaighte, 'Woodlands Stud', Greenmount. | PH |
| E. C. Behrendorff, 'Inavale' Stud, M.S. 488, Boonah. | FS |
| A. J. and M. A. Bell, 'Belheath' Stud, 'Karingal', M.S. 1231, Millmerran. | PH |
| J. Bennett and S. A. Wells, Box 3202, Townhall, Toowoomba. | FS, HF |
| H. G. and C. M. Benstead, 'Analwon', Wonglepong, via Tamborine. | AIS |
| J. W. and J. K. Best, 'Idlewild' Stud, 'Idlewild', Warwick. | CL |
| Binda Brae Past. Co., 'Binda Brae', P.O. Box 2, Jimbour. | BF, HF |
| C. J. H. and M. E. Blackley, 'Alcheringa', M.S. 851, Wandoan. | BF |
| J. J. and S. L. Brider, 'Kenmar' Stud, Cryna, M.S. 1916, Beaudesert. | FS |
| H. D. and P. R. Brown, 'Westerngales' Stud, Wight's Mountain Rd., Samford. | SG |
| W. L. and J. M. Brown, 'Acedale' Stud, P.O. Box 18, Southbrook. | AIS |
| T. J. Brownlie, 'Thornton', Columboola. | SG |
| F. and E. L. Cameron, Evelor AIS Stud, M.S. 767, Yarraman. | AIS |
| D. I. and J. C. Carlyle, 'Wonga Hills' Stud, M.S. 355, Chinchilla. | PH |
| L. A. and C. M. Chesworth, 'Willette', Cryna Rd. Beaudesert. | FS, SW |
| P. J. Clarkson, 'Baroona', Bowenville. | BF |
| D. B. Coates, 'Narayen', Mundubbera. | BR |
| B. K. Coleman, 'Greenstock', P.O. Goombungee. | JS |
| C.S.I.R.O., 'Belmont Research Station', P.O. Box 542, Rockhampton. | BR |
| Dandilla Past. Co., 'Dandilla', M.S. 514, Kingaroy. | BF |
| G. D. Evans, 'Arababy Stud', 'Arababy', Moore. | AG |
| P. J. Evans, Dragon St., Warwick. | FS |
| G. T. C. Farrawell, Lander Shute Rd., Palmwoods. | DM |
| M. J. and J. Ferguson, 'Antrim', The Gums. | HF |
| D. H. and G. M. Glasser, 'Yagaburne', Goondiwindi. | PH |
| K. J. and J. L. Gordon. 'Merriwa', M.S. 499, Toowoomba. | BF |
| G. B. Gould, 'Guluguba' Stud, 'Waitangi', Guluguba. | PS |
| N. J. and H. M. Guppy, 'River Dell', M.S. 852, Hodgson Vale, via Toowoomba. | FS |
| H. R. Harris, 'Temora Park' Stud, M.S. 33, Cedar Creek, via Samford. | PH |
| T. R. Hay and Co., Pindi Pindi. | BM |
| G. H. and L. F. Hayward, 'Nashville', M.S. 1840, Greenmount. | PH |
| J. and J. L. Henry, 'Rocky Ponds', Massie, via Warwick. | HF |
| H.M. State Farm, Numinbah Valley Numinbah, via Nerang. | FS |
| H. L. Higgs, 'Bangalla', River Rd., Tinana. | BR |
| J. L., Z. P. and L. M. Hoey, 'Emoh-Ruo' and 'East Lynne', M.S. 74, Clifton. | SG |
| I. C. and S. D. Huey, 'Ashview', M.S. 918, Toowoomba. | JS |
| S. E. Hunt and D. J. and M. Doyle, 'Kudo' Stud, 'Komirra Pastures', Glasshouse Mountains. | PH |
| R. B. and S. R. Huth, 'Crestview', Roadvale. | FS |
| L. G. Jensen, 'Towertown' Stud, Glenwood, Gunalda. | FS |
| F. A. and M. Kehl, 'Hillview', Wallumbilla. | BF |
| Kengoon Pastoral Co., 'Kengoon' Studs, Kengoon, Kalbar. | BM, CL, DM, AF, PH |
| K. R. and M. S. Knight, Mt. Mee, via Dayboro. | FS, SW |
| K. R. and E. A. B. Lawler, 'Coolibah' Stud M. S. 292, Marburg. | AIS |
| D. C. Lawrie, 'Croxley', M.S. 918, Toowoomba. | DM |
| Leacy and Pavan, 'Calmrancho', 93 Summit Rd., Pomona. | DM |
| K. J. Lee, 'Brigalow Park', Kurrumbul. | HF |
| W. M. Leonard and Sons, 'Welltown', Goondiwindi. | SH |
| R. and M. Little, Lauroy Past. Co., 'Lauroy', P.O. Box 72, Miles. | CL, SM |
| N. E. Lobley, 'Neloby', Mt. Pleasant, via Dayboro. | FS |
| C. R. Loweke, 'Willowside', Kenilworth. | JS |
| M. M. and G. E. McGuire, 13 Burton St., North Booval. | CL |
| J. B. and J. M. Matthews, 'Mt. Moriah', P.O. Box 15, Jondaryan. | SM |
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| R. G. Pharoah, 'Merroo' Encourage Stud, P.O. Box 34, Chinchilla. | HF, SM |
| J. Phillips and Sons, 'Sunny View' Stud, M.S. 90, Kingaroy. | DM |
| Dr. S. M. Piaggio, Natural Arch Farm, Numinbah Valley, via Nerang. | FS |
| Pickering Brothers, 'Granite Vale' Stud, Sellins Rd., Mt. Mee, via Dayboro. | FS |
| A. J. T. and I. M. Ross, 'Rosedale' Stud, Dayboro Rd., Samford. | FS |
| H. L. Rutledge and Co., 'Darrian', Jondaryan. | PS |
| G. C. Seibel, 'Mountvale', M.S. 848, Warwick. | HF |
| L. J. Sheahan, 'Kyilla Park Stud', 'Kyilla', Condamine. | HF |
| F. Sippel, 'Callemondah', Ballandean. | JS |
| L. D. and G. L. Smith, 140 Wecker Rd. Mansfield. | AIS |

