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COVER: Harvesting a pea crop at Gatton.
Photograph by E. Donnelly.

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Contents

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94210—16

Cotton growing in the

COTTON is the most important crop in the Emerald Irrigation Area.

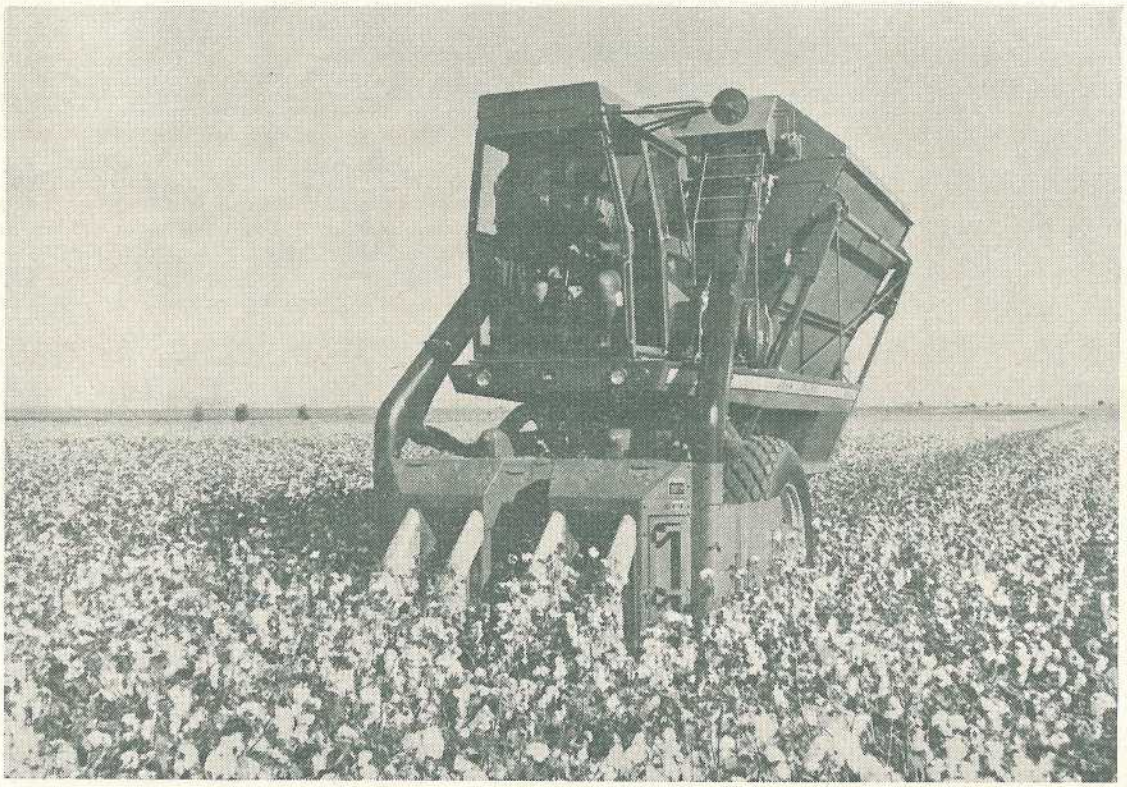
The Emerald district now produces more than one-quarter of the cotton grown in Queensland with yields in excess of four bales per ha being grown (table 1).

Until 1979, the cotton grown at Emerald was transported to Biloela for ginning. A cotton gin was established at Emerald in 1979 and the crop is now processed locally.

Climatically, Emerald is well suited to cotton growing. The long, hot summers are ideal but wet weather during March, April or May can reduce yields and quality in some years. Irrigation water is supplied from the Fairbairn Dam which is situated upstream of Emerald on the Nogoa River.

Photograph above. An aerial view of part of the Emerald Irrigation Area. Modules of cotton can be seen standing along the head ditch on the contour

by W. D. Hamilton, Agriculture Branch



Emerald Irrigation Area

Soils in the Emerald Irrigation Scheme are also suitable for cotton growing. On the left or west bank of the Nogoa River where the irrigation scheme commenced, the soils have been mapped into three basic soil types:

- The **open downs** is the major soil type. These soils are dark cracking soils formed on basalt. They are usually less than 1 m deep and are deficient in phosphorus.
- The **scrub** soils are similar in texture to the open downs soils but are usually deeper (more than 1·5 m deep) and are more fertile. They also hold slightly more available water but, like the open downs soils, they overlie basalt.
- **Alluvial** soils make up most of the remaining area that is cropped. These soils vary from clay loams to heavy clays. They are usually fertile but some areas of texture contrast or duplex soils are difficult to irrigate. On the right bank of the scheme, cotton is mainly grown on alluvial soils.

Photograph above. Harvesting the crop.

The cotton plant is a drought-tolerant perennial species that is grown as an irrigated annual crop. It is usually planted in Emerald in October/November and harvested in May/June. Figure 1 shows the seasonal events in cotton growing at Emerald. Crop management is critical because management decisions on fertilizers, irrigations and pest control significantly affect yields.

TABLE 1

COTTON PRODUCTION, EMERALD

Year	Area (ha)	Emerald Production (225 kg bales)	Yield (bales/ha)	No. of Growers
1970	499	188	0·4	2
1971	442	327	0·7	2
1972	1 019	1 485	1·5	7
1973	894	354	0·4	2
1974	75	3	..	1
1975	643	1 527	2·4	7
1976	760	1 653	2·2	12
1977	2 818	6 130	2·2	34
1978	2 032	7 617	3·7	28
1979	3 652	17 133	4·7	36
1980 Est.	5 060	22 500	4·4	36

Source: The Cotton Marketing Board

The cotton plant

Cotton differs from most other field crops because of its indeterminate growth habit. It has both vegetative and fruiting branches. The vegetative branches develop first, normally from the lower sixth to ninth main stalk nodes. Fruiting branches then appear at successively higher nodes up the plant.

Once these branches appear, new fruiting branches appear every 3 days. Successive nodes on the branches appear in about 6 days. Each of these nodes has a floral bud or square. These squares ultimately develop into flowers and then bolls but it is usual for a large number of squares to be shed. Table 2 shows the times for the various stages of development.

At Emerald, October planted cotton emerges in early November, squares in early December, flowers in late December and bolls begin to open in late February.

The fruiting pattern of a crop grown at Emerald in 1978–79 is shown in figure 2.

TABLE 2

GROWTH STAGES OF THE COTTON PLANT

Growth stages	Development time (Days)	
	Range	Average
Planting to emergence	7–20	10
Emergence to first squares	15–60	40
Squaring to flowering	20–30	25
Flowering to mature boll	40–60	50

Figure 1

SEASONAL EVENTS IN COTTON GROWING AT EMERALD

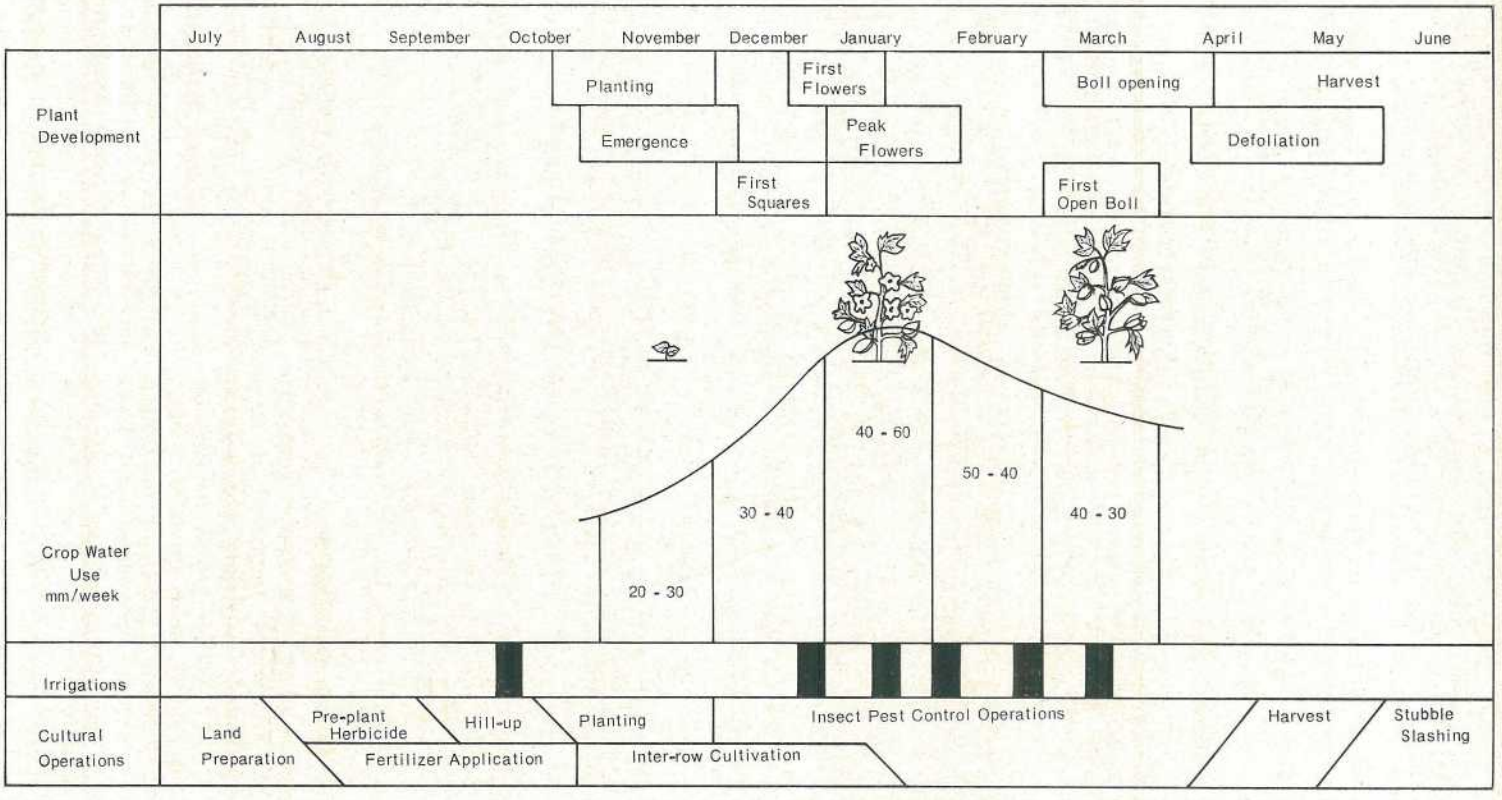
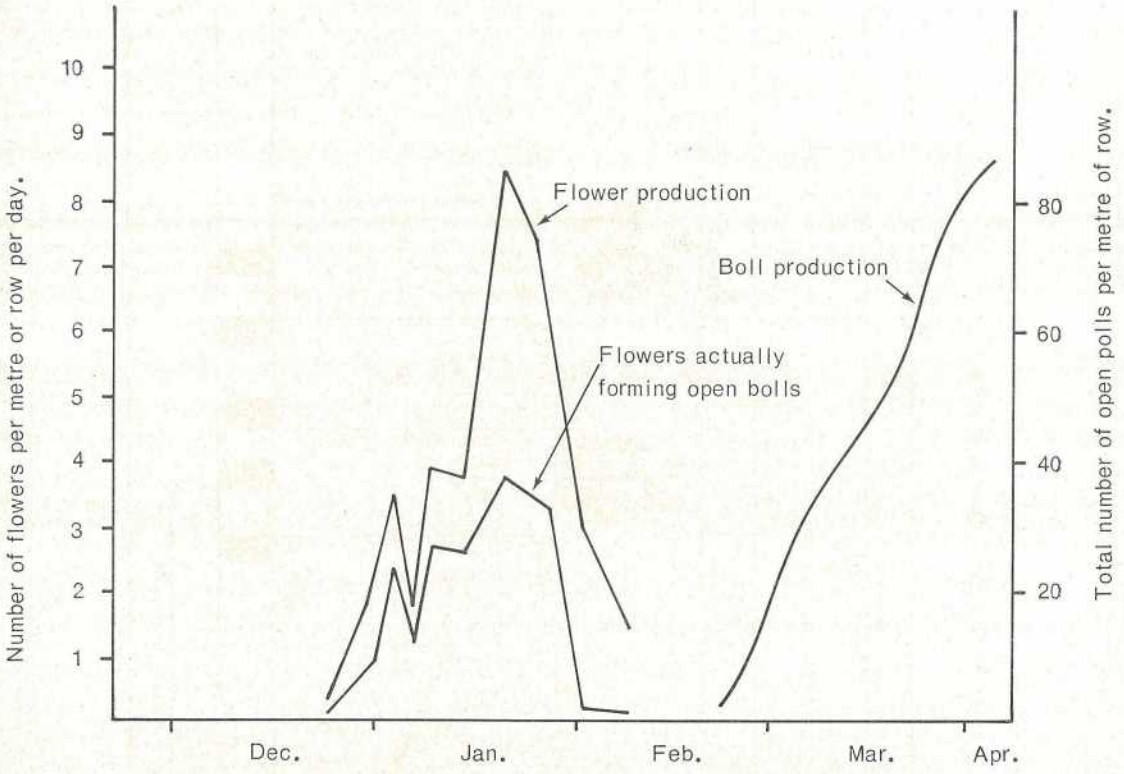


Figure 2

FRUITING PATTERN IN COTTON EMERALD 1978/79



Data supplied by G.D. Keever, D.P.I., Emerald.

Planting date: 16/10/78
Soil type: Scrub (Tb. Ug)
Plot yield: 7.3 bales/ha (hand harvest)
Fertilizer: 140 kg N/ha as urea
3 kg P/ha as superphosphate

Crop rotations

Continuous cropping of cotton is generally practised but yields are improved if crop rotation is practised. Soybeans are a good rotation crop and cotton grown in rotation with soybeans usually yields up to 0·5 bales per ha more than crops grown on old cotton areas. A cotton/soybean rotation may, however, lead to a build up of summer weeds and soybeans compete with cotton for irrigation water in summer.

Rotation with a winter crop such as wheat, spreads the demand for irrigation water, facilitates control of summer weeds and assists in controlling some diseases of cotton.

Land preparation

Cotton growers at Emerald aim to have a weed-free area with fertilizer applied, hilled up and irrigated ready for planting in October.

Operations should commence immediately following the cotton harvest. If old cotton

stubble is standing, it is usually slashed. This shreds the stalks so that they will not interfere with subsequent operations. Disc or chisel ploughs are then used to plough in the stubs of cotton and the soil is worked to a depth of about 20 cm. Thorough incorporation of plant material is important because this reduces the carry-over of disease. It also kills many of the insect pests that overwinter in the soil and in crop residues.

Land levelling is carried out after the first or second working. This is required so that irrigation water will readily flow on and off the paddock. In areas that were naturally gilgaied, attention to land levelling is regularly required. On gently sloping land, levelling may only be required in troublesome areas every second year. Laser-controlled levelling equipment is becoming more widely used for this operation.

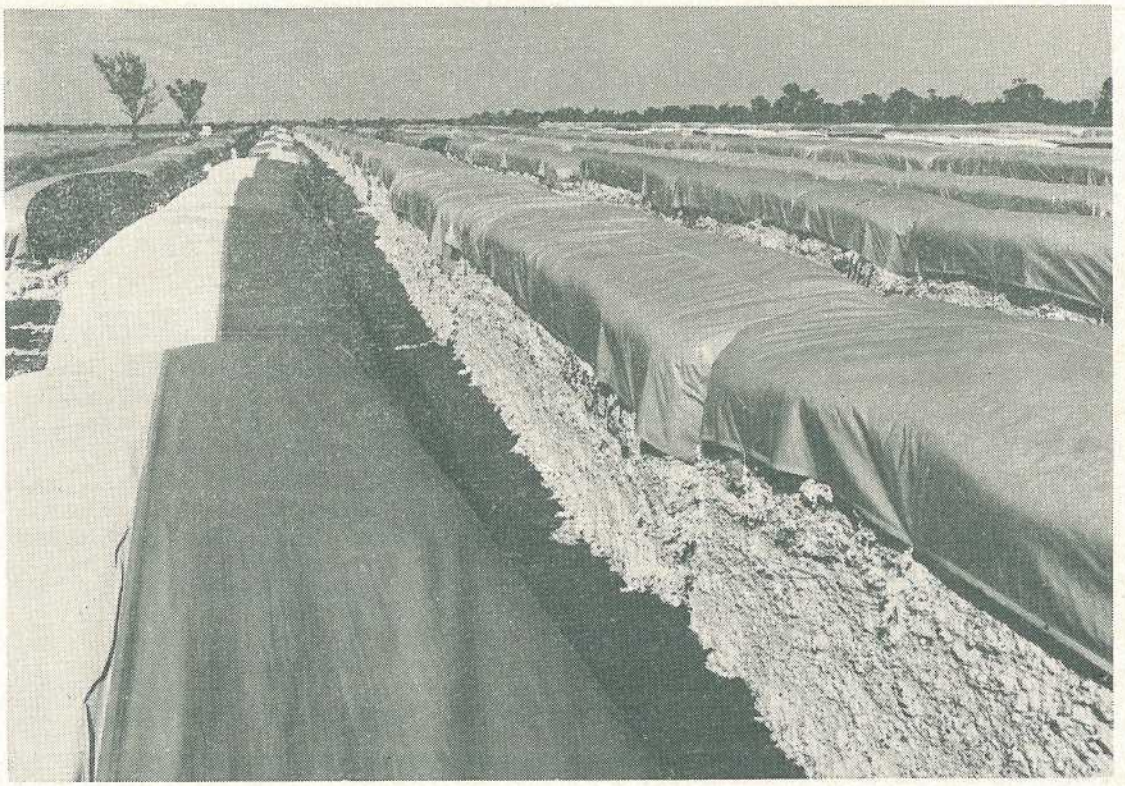
After levelling, the soil is again worked to a depth of about 20 cm and 'hilled-up' in beds 1 m apart. Nitrogenous fertilizer is usually applied at the same time as the hilling-up operation.

Varieties

Deltapine 16 has been the most widely grown variety in the Emerald district and it has consistently produced high yields. In 1980–81, Deltapine 61 will be available. This variety is similar to Deltapine 16 but its yield has been slightly better in trial areas.

Namcala has also been grown commercially. Although it has good fibre quality attributes (particularly fibre length and strength) its yield performance has been generally inferior to Deltapine 16.

A breeding programme to develop better varieties is continuing. Varieties with improved insect and disease resistance are being sought. Increasing fibre strength, while maintaining current yield standards, is also part of the aim of this research programme.



Modules of cotton in the gin yard. They are waiting to be processed by the Emerald gin which commenced operation in 1979.

Planting and spacing

The optimum planting time at Emerald is the middle to the end of October. Plantings made in September may suffer from exposure to cool weather and plantings made after the end of November usually have a reduced yield potential. If large areas are to be planted, it is better to start planting early rather than finish late.

A plant population of 100 000 plants per ha is ideal, but populations within the range of 75 000 to 125 000 plants per ha have a similar yield potential. In metre rows, this means a population of between 7 and 13 plants per m should be obtained. Gaps of more than 1 m within the row restrict the yield.

Planting depth is determined by the soil type and prevailing weather conditions. The seed should be planted as shallow as possible but into sufficient moisture to ensure rapid germination. This is usually 4 to 6 cm.

Fertilizer

In the Emerald area, responses to nitrogenous and phosphatic fertilizers are common. In a few soils, responses to potassium and sulphur fertilizers have also been recorded.

Nitrogen

The nitrogen fertilizer requirement depends on the present soil nitrogen status and the length of growing season of the crop. Too little soil nitrogen for plant growth and reproduction will seriously reduce yield. Excess soil nitrogen promotes rank crop growth in which insect control is difficult. It also delays crop maturity, makes defoliation difficult and promotes the development of boll rots in the humid, overgrown crop canopy.

A base rate of 120 kg N per ha application is recommended. This should be increased to 150 kg per ha on nitrogen deficient soils with a cotton/cotton crop sequence. Lower rates should be used in situations where soil nitrogen status is high.

All of the nitrogen fertilizer should be applied before the area is pre-irrigated. In most instances, no advantage has been found from split treatment. Urea is the least expensive form of nitrogenous fertilizer for the Emerald district and it should be applied in a band under the bed. It is convenient to apply this urea in the hilling-up operation.

Phosphorus

Phosphorus deficiency is widespread in soils of the Emerald Irrigation Area. The open downs soils are particularly deficient but most of the scrub soils require the addition of phosphatic fertilizer. Alluvial soils are variable in their phosphate status and some require the addition of fertilizer.

Soil analysis can be used as a guide. On deficient soils (those with less than 10 p.p.m. P using the bicarbonate extraction method) 40 kg P per ha is recommended. This rate can be reduced to 20 kg P per ha on soils with between 10 and 20 p.p.m. P. This fertilizer rate can be reduced further for soils with more than 20 p.p.m.

Phosphate fertilizers should be applied in a band close to the seed at planting. Superphosphate is the preferred form because the sulphur content of approximately 10% may be useful and is included at little extra cost. However, handling difficulties may mean that the high analysis forms of phosphate fertilizer which have no sulphur content will need to be used.

Other nutrients

Potassium deficiency has been recorded on some of the open downs soils in the Emerald area. Most other soils in the area have adequate reserves of potassium. Again, soil analysis is a useful guide. On deficient soils, 50 kg K per ha is recommended.

Sulphur fertilizer responses have been recorded in some areas. The open downs soils have low levels of available sulphur. The use of superphosphate instead of high analysis forms of phosphate fertilizer should correct any deficiencies.

Trace element deficiencies have not been recorded in field tests of soils in the Emerald area at this stage. Test strips should be used if a deficiency is suspected and these must be harvested separately. Profitable yield responses may not be visual.

Irrigation

Cotton is regarded as a drought-tolerant plant but it responds well to irrigation. The plant is tolerant of dry conditions because it is able to shed fruiting parts in times of drought stress and set more squares and bolls when adequate moisture is available. Under

The author standing in a seven bales per ha crop grown by Mr C. Smith of Overlook, Emerald in 1979/80.

dry conditions, the internodes are shortened and squares and bolls up to 1 cm in diameter are shed. Under irrigation, the number of bolls set can be increased and the period of boll setting prolonged.

Crop water requirements must be met in the peak flowering period. This occurs between mid January and mid February and crop areas should be planned so that water requirements can be met in peak demand times.

Crop water use varies from season to season but in most years cotton grown in the Emerald district will require from 5 to 6 ML of water per ha. This is usually applied in one pre-planting irrigation and four or five follow-up irrigations depending on rainfall.

Pre-planting irrigation is recommended and permits easier weed control. Planting dry and 'watering-up' to establish the crop provides good conditions for the early growth of cotton seedlings, but allows weed seedlings to establish at the same time.

The first post-planting irrigation should be delayed until after squaring commences. This is usually 5 to 7 weeks after planting. In some cases, the first post-planting irrigation can be delayed until flowering is well initiated, for example, in soils with a high moisture holding capacity, in a cool season or if rain falls.

Once the first post-planting irrigation is applied, the cotton crop should be irrigated so that the plant does not suffer any severe water stress. The required frequency of irrigation is determined by the weather conditions, the stage of crop growth and the amount of available stored soil moisture.

A high yielding cotton crop grown by Mr D. McCullagh in the Emerald Irrigation Area.

A crop growing in hot, dry weather (pan evaporation greater than 10 mm per day) with a full crop canopy will require irrigation at least every 10 days on a soil with low plant available water (that is, less than 10 cm). Alternatively, in cool, cloudy weather a crop that has not covered the inter-row space would not require irrigation for 3 weeks on a soil type that has high plant available water (that is, more than 15 cm).

The rate of water use and the stages of development of the crop are described in figure 1.

Several methods are available to determine the need for mid season irrigations. Measurements of pan evaporation and the use of a 'crop factor' give a good estimate of crop water use. The crop factor is related to the stage of growth of the crop and, if the amount of available soil moisture is known, the irrigation interval can be calculated.

Emerald soils differ in the amount of available water they hold. The alluvial soils hold about 9 cm of available water, the open downs soils 10 cm, and the scrub soils about 12 cm. In an average season, alluvial soils may require six irrigations after planting while scrub soils may only require four irrigations.

The cotton plants should be closely scrutinised. After the commencement of flowering, the plant should grow steadily but not luxuriantly. The squares at the top of the plant should be prominent and a few flowers should be visible among the top leaves. When flowers are hidden by the leaves, growth is too rapid. Alternatively, a flower garden effect indicates that growth is restricted and irrigation has been delayed too long.

Plant colour is another indication of the need for irrigation. Crop foliage becomes darker with a slightly bluish tinge before signs of wilting appear. When the plant is growing rapidly there is usually 8 to 10 cm of light green stem between the terminal bud and the reddish colour of the stalk. An extension of this reddish colour towards the terminal bud indicates that plant growth has slowed.

Irrigation should be completed by the end of March. Although some water is needed by the cotton plant as long as the bolls are maturing, the rate of water use declines rapidly when bolls begin to open. Late irrigations seldom improve yields and may often interfere with subsequent crop management.

Weed control

Weed control is essential. Weeds compete with the crop for moisture, sunlight and nutrients and heavy weed infestations reduce picking efficiency and can lower the grade of the lint.

Sound cultural practices including crop rotation, inter-row cultivation and farm hygiene will reduce the need for herbicides.

The crop should be inter-row cultivated when weed seedlings are small. Good control can be achieved by cultivating weeds in the inter-rows and smothering weeds in the cotton rows. Several inter-row cultivations are usually required and should be continued as long as possible.

Herbicides are particularly useful when used in conjunction with other weed control measures. Special care is required as many herbicides can damage the crop if they are not correctly applied. Poor weed control may also result from incorrect herbicide application.

Annual grass weeds such as annual summer couch (*Brachiaria eruciformis*) can be a problem in the Emerald district. Trifluralin is recommended for the control of these grass species. It will also control seedlings of *Sorghum almum*.

Annual broad-leaved weeds can be controlled with fluometuron. It should be applied as a post planting pre-emergence application at the rate of 4 to 6 L per ha of 500 g per L commercial product. It is usually applied with a nozzle mounted on the planter behind each row. A 30 cm band is applied over the row on to moist soil. Most broad-leaved annuals are controlled but noogoora burr (*Xanthium pungens*) and *Datura* species show some resistance.

Sesbania spp. is satisfactorily controlled but rates in excess of 4 L per ha are required. In areas of heavy *Sesbania* spp. infestations, a lay-by spray will give improved control. This involves mounting spray equipment on the cultivation rig and directing a spray on to the soil beneath the growing cotton plants when they are more than 10 cm tall.

In areas where bell vine (*Ipomoea plebeia*) is a particular problem, prometryne is recommended instead of fluometuron.

Noogoora burr and *Sorghum almum* can be controlled with M.S.M.A. as a post-emergence directed spray. A new herbicide, phenisopham,

registered as Verdinal, shows promise for *Sesbania* spp. control as an overall post-emergence spray.

Datura spp. are not easily controlled with these herbicides. Hand chipping is warranted where infestations are light.