| | |
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| M. D. Stokes, P.O. Box 56, Laidley. | JS |
| A. J. and E. A. Tigell, 'Avondale', Googa Ck., Blackbutt. | MG |
| W. T. and L. Voss, Mt. Vista Stud, M.S. 292, Glamorganvale, Ipswich. | AIS |
| I. L. and M. R. Walker, Menlo Park Stud, M.S. 1573, Southbrook. | DM |
| Sir James Walker, 'Cumberland', Longreach. | SG |
| Sir James Walker, 'Camden Park', Longreach. | SG |
| G. I. Warfield, 'Dernan Court', M.S. 223, Nobby. | PH |
| P. R. and H. D. Watters, 'Lynford' Stud, Callemondah, Ballandean. | JS, HF |
| G. C. and C. A. Webster, Gympie. | BF |
| Wyalla T.D.T., 'Wyalla', M.S. 886, Texas. | CL, LM, SM |
| L. and J. Wyvill, P.O. Box 116, Warwick. | SM |
| L. W. and H. M. Zirbel. 'Lacewood', Derrymore, via Helidon. | PH |

**KEY**

| | |
|---|---|
| Afrikaander | AF |
| Angus | AG |
| Australian Illawarra Shorthorn | AIS |
| Ayrshire | AY |
| Belmont Red | BR |
| Braford | BF |
| Brahman | BM |
| Charolais | CL |
| Droughtmaster | DM |
| Friesian | FS |
| Guernsey | GS |
| Hereford | HF |
| Jersey | JS |
| Limousin | LM |
| Murray Grey | MG |
| Poll Hereford | PH |
| Poll Shorthorn | PS |
| Red Poll | RP |
| Sahiwal | SW |
| Santa Gertrudis | SG |
| Shorthorn | SH |
| Simmental | SM |

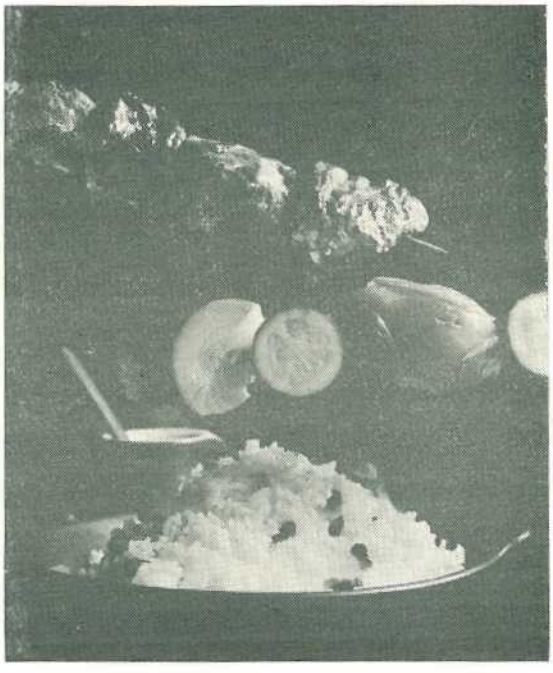
# Be inventive with skewers

**KEBABS, small pieces of lamb interspersed with onions and bayleaves . . . grilled or fried are predominantly Turkish in origin.**

Yet over the centuries, the culinary arts of many countries have developed their own variations, just like these skewer-cooked versions.