Insect pest management

Good insect pest management is the key to success in growing profitable crops of cotton. An understanding of the pests, their natural enemies and the effects of the various insecticides available, is required. The cotton plant can support some pest attack at various stages of growth but heavy infestations during flowering and boll development will seriously reduce yields.

During early plant development, aphids and thrips can cause some plant damage. Aphids (*Aphis gossypii*) are soft-bodied insects about 1 mm long. They feed on plant sap and secrete honey dew which gives the plant a shiny appearance.

Cotton thrips (*Thrips tabaci*) are small insects about 1 mm long. They are yellowish-brown in colour and feed by lacerating the surface of the plant and sucking sap from the injured tissue. These seedling pests rarely require insecticide control.

As the plant develops to the squaring stage, *Heliothis* spp. begin to damage the plant. There are two species of this pest that damage cotton crops, the cotton bollworm (*Heliothis armigera*) and the native budworm (*Heliothis punctigera*). They have similar life cycles and are similar in appearance.

The adult stage is a stout-bodied moth which lays eggs on the young leaves and squares. The eggs take 3 to 4 days to hatch and the larvae develop through six growth stages. They feed on the fruiting parts of the plant and work their way down to the bolls lower in the crop canopy.

Heliothis are the major pests of cotton in Queensland and treatment with insecticide is required, particularly during the peak fruiting period of January and February. The larvae must be treated before the third instar stage which occurs about 7 days after hatching. Large larvae are much more difficult to kill and resistance to some insecticides has developed in *Heliothis armigera.*

The choice of insecticide and the timing of application are very important. Beneficial insects should be preserved where possible with the use of selective insecticides.

Various techniques of deciding when to spray have been developed. Independent insect management consultants are available at Emerald.

The decision on when to spray depends on pest incidence, crop stage, yield potential and the presence of beneficial insects. However, a simple guide to pest management is:

- **Before squaring (November to early December).** Inspect the crop weekly. Treat for pests only if insect damage is reducing the plant stand.
- **Squaring to early flowering (mid December to mid January).** Inspect the crop every second day. Treat with a selective insecticide if larvae numbers exceed two per m of row or egg numbers exceed four per m of row.
- **Peak flowering to boll setting (mid January to mid March).** Inspect the crop every second day. Treat with insecticide when larvae numbers exceed one per m or egg numbers exceed two per m of row. Ensure that insecticide treatments are effective.
- **Boll opening to late season.** Inspect weekly. Treat only when larvae numbers exceed two per m and damage to green bolls can occur. Watch for aphids.

When egg numbers are used as a guide for scheduling insecticide spraying, applications should be timed to coincide with the hatching of most eggs.

Most other pests of cotton are controlled with the insecticides used for heliothis control. The rough bollworm (*Earias huegeli*), cotton loopers (*Anomis* spp.), spider mites (*Tetranychus* spp.), cotton tipworms (*Crocidosema plebiana*) and the cotton jassid (*Austroasca terraereginae*) can be troublesome from time to time. Various insecticides are registered for the control of these pests.

Regardless of the approach adopted for insect pest management in the crop, regular and thorough checks of the crop are essential if sound decisions are to be made.

Care should be taken to ensure that insecticides are not wasted. They should be applied under the best available conditions. Cool, humid conditions with a steady cross-wind give best results when aircraft are used. Often these conditions apply in the early morning. In mid summer, weather conditions are not always favourable but insecticides applied in hot, dry, still conditions are often wasted.

Diseases

Seedling diseases or damping-off can cause losses in plant stand in some seasons. The causal organisms are usually *Rhizoctonia solani* and *Pythium* spp. Control of damping-off is best achieved by encouraging rapid seedling emergence. Planting at the correct depth, using quality seed, planting into a well-prepared and pre-irrigated seed bed, and avoiding cool conditions all help reduce seedling disease incidence.

Bacterial blight (*Xanthomononas malvacearum*) is the only bacterial disease of economic importance in cotton at Emerald. The disease occurs as an angular leaf spot. It usually is more severe on older leaves and often these spots coalesce and form green water-soaked areas along the veins on the underside of the leaf. Boll infection occurs as water-soaked spots which have a greasy appearance. Secondary boll-rotting organisms may gain entry to the boll through these lesions and affected locks usually fail to open.

Bacterial blight spreads rapidly in humid conditions and infection can be severe following plant damage from cultivation or hail. Because the disease is seed borne, some control is achieved by using acid delinted seed. The disease will, however, also carry-over on trash and early ploughing of cotton stubble will reduce inoculum levels. Breeding of varieties with resistance to this disease is continuing in Queensland.

Boll rots caused by organisms other than bacterial blight can also cause losses in some seasons. A heavy crop canopy and prolonged wet weather as the bolls begin to open are ideal conditions for these organisms. If high levels of humidity are maintained under the bushes, large losses can occur. No effective control of these boll rots is available but losses are reduced if the crop is managed to avoid a rank overgrown plant and insect damage is minimized.

Alternaria leaf spot has been observed at Emerald but it is not a virulent disease and usually only attacks plants that have suffered some stress.

Verticillium wilt has not been recorded at Emerald although it is a disease of major importance in other cotton growing areas of Australia.

Defoliation and harvest

Chemical defoliants are usually applied to cotton before harvest to permit more efficient use of mechanical harvesters. Defoliants should be applied when 60% of bolls are open. Premature defoliation results in lowered micronaire values and reduced yields.

Cotton defoliates easier if it has developed an early boll load and vegetative growth has slowed or plants have 'cut-out'. Plants with young, actively-growing leaves and plants under severe moisture stress are difficult to defoliate. Excessive applications of nitrogenous fertilizer also make defoliation more difficult.

Harvest can commence about 10 days after the application of a defoliant. Sufficient area to keep ahead of harvesting machinery should be defoliated at one time.

The chemicals used are organic phosphates or chlorates. The organic phosphates are more effective when temperatures are high. When temperatures fall below 15°C, chlorate defoliants are usually more effective.

Dessicants such as diquat can be used for crop salvage when weeds are a problem. Bell vine can be treated in this way to facilitate harvest.

Machine picking should begin when the seed cotton moisture is less than 8%. Although the picking adds a small quantity of water to the lint to keep the picking spindles clean, seed cotton should be kept as dry as possible. Moist cotton will heat and encourage lint-staining micro-organisms to develop.

Much of the Emerald crop is machine-harvested in one operation but some areas are picked twice. The second pick usually has less than 10% of the crop yield, but it will be profitable if late bolls mature and open. As the crop is harvested, it is compacted into modules for transport to the local ginnery. Here the seed is removed and the lint baled ready for market.

Race-crutching saves time, effort and money

ROGER Arden of 'Akaray', Augathella has race-crutched his own sheep for 5 years.

He can channel-crutch and wig over 800 ewes per day for a saving of $188, or 23 cents per head.

Roger uses jetting races already on the property rather than a portable crutching race. He has fitted lengths of old bore casing along the inside of the nearside of his races (plate 1). He sits on the casing and secures the sheep against the opposite side of the race with his knee (plate 2). It can then be channel-crutched in the standing position. This obviates the need to throw the sheep and reduces much of the time and effort involved in crutching.

An essential item in this form of race-crutching is a handpiece that can be taken to the sheep along the full length of the race. Roger has an 'Abel Star' pneumatic handpiece attached to a length of air hose. This means the handpiece can be taken along any race without moving the compressor (plate 3). An alternative is to mount a portable crutching unit with a flexible down tube in such a way that the unit can be easily moved along the race.

The compressor

Roger has modified an old six cylinder motor to pump air for his handpiece (plate 4). The air is pumped from the motor's cylinders into the high pressure gas cylinder via the spark plug holes (plate 5). Gas piping takes it to the gas cylinder. Air return is prevented by back pressure operating on ball bearings seated on modified spark plug bases. Excess air is released via a safety valve on the cylinder. The compressor provides ample air to power two handpieces running continuously.

The cam shaft, timing gear, oil pump and electricals have been removed from the engine. Also, the tappet springs on the inlet valves have been cut to allow them to open and seal with each cycle of the compressor's pistons. This means every downstroke takes in air and every upstroke scavenges air via the spark plug holes.

All air is introduced via the inlet manifold and is pre-cleaned through an oil bath filter. The compressor is splash-lubricated and water-cooled. Roger has a drip-cooling on the air outlets to prevent overheating.

The compressor is mounted on a chassis and can be taken to any site. It is driven via a P.T.O. shaft of a tractor. Air flow is altered by lifting tractor revs above 25% and/or changing the gears in the compressor's gear-box.

The operation

Roger Arden says, 'I half sit on the bore casing and press my knee into the flank of the sheep, pushing it tight against the opposite side of the race. The opening blow begins 5 cm above the tail. All blows can be worked from there. Hocks can be crutched by lifting the handpiece up and out when on the ham-string. If the sheep has to be wigged, the free hand is used to pull the muzzle around. Two blows will remove the topknot. If the udder is dirty, it can be cleaned up by lifting the nearest back leg'.

Wool and dags can be partly separated by holding the crutched wool in the free hand and letting the dags fall to the floor of the race.

As the crutchings are shorn off the breech they are thrown on to hessian laid along the ground on a convenient side of the race. Wool handling (piece picking, picking up and baling) is done after the job is completed. This gives the opportunity to make crutching a one-man operation. If the wool is short and will not bind together, Roger lays the hessian on the floor of the race and lets all wool fall on to it (plate 6). He then sweeps up between each raceful of sheep.

by L. Dunlop, Sheep and Wool Branch

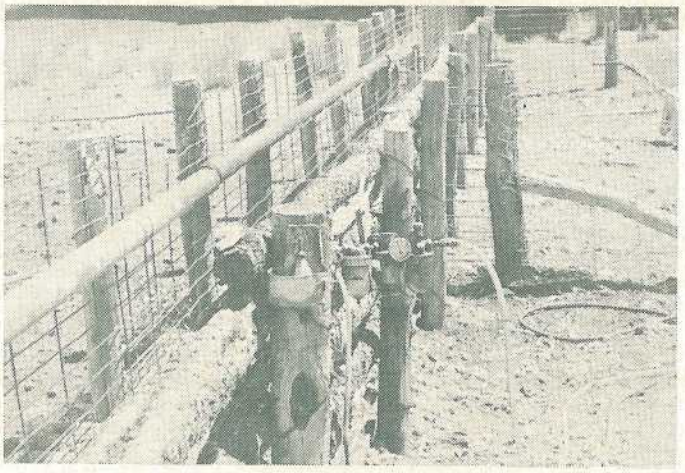


Plate 1. Bore casing is fitted along the inside of the race. The oil and air regulators for the handpiece are attached to the side of the race.

Plate 2. The sheep is pinned against the side of the race by the operator's knee.

Plate 3. The operator stands to take the wool from the near hind leg. A length of air hose attached to the handpiece allows it to travel the full length of the race.

Plate 4. A modified six cylinder motor pumps air for the pneumatic handpiece.

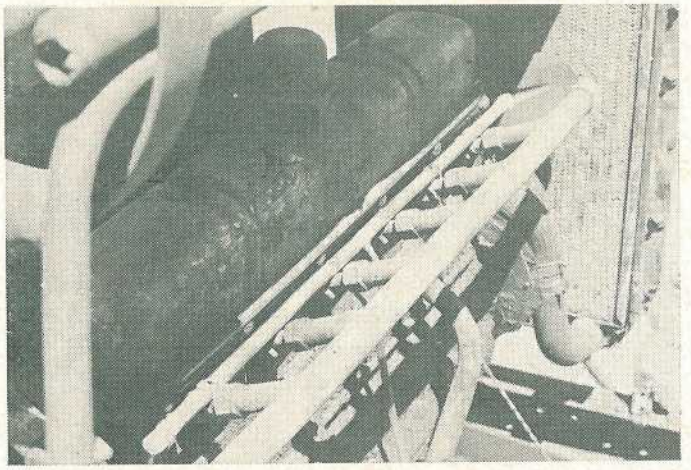


Plate 5. Air is pumped through gas piping into the gas cylinder via the spark plug holes.

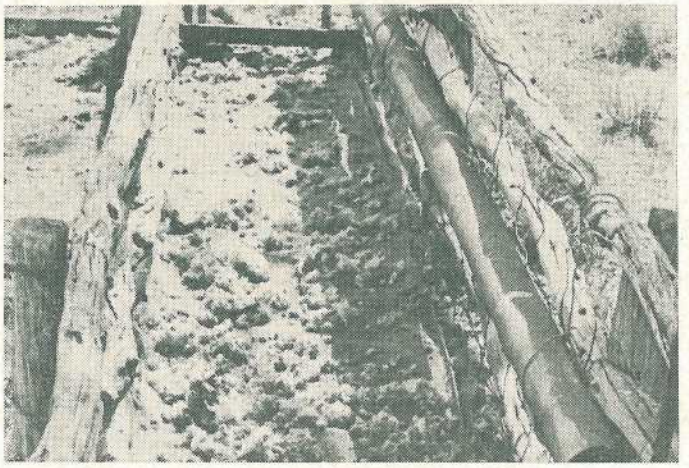


Plate 6. Short crutchings are allowed to fall on to the hessian on the floor of the race.

Advantages

SAVINGS. Roger saves the contract crutching price, currently $235.80 per 1 000 sheep. Because he channel-crutches, he takes only about 50% of the wool which would be taken in traditional crutching. The rest is left on the sheep as fleece wool. It is possible that crutching can be avoided entirely in a fly-free year.

SPEED. A learner can crutch 400 sheep per day; with a helper yarding sheep an experienced man can crutch 800. Roger says, 'The first race I ever did I crutched 44 in 21 minutes. Later, two of us crutched, drenched and counted out 50 in 32 minutes with the extra man drenching and piece picking the crutched wool'. Sheep yarded for crutching can also be wigged, jetted, classed and drafted if necessary. Two men speed the operation considerably although efficiency measured as sheep handled per man may drop.

REDUCED SHEEP WORK. Owners can use yards situated close to the paddocks where sheep are running. Mustering distances and travelling time are minimized, stress and handling time are reduced, and sheep are back in their paddocks sooner. As ewes do not have to be thrown, the crutcher expends less energy.

REDUCED LOSSES. Roger said, 'We crutched some ewes before lambing and I am amazed at the overall results. I have not seen one case of breech strike among them; but of 30 uncrutched stragglers, 15 have been blown and 4 have subsequently died'. Most properties have fewer than 4 000 ewes. This means two men can muster, crutch and jet all their ewes within 1 week of the commencement of a fly wave.

SMALL CAPITAL COST. Existing yards can be used or temporary yards adapted for use. The cost of installing a crutching machine with a handpiece that can be taken the length of the race is approximately $500.

Disadvantages

As with conventional crutching, the hamstring is prone to damage with this technique. Caution must be exercised while learning.

Wethers have to be tipped over for ringing.

Unmulesed sheep are more difficult to race-crutch than mulesed sheep.

As with most jobs done by the landowner, there is an opportunity cost with race-crutching, and a value has to be debited against it. However, seasonal crutching as practised by Roger Arden has a high priority and it is unlikely that any other job could exceed the cost savings available from race-crutching.

Slaughtering Statistics

Queensland meatworks killed nearly 2·3 million adult cattle in the year ended June 1980.

Some were totally condemned—6 700 (0·3%) in fact. The major causes were—emaciation (876, 0·4%), fever (866, 0·4%), malignancy (830, 0·36%), bruising (356, 0·15%), and tuberculosis (1 496, 0·65%). These figures do not include partial condemnations.

Of nearly 1·2 million sheep which were killed, 7 400 (0·64%) were condemned. The major causes were—caseous lymphadenitis (4 400, 0·4%) and emaciation (1 700, 0·15%).

More beef with less fat from Chianina cross

by R. T. Strachan, Beef Cattle Husbandry Branch, R. G. Coleman, Slaughtering and Meat Inspection Branch and W. J. Peart, 'Sunnyholt'.

BOS taurus cattle, in particular Herefords and Shorthorns, have been the traditional beef breeds in Queensland.

Over the past 30 years, *Bos indicus* infusion has occurred to the extent where 52% of breeding females now contain some *Bos indicus* blood. Improved tick resistance and superior weight gains have been advanced as reasons for the change.

Since 1968, semen supplies from European cattle breeds have been available in Australia. There is considerable interest in the use of these large animals with a potential for rapid growth and for increasing beef production.

The senior author of this article, Rod Strachan, is the District Adviser in beef cattle at Roma.

The largest of these breeds is the Chianina, which is primarily a draft breed, from Italy. Interest in the Chianina for cross-breeding purposes in northern Australia may not be confined to the breed's reported potential for growth. Of all the European breeds now available in Australia, the Chianina seems most suited to a tropical environment. It has a dark-pigmented skin and a short, white coat which may make it more heat-resistant than the other European breeds, and thus better adapted to the tropics.

There has been very limited information on the potential of the Chianina for cross-breeding purposes. This article reports on the growth rates and carcass characteristics of progeny of Hereford and Brahman cross Hereford cows and Brahman, Hereford and Chianina bulls on a commercial property in southern inland Queensland and suggests that the Chianina has a place in cross-breeding programmes.

94210—17

A trial in the Arcadia Valley has shown that Chianina cross steers have the potential to grow faster and to produce heavy carcasses without excess fat.

The Chianina cross Hereford steers in the trial grew 18% better than Hereford steers from weaning to 2½ years of age, and were superior to Brahman x Hereford steers.

The trial compared the growth rates and carcasses of Chianina, Brahman and Hereford cross and Hereford steers in two drafts over 3 years, from 1975 to 1978. Over 280 steers were involved in the trial and 220 carcasses were measured.

The site

The trial was conducted on Mr Wally Peart's property 'Sunnyholt', 180 km north of Roma.

The average annual rainfall of 670 mm falls mainly in summer. The principal pasture grasses are buffel and green panic which were sown in 1965, following the clearing of the brigalow scrub. The property is tick-free.

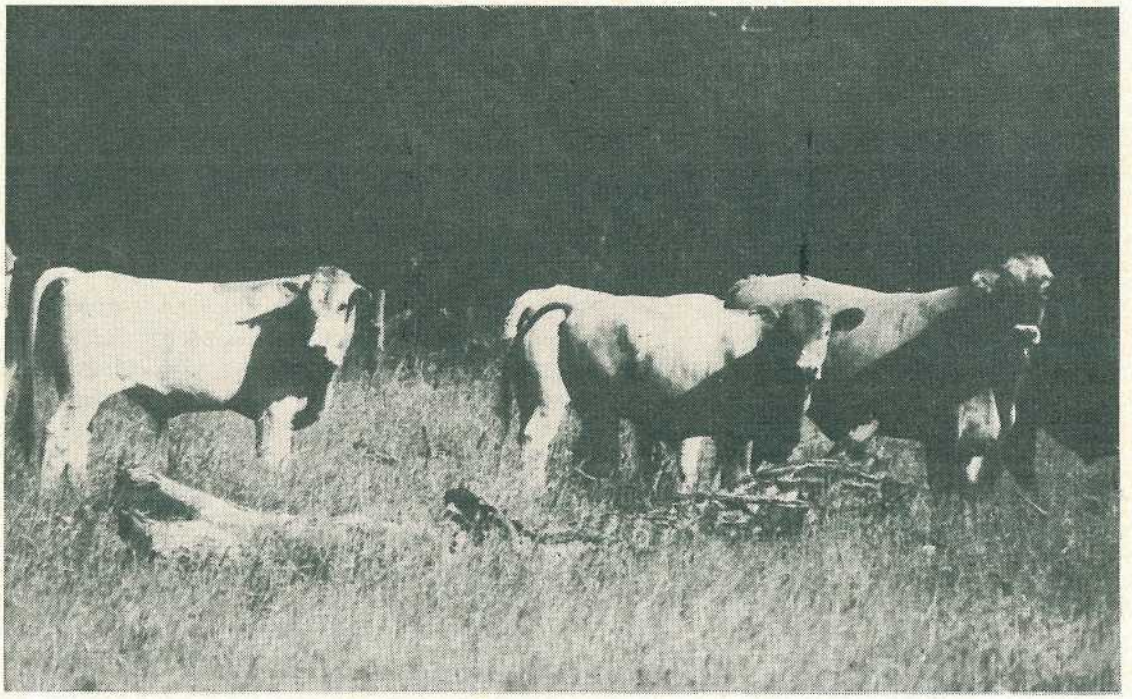
For the duration of the trial, the steers grazed the same paddock at a stocking rate of 0·8 beasts per ha. The annual rainfall was similar to the average in 2 years and slightly above average in the other 2 years.

The cattle

The following crosses were compared with Herefords:

Chianina x Hereford
Chianina x (Brahman x Hereford)
Brahman x Hereford
Hereford x (Brahman x Hereford).

The Hereford and Brahman cross steers were obtained by natural mating and the Chianina steers by artificial insemination. They were the progeny of eight Hereford, six Brahman and five Chianina bulls and were born from November to January in both years.



Half bred Chianina steers on 'Sunnyholt'.

TABLE 1

AVERAGE DAILY GAINS FROM WEANING TO 28 MONTHS

Breed or cross	No. of animals	Initial liveweight (kg)	Average daily gains (kg)		overall	Final liveweight (kg)
			9–20 mths.	20–28 mths.		
C x H	60	229·7	0·61	0·55	0·58	558·7
C x (B x H) ..	56	241·5	0·62	0·50	0·57	563·0
B x H	50	218·2	0·65	0·43	0·55	530·4
H x (B x H) ..	56	228·7	0·54	0·45	0·50	509·6
H	59	205·2	0·52	0·45	0·49	481·4

TABLE 2

CARCASS CHARACTERISTICS MEASURED AT 32 MONTHS OF AGE

Breed or cross	No. of animals	Hot carcass weight (kg)	Carcass length (cm)	Fat depth (mm)	Eye muscle area (cm^2)	A.B.C.A.S.*
C x H	43	309·2	116·9	6·6	78·7	67·9
C x (B x H) ..	43	307·8	117·1	7·0	80·8	70·8
B x H	47	290·8	111·1	11·6	68·0	57·2
H x (B x H) ..	41	278·2	111·3	10·2	69·6	62·7
H	47	259·8	109·2	9·6	65·2	60·6

* Australian Beef Carcass Appraisal System.

KEY

C—Chianina H—Hereford B—Brahman.

Growth rate

The steers were weighed at weaning at approximately 9 months, as yearlings at approximately 20 months, and finally at 28 months of age. For convenience, the growth rates of both drafts are combined and presented in table 1.

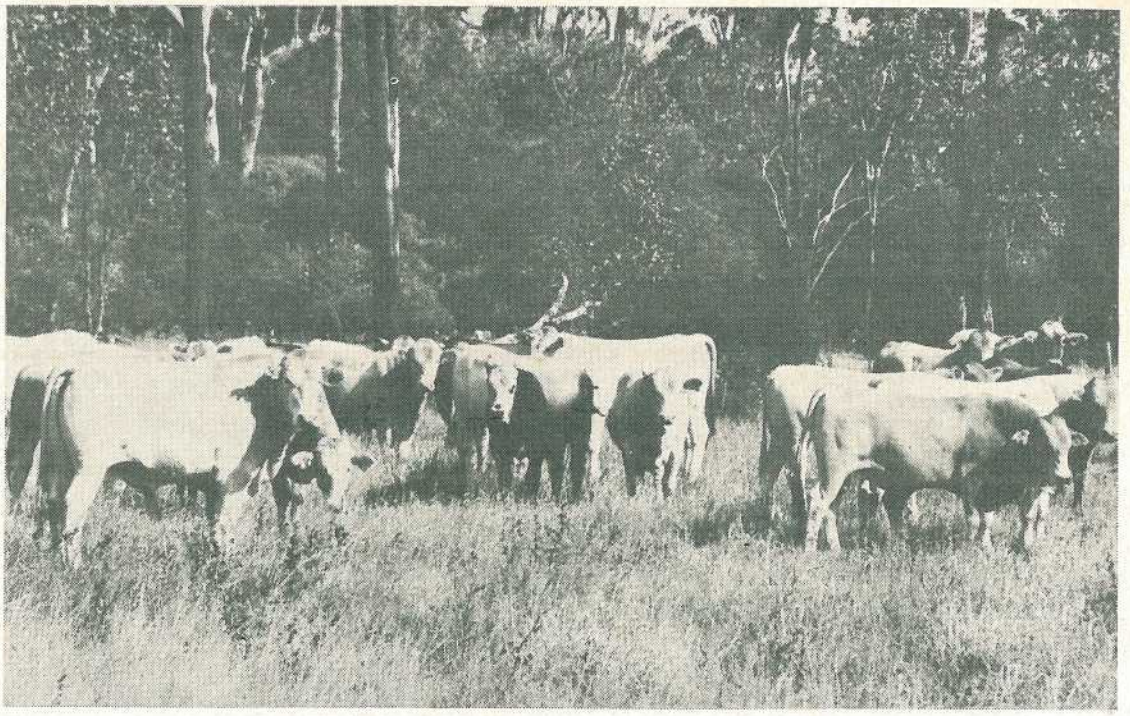
From weaning to yearling age, the Brahman x Hereford crosses gained faster than the Chianina crosses, which grew faster than the Hereford x (Brahman x Hereford) crosses and Hereford steers.

However, the Chianina cross steers made faster gains from yearling to 28 months with the Chianina x Hereford crosses gaining faster than the Chianina x (Brahman x Hereford) steers. The Chianina crosses had by far the heavier liveweights at slaughter.

The Chianina crosses recorded the best overall weight gains from weaning. In terms of the gain advantage from weaning to 28 months, the Chianina cross steers gained 13 kg more than the Brahman x Hereford cross steers and 44 kg and 49 kg more than the Hereford x (Brahman x Hereford) crosses and the Hereford steers, respectively.

Carcass comparisons

The characteristics of 221 carcasses slaughtered at an average age of 32 months are shown in table 2. The carcasses were assessed using the Australian Beef Carcass Appraisal System.



A group of Chianina cross steers on 'Sunnyholt'.

Overall, the Chianina crosses produced the heaviest carcasses, the Herefords produced the lightest and the Brahman crosses were intermediate.

Carcass length and eye muscle area tended to mirror carcass weight, the Chianina cross carcasses being longer with larger eye muscle areas.

The most significant finding was the minimum fat cover over the eye muscle of the Chianina cross carcasses. The Brahman x Hereford steers had the most fat.

The Chianina cross carcasses recorded the highest average point score when assessed by the Australian Beef Carcass Appraisal System, which is used in most carcass competitions. Their carcasses were therefore judged to be superior to all other groups in the trial.

Conclusions

This trial has shown that the crossing of Chianina bulls with Hereford or Brahman x Hereford cows in a tick-free Brigalow area will produce progeny which will grow faster and produce heavier carcasses with less fat than the progeny of Hereford bulls.