Any food can be skewered . . . lamb marinated in yoghurt; steak; flounder fillets; or frankfurters wrapped in cheese and ham slices. With ingredients like apple wedges, pineapple and banana, or separate skewers of tomato, onion and zucchini, they are grilled, brushed with butter to moisten and brown.

Be inventive and try oven braising beef kebabs with celery and onions, then top with tomato slices and parmesan cheese—a clever disguise for a family casserole.



*Recipes provided by the Dairy Foods Advisory Bureau.*

## Apple frankfurter Grill

Standard 250 ml measuring cup and 20 ml tablespoon are used. All measurements are level.

12 thin individual cocktail frankfurters.

4 Australian processed Cheddar cheese slices, cut into three strips.

1 x 125 g packet ham slices, cut in half.

2 medium green skinned apples, quartered, with cores removed.

Wrap a strip of cheese around each frankfurter, then wrap a ham slice over the cheese. Push kebab skewers through frankfurters where the cheese and ham slices join. Thread alternately with apple quarters on to four skewers allowing 3 frankfurters and 2 apple quarters on each skewer. Brush well with mustard butter (see below) and grill until ham begins to brown. Continue brushing with butter during cooking to prevent kebabs from drying out. Serve with toasted, buttered long bread rolls and mustard pickles. Serves 4.

THE MUSTARD BUTTER

Combine together:

125 g melted butter.

2 teaspoons prepared English mustard.

½ teaspoon salt.

★ ★

## Fresh fruit fish sticks

Standard 250 ml measuring cup and 20 ml measuring cup are used. All measurements are level.

750 g flounder fillets, cut into 2·5 cm squares.

3 large ripe bananas, cut into 16 pieces.

3 thick slices fresh pineapple, peeled, cut into 16 pieces.

Salt and pepper to taste.

4 tablespoons butter, melted.

Thread fish, banana and pineapple alternately on to 8 skewers. Season well with salt and pepper. Place under a hot griller and cook till browned, brushing at intervals with melted butter. Serve with cream sauce (see below). Serves 4.

THE CREAM SAUCE

Mix together in a bowl and chill till required:

¾ cup cream, semi-whipped.

⅓ cup chopped sweet-spiced gherkins.

¼ teaspoon salt.

1½ tablespoons lemon juice.

Finely grated rind of a lemon.

★ ★

## Yoghurt lamb skewers

Standard 250 ml measuring cup and 20 ml tablespoon are used. All measurements are level.

1 kg fillet of lamb, cut into 4 cm pieces.

THE MARINADE

Mix together in a large shallow dish:

1 x 200 g carton natural yoghurt.

½ teaspoon nutmeg.

½ teaspoon salt.

Add lamb to marinade. Cover and leave for at least 2 hours, or overnight. Turn the lamb pieces over occasionally to coat with marinade. Remove lamb and thread on to 6 skewers. Brush liberally with melted butter. Grill under moderate heat for approximately 25 minutes or till tender. Reserve marinade for sauce.

THE VEGETABLES

2 thin 13 cm zucchinis, each cut into 6 pieces.

6 whole table or round tomatoes.

6 small onions, peeled.

Drop zucchini and onions into boiling water for 5 minutes. Remove, rinse in cold water. Halve onions. Thread alternately on to 6 skewers with zucchini and tomatoes. Season well. Brush with melted butter. Place under griller 10 minutes before lamb kebabs are cooked, turning to lightly brown both sides. Serve on buttered rice tossed with currants. Spoon sauce over kebabs.

THE SAUCE

To the remaining marinade add:

1 tablespoon lemon juice.

1 tablespoon water.

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# The macadamia twig girdler

*by D. A. Ironside, Entomology Branch.*

THE macadamia twig girdler *(Neodrepta luteotactella* (Walker)) is most prevalent on young trees where it can cause severe growth checks and even death.

The insect is active throughout the year and the greatest damage to macadamia occurs during summer and autumn. The adult moths which belong to the family Xyloryctidae are least active during winter.