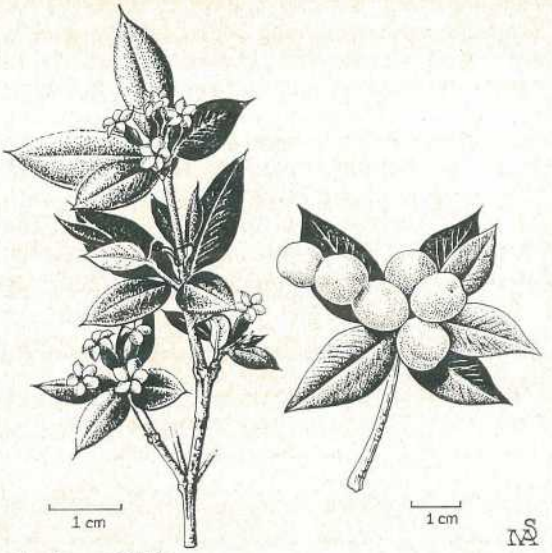
Despite the superior growth of first-cross Brahmans in the first year, their overall performance was inferior to that of the Chianina crosses. In this relatively favourable environment, the advantage of the first-cross Brahmans over the Herefords was smaller than that usually recorded when the Brahman cross is compared with British breeds in the tropics.

The superior performance of the Chianina cross animals is a reflection of the Chianina breed's greater potential for growth and later maturity. The breed would seem to have a role in producing a heavyweight carcass (that is, over 300 kg) without excessive fat cover.

There is a tendency for beef animals to be kept to heavyweights to satisfy export demand and to combat high processing costs. This trial has highlighted the usefulness of the Chianina cross to produce such carcasses.

The Alyxias of South-eastern Queensland

by Beryl A. Lebler, formerly of Botany Branch



Alyxia ruscifolia

SIR Joseph Banks and Dr Solander were the British botanists who accompanied Captain Cook on the H.M.S. Endeavour.

Among the plants they discovered were some with very fragrant flowers. Their fruits consisted of two or more fleshy articles placed end to end resembling a chain.

Since some of these plants had dark green leaves, Banks and Solander suggested the name Alyxia for them. This is derived from the Greek word *alyxis* which means grief or sorrow. Later, when Robert Brown described these plants he used the suggested name.

Other more recent authorities have suggested that the name is derived from the Greek work *halusis* meaning a chain and alluding to the fruits. The common name 'chain-fruit' applied to these plants alludes to the appearance of the fruits.

Alyxias are woody shrubs with leaves in whorls of three or four. In some species, the leaves are opposite. They are often glossy on the upper surface and are stiff or leathery in texture with pinnate lateral veins. The flowers are in small heads or clusters, or sometimes in short spikes. These inflorescences can be either terminal or axillary with either sessile or shortly pedunculate flowers. Each flower has five free sepals, five petals joined to form a slender tube and ending in spreading lobes, five stamens, and an ovary with two cells.

Although yellow flowers are found in some species from the Pacific Islands, the flowers in most Australian species are white or creamy-white. They are always sweetly scented with a perfume like Jasmine. Alyxia fruits are orange, orange-red or more rarely yellow in colour.

In some species, up to three articles are developed in the chain. A fleshy layer up to 0·3 cm thick surrounds a single hard seed in each of the ovoid-globular articles. Alyxias are found in the Pacific Islands, Southern Asia, and Australia. Only two species grow in South-eastern Queensland—*Alyxia ruscifolia* and *A. magnifolia.*

Alyxia ruscifolia

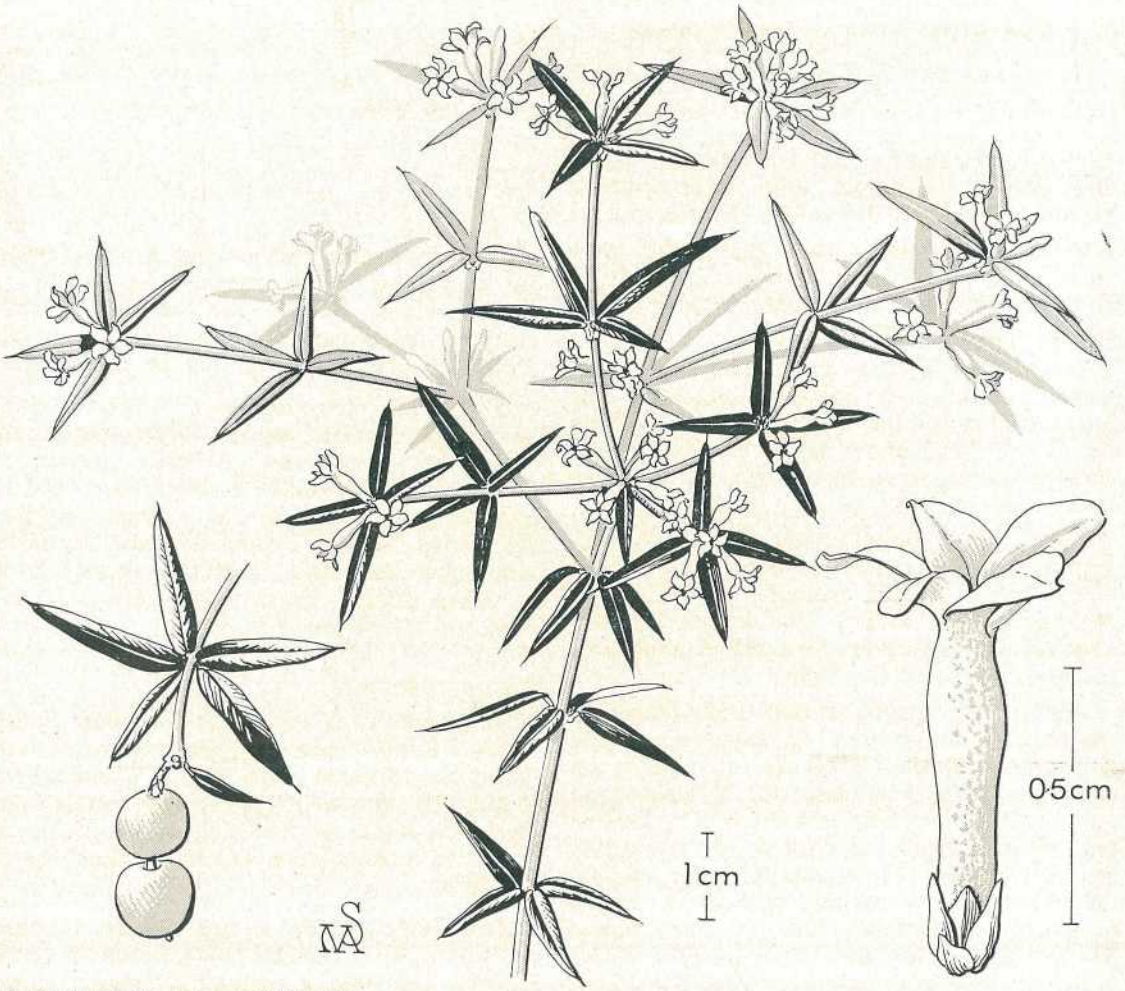
This plant was first found in New South Wales. Later, when a settlement was established at Moreton Bay, Allan Cunningham found this alyxia 'in the dense woods that clothe the banks of the Brisbane River'. Seeds from this locality were sent to the Kew Royal Gardens.

The name *ruscifolia* was chosen because the leaves were thought to resemble those of *ruscus.* This was a popular evergreen shrub with leathery, rather glossy, leaf-like branches.

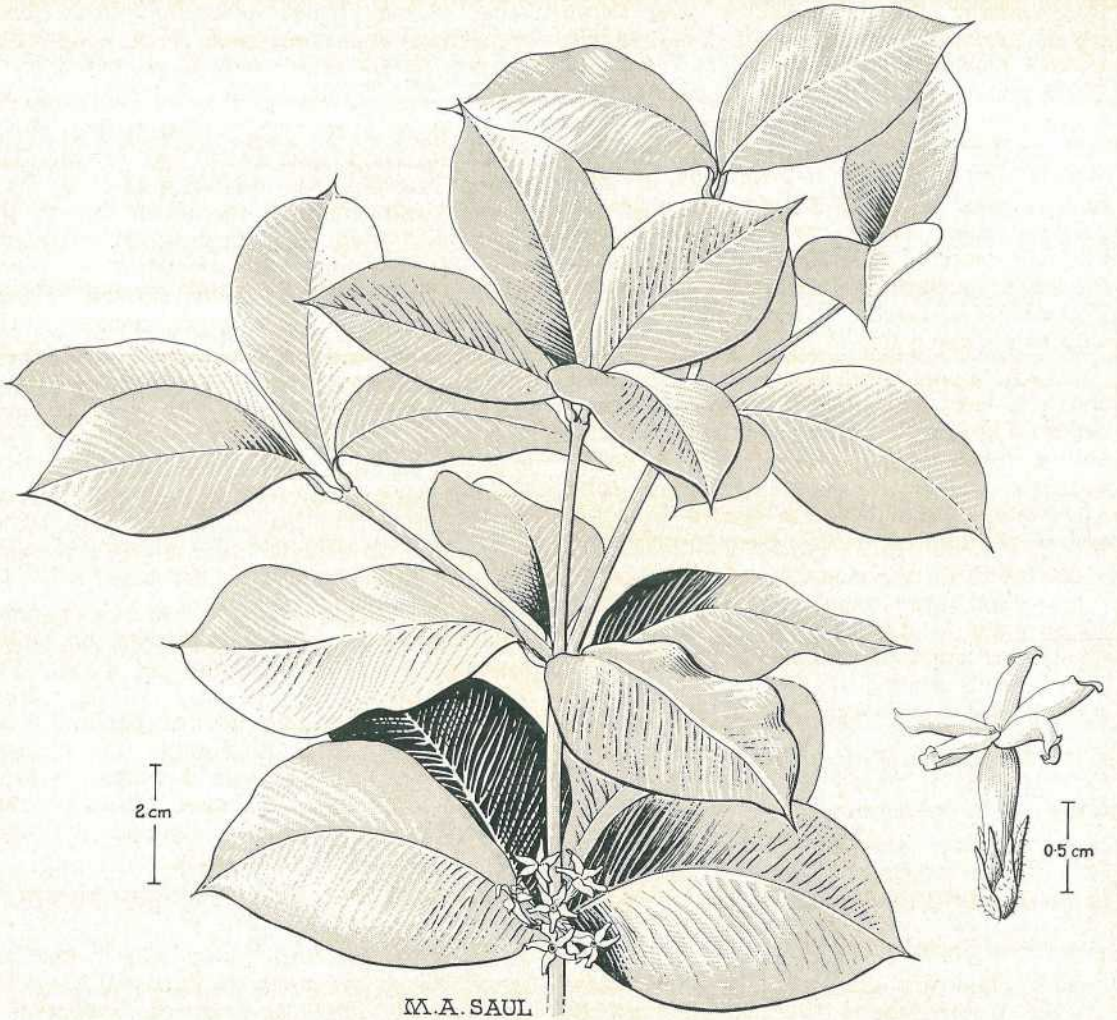
DESCRIPTION. This is a woody shrub 1 to 2 m high, with spreading grey-brown branches and rough twigs. The leaves are usually in whorls of three or four but on some branches whorls of six leaves can be found. The petioles are 0·2 cm long and lie close to the stem with the stiff leaves spreading around it. They can be either bright or dark green with the lower surface much paler in colour. The upper surface feels like sand paper and the lower surface is smooth.

Depending on their width, the leaves can be narrow lanceolate or broadly ovate-elliptical, from 2 to 3·5 cm long and 0·8 to 1·8 cm wide. Their texture is either leathery or stiff. In the broader leaves, the pinnate venation is raised and clearly visible. It is obscure in the narrower leaves and can be seen only when the leaf is held at certain angles.

Usually, five flowers are clustered in sessile terminal heads, the individual flowers also being sessile. They are 0·8 cm long, and just over 0·5 cm across the spreading corolla lobes. The lobes are about 0·2 cm long, rounded at the tip and overlapping at the base. On the outside, the narrow corolla tube is flushed with purple. The tube is swollen in the middle. The stamens, ovary or style cannot be seen until a flower is split open.



Alyxia ruscifolia var. *pugioniformis*



Alyxia magnifolia

As many as three articles can develop in the fruit, but often there is only one. They are ovoid-globular in shape, orange-red and about 1 cm in diameter with a fleshy layer surrounding each hard seed.

FLOWERING TIME. This plant blooms during the winter months.

HABITAT. It is found in dry, open sclerophyll woodland.

DISTRIBUTION. It grows only in New South Wales and Queensland from as far south as the Macleay River to as far north as Mossman.

Alyxia ruscifolia var. *pugioniformis*

In 1874, plants with narrow lanceolate leaves (2·5 to 3·75 cm long) were found near the Brisbane River. Later, F. M. Bailey, the Colonial Botanist at that time described the plants as a variety of *A. ruscifolia,* giving them a varietal name which means dagger-shaped and describes the shape of the leaf.

DESCRIPTION. This is a sparse, open shrub which can reach a height of 2 m. It has scabrid leaves in whorls about 1 cm apart. There are usually three to four leaves at each node, but occasionally twigs can be found with six leaves in the whorl. The leaves are 1 to 1·5 cm long, up to 0·3 cm wide, broadest in the lower half and tapering to a brown, pungent point. They are narrow-lanceolate, thick in texture, dark green and glossy on the upper surface and much paler beneath. The only vein visible is the midrib which is seen as a sunken line.

On the upper surface, up to ten scented, white flowers are in the sessile, terminal heads. The corolla tube is less than 1 cm long and is swollen above the middle. A purple flush can be seen on the outside of the tube. The rounded corolla lobes spread from the end of the tube with their bases overlapping.

As many as three articles develop in the fruit. They are orange-red, ovoid-globular, about 1 cm in diameter. A fleshy layer up to 0·3 cm thick surrounds the single hard seed in each article.

FLOWERING TIME. Flowers are produced in midwinter.

HABITAT. It is found in remnants of rainforest, or in dry scrubs.

DISTRIBUTION. This plant has been found only in the coastal lowlands of Queensland to as far north as Bundaberg.

Alyxia magnifolia

This plant was discovered by James Keys at Lake Cootharaba in 1909. It differed from other known alyxias in having leaves about 8 cm long and more than 5 cm wide. The specific epithet means with large leaves.

DESCRIPTION. This is an erect shrub usually about 3 to 4 m high, although the plants found by Keys were twice that height. The lateral branches are ascending and the bark is tight and rough to the touch due to the sparse scattering of lenticels. Like all members of the family Apocynaceae to which these plants belong, a milky sap can be seen when a leaf is pulled from the stem.

The ovate leaves are in whorls of four or occasionally three. They are discolorous, dark green and slightly glossy on the upper surface, and much paler beneath. Their texture is very firm and leathery. The upper surface is rough to the touch because of the oblique, raised, lateral veins. The leaves can be up to 10 cm long and 6 cm wide with the midrib prolonged into a pungent point 0·4 cm long.

Terminal heads of sessile flowers can sometimes be found but the majority of inflorescences are axillary on the old wood. The white flowers have a very strong, sweet perfume. The corolla tube is narrow, 1 cm long and swollen at the middle. The narrow, pointed corolla lobes spread widely to form a flat star about 2 cm across. The fruits are similar to those of *A. ruscifolia* but consistently have only one article.

FLOWERING TIME. This plant also blooms in midwinter.

HABITAT. It has been found only in Queensland from as far south as Eumundi to as far north as Mt. Finnegan south of Cooktown.

FIELD KEY TO THE ALYXIAS

1. Woody shrub to 4 m high. Leaves ovate, up to 10 cm long and 4 cm wide ..... *Alyxia magnifolia*
   Slender, twiggy shrub to 2 m high. Leaves narrow-lanceolate to ovate-elliptical 2
2. Leaves to 3·5 cm long and 1·8 cm wide ..... *Alyxia ruscifolia*
   Leaves to 1·5 cm long and 0·3 cm wide ..... *Alyxia ruscifolia* var. *pugioniformis*

Colic in the horse

Rolling is a common response to severe pain spasms. In the collicky horse, it can result in bowel strangulation.

by R. E. Nieper, Veterinary Services Branch

ABDOMINAL pain or colic is very common in horses.

Colic means pain in the digestive tract, and horses are particularly prone to colic as their digestive tract has numerous turns and constrictions where blockages can occur. These blockages can cause pain, distention or muscular spasms of the intestinal wall.

The term colic is also used loosely to describe symptoms of other conditions (for example foaling colic), and these conditions must not be confused with true colic.

Causes

There are many causes of digestive upsets in the horse, but often the exact cause of the upset cannot be found. The more common ones are:

- FAULTY FEEDING TECHNIQUES. Poor quality feed, irregular feeding times, feeding too much or sudden changes in any component of the diet may all cause digestive upsets.
- EXCESSIVE HIGHLY DIGESTIBLE FEED. Cracked grain, pollard, bread, lush pasture or high quality lucerne hay are digested rapidly by the horse, producing excessive amounts of gas or flatulent colic.

- EXCESSIVE INDIGESTIBLE FEED. Fibrous feeds such as sugar-cane tops, maize stalks or poor quality hay which are slowly digested may remain in the gut for long periods and lead to impaction and intestinal blockages.
- POISONS. Chemical poisons, plants and mouldy hay (fungal poison) also damage the digestive tract.
- INFECTIONS. Gastroenteritis of bacterial, viral or fungal origin damages the gut and causes abdominal pain.
- COLD WATER. Cold water, especially if allowed in excess after exercise may lead to chilling and stomach cramps.
- FOREIGN BODIES. Plastic bags, plastic bread wrappings and sand may partially or completely block the intestines.
- FAULTY TEETH. Teeth troubles lead to feed being swallowed unchewed, slower digestion and increased risk of impaction, particularly if the diet is high in coarse fibre.
- INTERNAL PARASITES. Mature worms in the gut cause irritation and spasms of the intestinal wall. Immature worms (larvae) migrate through the blood vessels in the chest and abdomen. This affects the blood supply to the gut, the intestinal walls and other abdominal organs.
- INTESTINAL ACCIDENTS. Twists and strangulations of the intestines block the passage of food. Severe colic results, which is invariably fatal unless treated surgically.

Signs

A horse showing the first signs of colic will initially appear ill at ease, stamp its feet and paw at the ground. The horse turns its head to its flank, kicks at its belly and will often stretch out in an attempt to urinate, passing only small amounts.

As the condition worsens, the horse becomes more violent and is obviously in pain.

Sweating may be profuse. Temperature and pulse increase and can be used as a guide to the severity of the condition. The higher the temperature and pulse rate above normal, the more critical the condition of the horse.

Abdominal pain may be continuous, or it may appear in spasms during which the horse will possibly crouch down at the loins or throw itself to the ground and roll in an attempt to ease the pain.

The more often the horse rolls, the greater the risk of twisted or strangulated bowels occurring which invariably results in the death of the horse.

It must be realised that many colics represent a major abdominal emergency and that 20 to 25% of cases will possibly die despite intensive treatment.

Treatment

Mild cases of colic are often resolved without treatment. However, if the horse is showing signs of acute pain, veterinary attention is necessary.

Treatment is generally aimed at controlling the pain with tranquillisers and pain-killing drugs, and at relieving the digestive upset with drenches.

While waiting for veterinary treatment, the horse should be kept on its feet, preferably walking around to assist the movement of wind and to reduce pain. It should be stopped from rolling to reduce the risk of twisted bowels.

If twists and strangulations do occur, major abdominal surgery is required immediately to save the horse.

Prevention

Colic cannot be completely prevented in the horse, but attention to the following points will reduce its occurrence and its severity:

- INTERNAL PARASITE CONTROL. The incidence of colic can be reduced by as much as 50% with regular drenching for internal parasites.
- FEEDING PRACTICES. Intelligent and commonsense feeding practices reduce the incidence of colic. Good quality feed at regular intervals and avoiding abrupt and sudden changes of feed are of major importance. Remember that the horse has a relatively small stomach, and needs to eat frequently. Hand-fed horses should be fed at least three times each day.
- ATTENTION TO TEETH. Defective teeth will increase the incidence of colic, particularly in older horses, and attention to teeth is essential.

Indian bluegrass has special uses

by W. J. Bisset, Agriculture Branch

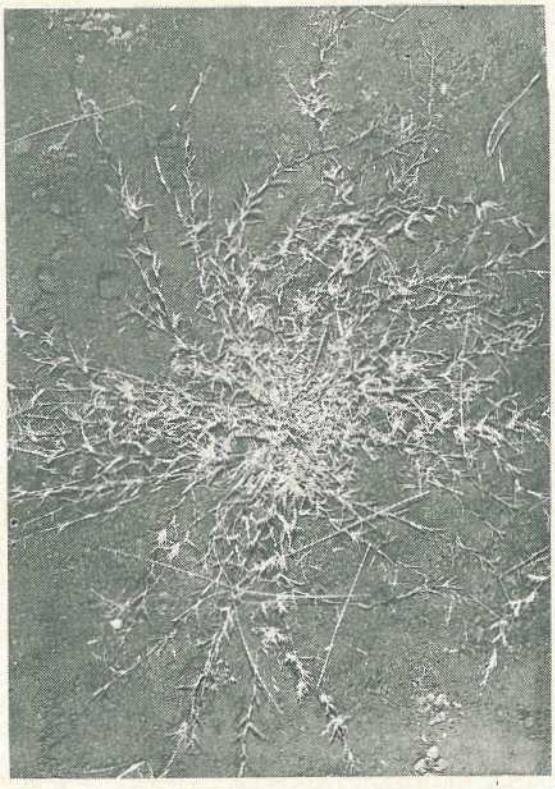
OVER the last 20 years, this naturalized creeping grass has spread at a phenomenal rate over some 80 000 ha of native pasture in the Bowen-Collinsville area. It continues to spread through the Burdekin basin.

Indian bluegrass is undemanding as to soil fertility and has proved itself a persistent grass component in Townsville stylo pastures.

Since 1970, it has colonized large areas of degraded Townsville stylo pasture on erodible country near Bowen and has arrested active gully erosion.

The grass has shown outstanding promise for soil conservation uses in central Queensland, especially on open downs black soils around Emerald. It is also valuable for lawns and recreation purposes in inland areas.

Six distinct strains have been identified, with differences which determine their suitability for particular uses.



A young Indian bluegrass plant showing prolific stolon growth.

Origin

Indian bluegrass, known botanically as *Bothriochloa pertusa,* is widely distributed in the old world tropics from East Africa to Indonesia, and is naturalized in tropical America. It occurs in dry areas with annual rainfall ranging from 500 to 900 mm, mainly on well-drained soils. The grass is valued for grazing in India, Burma and the West Indies. It is also used for lawns and playing fields in India.

Introduction into Australia

Several introductions of Indian bluegrass were made by CSIRO in the 1930s from India and East Africa. They were grown experimentally at Gatton College and, from 1936 to 1946, at the former Fitzroyvale Field Station near Rockhampton.

The officer-in-charge of Fitzroyvale, Mr J. F. Miles, reported on two lines of Indian bluegrass as producing a good body of short feed in autumn that was well accepted by cattle. He also suggested that the grass was worth testing as a lawn grass for northern Australia. Planting material was made available to the curator of the Rockhampton Botanic Gardens for use in recreational areas. Today the grass is common in roadside patches in the Rockhampton-Emu Park-Yeppoon area.

A further introduction was made from India in 1950. After seed increase and testing at Samford and the former Strathpine field stations, seed was supplied to the Department of Civil Aviation (now Transport) for experimental plantings on several country aerodromes in the drier areas of the State. Plantings were made in the mid 1950s at Cloncurry, Charleville and Bowen aerodromes. The Cloncurry planting did not survive but the grass is still present at Charleville and has spread 'like wildfire' at Bowen.

Description

Indian bluegrass is a smaller relation of creeping bluegrass (*Bothriochloa insculpta*), which is an important sown pasture grass in the Rockhampton area (see 'Creeping bluegrass finds favour', *Queensland Agricultural Journal*, May-June 1978). The crushed leaves and stems have the same scent, and the seeds also have a pit in the hull. However, the sterile spikelet is rarely pitted while that of creeping bluegrass has two pits, and the seeds of Indian bluegrass are more hairy.

Another bluegrass naturalized in central Queensland can easily be confused with Indian bluegrass. It is a form of sheda grass (*Dichanthium annulatum*) and it can be distinguished from Indian bluegrass by its lack of scent and by its seedheads. The general structure of the seedhead is similar but the seeds of sheda grass differ in having no pits, and rounded instead of pointed tips. These differences are illustrated in figure 1. Sheda grass is mainly confined to roadsides and cultivation headlands in the wetter coastal zone, and to urban areas inland.

Indian bluegrass produces many stolons (runners) that take root readily. Some time in autumn, depending on the strain, upright flowering stems are produced. Flowering is checked by frost but it resumes in spring if soil moisture is adequate.

Leaves and stems are frost tender but the basal parts of the plant survive. Severe drought can thin out the stand to the better rooted tussocks. After the drought, regrowth from these and from new seedlings is rapid. Severe fire can also thin the stand and recovery can be equally rapid.

In the Bowen and Rockhampton districts *Bothriochloa pertusa* acquired the name 'Indian couch' from its origin and low-growing, creeping habit. However, since this name was already used for green couch (*Cynodon dactylon*) the name 'Indian bluegrass' was adopted by the Department of Primary Industries in the 1950s.

Naturalized strains

Among the natural stands of Indian bluegrass occurring in various localities in central Queensland, many distinct types have been observed. They differ in growth habit, hairiness and potential flowering time. Six of these 'strains' are considered to be of particular interest and have been provisionally named after the localities in which they first attracted attention.

Bowen

The origin of the type present in the Bowen-Collinsville area is not known. The first official record is provided by a botanist who collected a specimen from the Bowen showgrounds in 1950—well before the aerodrome planting. Old residents claim that 'Indian couch' was present as far back as the mid 1940s. It did not attract attention until the early 1960s, but has since spread at a phenomenal rate. Today it occurs as solid stands over whole paddocks and whole properties between the coast and the Bogie River. The total area of solid bluegrass in the Bowen Shire could well exceed 80 000 ha. It virtually forms an unbroken ribbon along the Bowen–Collinsville road, and is strongly present around Mt. Coolon to the south-west.

The grass is also present and actively spreading along roads and around townships in the Ayr, Thuringowa and Dalrymple Shires.

Patches were recorded in road verges near Emerald in 1963. They probably resulted from store cattle movements from the Bowen district. Today these patches have extended over several hectares into bare spaces in buffel grass pastures in adjacent cleared brigalow country.

The material present at Charleville aerodrome is identical with the Bowen material.

The Bowen strain is the earliest of all in flowering time, which in that area can commence in January. This ensures some seed production in a short, wet season and well ahead of frost. This could be an important factor influencing the superior spreading capacity of this strain.