Typically, the twigs of infested trees show signs of girdling at the forks or leaf whorls and the leaves may be skeletonized and incorporated into larval shelters. Tunnelling in the nuts may occur on bearing trees but this is rarely a serious problem.

## Host plants and distribution

As well as macadamia, the insect also attacks many other native proteaceous trees such as *Banksia, Grevillea, Hakea, Persoonia, Buckinghamia, Stenocarpus,* and *Xylomelum.* It occurs in all macadamia areas in coastal Queensland but the heaviest infestations are usually in elevated areas.

## Life history, habits and damage

- ADULT—The adult is a silvery-white moth, satiny in appearance with yellow legs and antennae and with a wing span of up to 26 mm. It is mainly active at night and is attracted to mercury vapour light which has been used in traps to monitor pest abundance.
- EGG—The egg is approxiately 0·7 x 0·4 mm, yellow when laid and changing to reddish-orange. It is proportioned and patterned in such a way as to resemble corn on the cob. Eggs are laid singly at leaf axils on terminal shoots and apparently in the vicinity of old twig girdler damage.
- LARVA—During development, the larvae may pass through 6 to 9 stages; 6 to 7 being more common. On hatching, it is about 1·5 mm long and yellow-orange in colour with a black head.

Feeding commences in crevices at leaf axils, in folds of leaves or at old damage sites. The larva feeds under webbed shelters which become cluttered with excrement and damaged foliage as larval development proceeds. Numerous larvae at various stages of development often occur in the one shelter. Webbed shelters may remain on the tree long after the life cycle is completed, giving it a ragged appearance.

Twigs weakened by girdling readily snap off and this tends to induce a bunched habit of growth. Tunnelling in the husks and kernels causes damage similar to that of the macadamia nut borer.

When fully grown, the larva may be up to 23 mm long. It has a dark brown to black head capsule and its body is mottled brown relieved by longitudinal rows of dark brown dots.

The larva, on reaching its pre-pupal stage, contracts and becomes lighter in colour. It constructs a dull brown, silken cocoon (about 12 mm in length) in which the transformation to the pupa occurs.

- DURATION OF THE LIFE CYCLE—Development time, when the insect is reared in the laboratory at 26°C on macadamia nut husks, is from 62 to 84 days. This comprises 7 days for eggs, 39 to 69 for larvae, and 12 to 17 for pupae. During spring and summer, however, egg laying to adult emergence on trees in the field can take from 3 to 5 months.

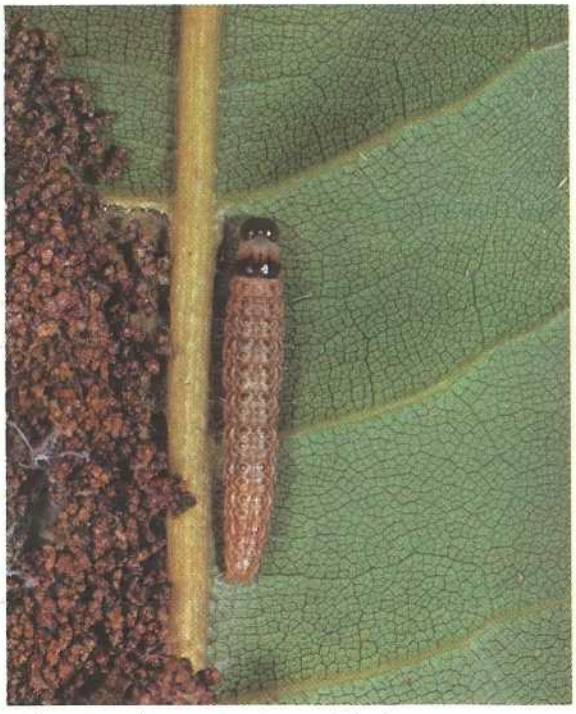
## Natural enemies

Over 20 natural enemies have been recorded and it appears likely that these are important in regulating pest populations. Most of these enemies are wasp parasites which attack the insect during its larval stage. An unidentified bethylid, a braconid, *Agathiella* sp. and the ichneumonids *Goryphus turneri* Cheesman and *Stiromesostenus albiorbitalis* Cheesman are among the more common parasites.

# The macadamia twig girdler

*Adult moth of the macadamia twig girdler (wing span up to 26 mm).*

*Fully grown larva up to 23 mm long on a macadamia nut.*



*Immature larva on a damaged leaf.*

*ABOVE. Typical twig girdling damage on a young grafted tree.*

*LEFT. Webbed shelter of the larva incorporating insect excrement and damaged leaves.*