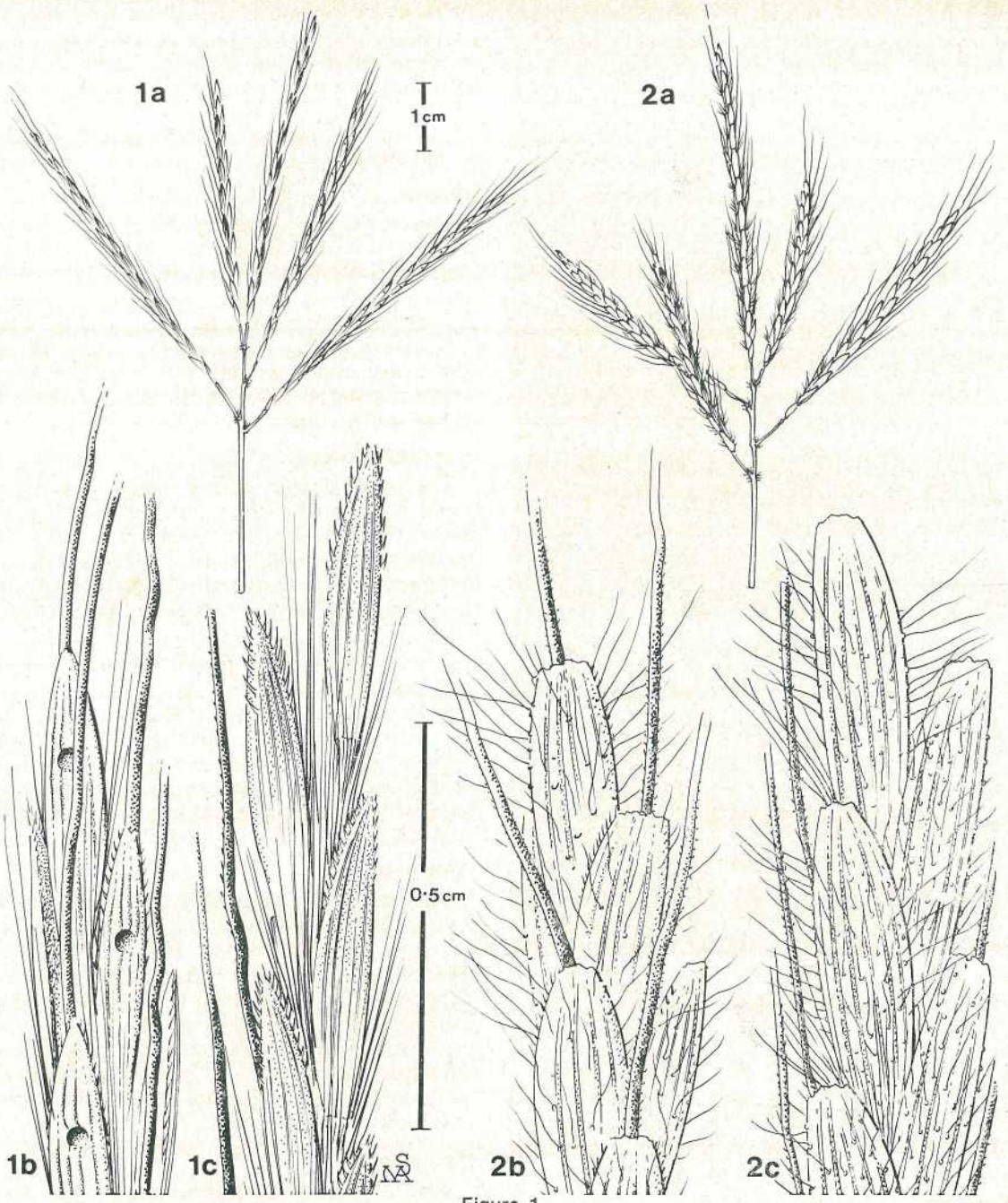


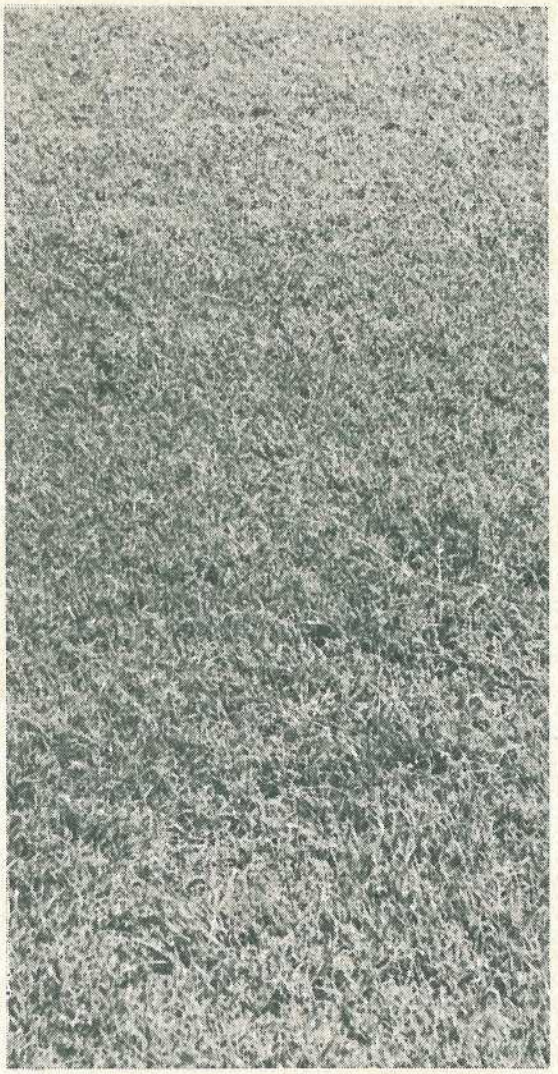
Figure 1.

1. Indian bluegrass *(Bothriochloa pertusa)*
2. Sheda grass *(Dichanthium annulatum)*

a. Seedhead

b. Portion of branch of seedhead showing lower (fertile) spikelets. These become the seeds. Note the pit in Indian bluegrass.

c. View from other side showing upper (sterile) spikelets.



A good sward of Indian bluegrass (Capella strain) on a Theodore Golf Course fairway.

The Bowen strain forms a loose sward which, with early flowering, makes it inferior for lawns. If ungrazed or unmown it produces erect stems up to 0·4 m in late summer.

Capella

This strain is naturalized over several hundred hectares of grazing country near Old Gordon Station, east of Capella. When first recorded in 1957 it had obviously been there for many years, and is thought to have originated from Fitzroyvale. Grazing by sheep aided its spread until about 1968. It forms a good lawn and has been planted on the lawns and airstrip at Brigalow Research Station and the Theodore golf course. Flowering commences in late April.

Biloela

This is the main strain present in the lawns of Biloela Research Station. It originated as roots obtained from Fitzroyvale in 1946 which were planted on the old Biloela golf course. This strain is the best one for lawns because of its late flowering (commencing in mid May) and dense, fine-textured turf. It has been widely planted in lawns in Biloela, but has not spread into pastures.

Emerald Downs

The original seed of this strain was introduced by a grazier from the southern United States of America and sown in a D.P.I. nursery near Emerald in 1955. The grass was unimpressive for pastures because of low productivity. However, it was suited to the local black soil and looked promising for lawns.

It was subsequently grown on the Emerald golf course, the lawns at Brian Pastures Pasture Research Station (black soil) and the golf course and some lawns in Gayndah. It forms a good turf, if somewhat coarser than the Biloela strain. However, its early flowering (commencing in late March) necessitates frequent mowing over a longer period.

Yeppoon

This strain is now prominent in pastures at the old Fitzroyvale Field Station site. Patches are also common along roadsides and in adjacent paddocks in the Rockhampton–Yeppoon–Emu Park area. Its vigour, long growing season (flowering in May) and dense sward make it valuable for grazing, soil conservation and lawns. It is present in some lawns in Rockhampton and to a minor extent at Biloela.

Medway

This strain, of unknown origin, was well established at Medway Station near Boguntungan in 1960 but has not been found anywhere else. Its main strength has been its ability to colonise eroded duplex (texture-contrast) soils from which the native desert

A roadside patch of Indian bluegrass (foreground) along the Bruce Highway north of Rockhampton. This example is the Yeppoon strain of Indian bluegrass.

bluegrass (*Bothriochloa ewartiana*) had disappeared through overgrazing during the 1969–70 drought. It is vigorous and when ungrazed produces erect stems to 0·4 m high. Because of its loose turf it is not suitable for lawns.

Identification of strains

Identification of the different strains is not an easy matter and requires observation of the plants during both the early growth and flowering stages. Some distinguishing features of the strains are set out in table 1.

Adaptation

Climatic range

Mean annual rainfall over the present area of naturalization of Indian bluegrass in the Bowen Shire ranges from 1 100 mm at the coast to 580 mm at Mt. Coolon. Mean annual rainfall over the zone of naturalization in central Queensland ranges from 1 350 mm at Yeppoon to 580 mm at Capella. In the 20-odd years that the grass has persisted at Charleville airport (500 mm) it has not spread.

Failure to naturalize from the experimental plantings at Strathpine and Samford suggests that it is not adapted to the wetter parts of south-eastern Queensland.

All the natural stands survived the severe drought of 1969–70.

Soils and situations

In the Bowen Shire, Indian bluegrass is present on most soil types including poorly-structured infertile solodics carrying sandalwood (*Eremophila mitchellii*) or bull-oak (*Casuarina luehmannii*), acid granites, red forest loams, brigalow soils and open downs black soils.

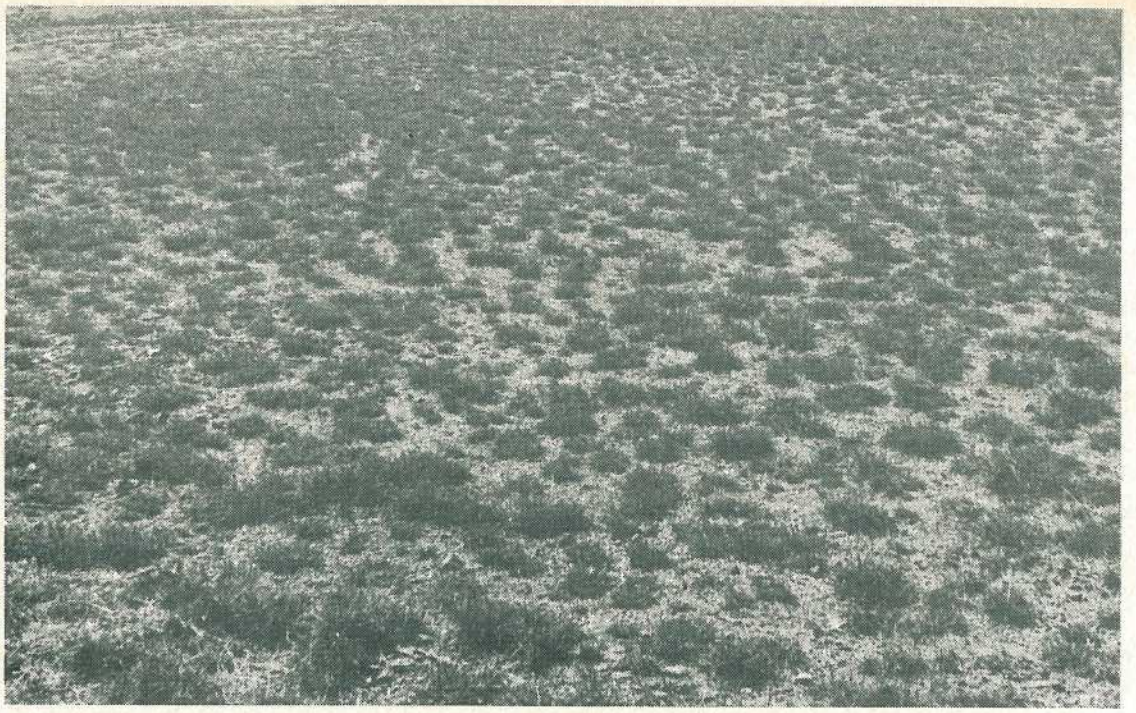
TABLE 1

DISTINGUISHING FEATURES OF INDIAN BLUEGRASS (*Bothriochloa pertusa*) STRAINS

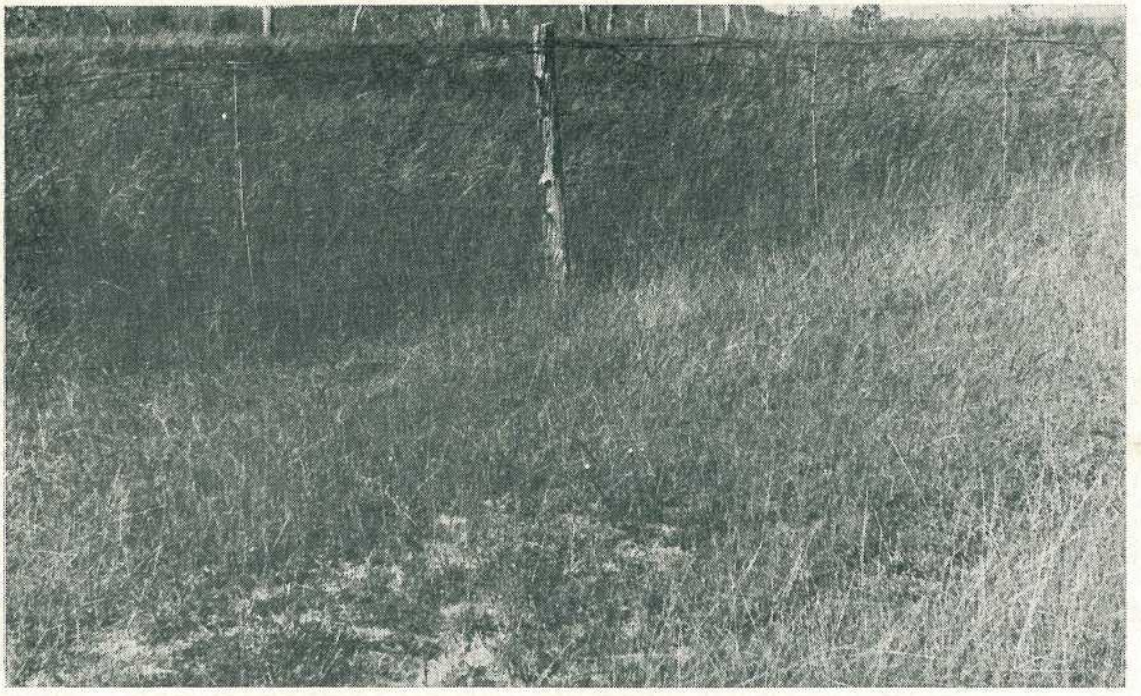
Pre-flowering phase (with actively growing stolons)

Feature/Strain	Bowen	Emerald Downs	Biloela	Capella	Medway	Yeppoon
Long hairs (3 mm) on upper surface of leaf (excluding those at the leaf-sheath junction)	numerous, extending about 1 cm from base	numerous, extending about 1 cm from base	few or nil	few or nil	few or nil	few or nil
Hairs on sheath	conspicuous, 4 mm long	sparse, 3 mm long	sparse, 3 mm long	sparse, 3 mm long	absent	absent
Nodal hairs	conspicuous, 3 mm long	sparse, 2 mm long	conspicuous, 2–3 mm long	numerous, 2 mm long	absent	absent
Sward structure	loose	tight	tight	tight	very loose	tight
Sward texture	coarse	coarse	fine	fine	coarse	coarse
Special				stolons often arched		
Flowering phase						
Long hairs on upper surface of leaf	as for pre-flowering phase					
Hairs on topmost node ..	conspicuous	conspicuous	obvious, but fewer than in Bowen and Emerald Downs	obscure or none	none	obvious, but fewer than in Bowen and Emerald Downs
Flowering commences* ..	January	late March	mid May	late April	mid April	mid May
Growth habit	erect if not mown	creeping	creeping	creeping	erect if not mown	creeping
Special features				tufts of hairs at bases of branches of seedhead more obvious than in the other strains		

* The onset of flowering can be delayed by poor growing conditions.



Indian bluegrass (Bowen strain) showing tussock formation on hard, gravelly soil at Charters Towers aerodrome.



Indian bluegrass (foreground) will not invade ungrazed (and annually burnt) speargrass in this railway enclosure on the Bowen-Collinsville line.

Indian bluegrass only invades areas where the native tussock grasses have been weakened by grazing, mowing, cultivation or traffic. Examples can be seen where it has not invaded railway enclosures or lightly grazed mountain country. By far the greatest spread has been in Townsville stylo pastures where it has replaced the native speargrass (*Heteropogon contortus*) under the heavy grazing involved.

Value for soil conservation

Indian bluegrass has great potential for soil conservation purposes in those areas of central Queensland having more than 580 mm mean annual rainfall. The features which make this so are:

- Wide adaptation to soil types including low-fertility and eroded soil situations; at the same time it will respond to nitrogen fertilizer.
- Vigorous, readily-rooting stolons.
- Resistance to grazing.
- Low growth means that mowing is rarely required and makes it an excellent lining for waterways.

Without any assistance from man it has proved its worth in three noteworthy situations:

- In Townsville stylo pastures on a low fertility texture-contrast soil some 20 km inland from Bowen, gully erosion became widespread during the 1960s following the disappearance of the native grasses. Indian bluegrass has made history by colonizing the area and stabilizing the gullies.
- At the Collinsville open-cut coal mine, Indian bluegrass has rapidly colonized back-filled areas from adjacent natural stands. Obviously it has great potential for the reclamation of the vast areas currently being mined in central Queensland.
- Natural stands are providing soil stabilization along hundreds of kilometres of roadside in the Bowen Shire. This use could be extended considerably in central Queensland.

Indian bluegrass provides a low maintenance ground cover for orchards around Bowen. It should also be suitable for this purpose at Yeppoon.

The Bowen strain has established well in waterway stabilization trials on open downs black soils near Emerald.

In the 30-odd years that Indian bluegrass has been present around Bowen, Biloela and Rockhampton it has not posed any weed problems in agricultural or horticultural crop land. Absence of rhizomes (underground stems) makes Indian bluegrass easy to control by cultivation.

Grazing attributes

No formal grazing studies on Indian bluegrass have been made in Queensland. For the present, we can only be guided by graziers' experience.

When the grass first became obvious in pastures around Bowen, graziers were concerned that it appeared to suppress Townsville stylo. However, the occurrence of a run of good seasons in the 1970s enabled Townsville stylo to hold its own and Indian bluegrass is now more favourably regarded. More recently, Townsville stylo has been severely reduced by the disease anthracnose (*Colletotrichum gloeosporioides*), so that there is now generally a low proportion of legume in these pastures.

Graziers claim that cattle grazing present day pastures of Indian bluegrass take a year longer to fatten than they did on the former speargrass/Townsville stylo pastures. Obviously, an adapted legume will improve the grazing on Indian bluegrass pastures. Testing of promising legumes is in progress.

Indian bluegrass provides softer growth than speargrass in autumn, and the hayed off growth is eaten through the winter.

The strength of Indian bluegrass lies in its ability to provide acceptable feed over extensive areas of moderate to low fertility soils where no other sown grass will survive, and its low management requirements.

Some people have expressed concern at the spread of the Bowen strain into buffel grass pastures in the Collinsville–Mt. Coolon area. When the Indian bluegrass is flowering, cattle selectively graze the buffel grass. However, inspection has shown that the bluegrass is only colonizing areas where buffel grass is either absent or declining from other causes such as overgrazing, heavy soil texture, poor drainage or low fertility.

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Disadvantages of Indian bluegrass are winter dormancy, poor frost tolerance, and the prevalence of seedheads in autumn and spring which require frequent mowing. The seedhead problem is reduced under dry conditions, as is also the problem of winter weeds. Thus, watering during the cooler months can be unwise.

The Biloela, Capella and Yeppoon strains are the best for lawns because of their late flowering and dense sward characteristics. The Yeppoon strain is somewhat coarser than the other two.

Indian bluegrass is well suited for golf course fairways, of which excellent examples can be seen at Charters Towers, Theodore, Emerald and Gayndah. It is too coarse-textured for golf and bowling greens.

Seed production

With the early flowering strains (Bowen, Emerald Downs and Medway) seed can be produced without irrigation except during summer droughts.

With the late flowering strains (Biloela, Capella and Yeppoon) dry autumn weather and frost make seed production hazardous. At Biloela Research Station, irrigation has enabled a seed crop to be taken in spring.

For intensive seed production, strategic irrigation and nitrogen fertilizer are required with all strains.

Harvesting is indicated when seed commences to drop. If growing conditions are favourable, a second and possibly a third harvest can be taken.

The presence of Indian bluegrass has prevented gully development in this portion of the pasture shown on the previous page.

Indian bluegrass colonizing an erosion gully which developed in Townsville stylo pastures in bull-oak *(Casuarina luehmannii)* country inland from Bowen.

There has been no suggestion of harmful effects in stock grazing Indian bluegrass. Because it is a low-oxalate grass, its presence in buffel grass pastures could reduce the likelihood of 'big-head disease' in grazing horses.

Hay has been made from Indian bluegrass growing on airstrips and small, cleared areas on a few properties around Bowen. Its value was formerly enhanced by the Townsville stylo content but it is claimed to be well eaten on its own. The hay is used to augment that used during weaning.

Because of its ability to colonize bare areas within improved or native pastures, Indian bluegrass could play a useful role in preventing the spread of parthenium weed (*Parthenium hysterophorus*) in the south-western portion of the Bowen Shire.

The Medway, Yeppoon and Capella strains have the advantage over Bowen strain of a longer growing season before flowering. The Emerald and Biloela strains are too low-yielding for consideration for grazing.

Lawns and recreation areas

Because of its drought tolerance Indian bluegrass is superior to conventional lawn grasses in inland areas of central Queensland. It also has lower fertilizer requirements and is reported to be relatively resistant to grass-eating caterpillars. On the hard, dry hill at Biloela Research Station it reverts to an open tussocky stand in dry spells but quickly reforms its sward in wet periods without watering.

A notable feature of Indian bluegrass lawns is their resistance to invasion by khaki weed (*Alternanthera pungens*) which is the bane of blue couch (*Digitaria didactyla*) lawns during dry spells.

A reciprocating mower with a collecting attachment mounted behind the blade can be used when harvesting on a small scale. The seedstalks should be cut with at least 10 cm length of stem. Rotary-type mowers are unsuitable as they cut the seedstalks into short lengths which are difficult to remove in the cleaning process.

The harvested material should be dried slowly to allow immature seed to ripen. It can then be passed over a chicken wire (1 cm) screen and bagged.

Mechanical cleaning, handling and sowing of the seed are difficult using currently available equipment. The light, fluffy seed mass clumps together and will not flow. The difficulty is due to the presence of awns and hairs on the seed together with minute stem attachments. Research is aimed at eliminating or reducing these to make the mass more amenable to mechanical handling.

Seed dormancy

Tests carried out by the D.P.I. Standards Branch have shown that germination of freshly harvested seed is virtually nil. The situation improves with time of storage, and maximum germination is attained after 7 months.

Some examples

A small scale harvest from the lawns at Brian Pastures Research Station yielded seed with a purity of 75% and 45% germination.

A few kilograms have been harvested from the lawns of Biloela Research Station using an insect-collecting net. After simple cleaning, the seed had a purity of 80% with 60% germination.

Seed was harvested from a grazing paddock near Bowen in March 1979 by a commercial operator using an all-crop header. A yield of 23 kg per ha of 51% purity was obtained. Attempts to clean the seed further showed insufficient improvement to warrant the effort. Germination was 51%.

At present there is no regular commercial supply of seed.

Establishment

To date, all sowings of seed have been on a small scale, using hand broadcasting.

Indian bluegrass has a strong capacity to establish with minimal cultivation. The vigorous stolon development enables an initially sparse stand to thicken up rapidly. However, a fully cultivated seed-bed will give the quickest results.

Sowing rate and degree of seed-bed preparation will vary according to circumstances. A general sowing rate would be 2 kg per ha for seed of 50% purity and 50% germination.

In an erosion-prone seedbed the inclusion of white panicum or Japanese millet at about 3 kg per ha will give quick early soil protection while the Indian bluegrass is thickening up.

Seed should not be covered to more than 10 mm depth and on rough seedbeds is best left uncovered.

Vegetative planting using rooted pieces requires wet weather or irrigation for success.

Indian bluegrass can be introduced into an existing native grass sward by planting seed or rooted pieces in cultivated strips. In this situation, regular mowing or grazing during the growing season is essential to enable the Indian bluegrass to replace the existing tussock grasses. This should be suspended during the flowering period of Indian bluegrass.

For rain-grown conditions, the best planting time is December–January. If irrigation is available, planting can commence in October and, with the late flowering strains, can extend to early March.

Conclusion

We have a lot more to learn about this grass. However, its performance to date suggests that it is a most useful addition to Queensland's grass flora.

Sunflower varieties 1980-81 season

Compiled by S. R. Walsh, formerly of Agriculture Branch

A number of hybrid sunflower varieties are available for commercial sowing this season.

Specific varietal recommendations for the 1980-81 season have not been made. It is suggested that growers should read the chart of varietal characteristics based on yield performance with desirable agronomic features.

Sunflowers are a versatile crop with a wide range of planting times. In South Queensland they may be sown from late August to mid November and December to late February; this period may be extended in the more northern regions.

Plant populations

The planting rate is governed by a number of factors such as soil type, variety, climatic conditions, soil moisture and the district.

Seed is available commercially in a range of sizes. Selection should be made to suit the type of planting equipment being used.

Seed size varies:

Seed size	Seeds per kg
10/14	11 000–14 000
8/10	13 000–18 000
7/8	15 000–22 000
14/18	8 000–12 000

Most commercial companies mark the seed count per kg on the container. The label on the container also shows the seed quality such as date, germination, and purity test.

The planting rate for rain-grown crops varies between 30 000 to 65 000 plants per ha—the lower rate in the drier districts. When sown under irrigation, the planting rate should be increased to 100 000 to 120 000 plants per ha.

Disease

The main diseases affecting sunflowers are illustrated in the *Handbook of Plant Diseases, Volume* 2 published by the Department of Primary Industries.

The following summary of the more important diseases has been extracted from that publication.

Rust—May be serious particularly in susceptible varieties sown late in the season—Use resistant cultivars.

White blister—Minor. Control generally not warranted.

Septoria leaf spot—Minor. Spores spread during wet, windy weather.

Rhizopus head rot—May be serious under prolonged humid conditions.

Sclerotinia rot—May be serious under cool, wet conditions.

Charcoal rot—May be serious under hot, dry conditions.

Alternaria spot—May be serious if prolonged wet and overcast weather occurs.

Other diseases are of minor importance.

Maturity

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

Harvesting and drying

Sunflowers may be harvested as soon as they are physiologically mature.

If harvesting is delayed after maturity, the sunflower heads break-up then dry, the soil content may be reduced, and yield loss and quality may also occur.

It is extremely dangerous to store sunflowers with a high moisture content. Care should also be taken when drying sunflowers and the seed should be thoroughly cooled after drying.

Guide to Sunflower Characteristics

Mean yield as percentage of Sunfola 68 up to and including 1979–80 trials

	Yield as % of Sunfola 68		Darling Downs Irrigated (up to & inc. 1978/79)		Maturity	Height	Uniformity	Reaction to Rust	Seed Colour	Use	Type	Head Inclination
	Yield %	No. of Trials	Yield %	No. of Trials								
Yates												
Suncross 150 ..	119	5	N.A.	..	MQ	S	4	N.A.	Black	Oil	H	P
Suncross 51	136	24	165	4	MS	M	4	R	Black	Oil	H	P
Suncross 52	124	25	141	4	S	MT	4	R	Black	Oil	H	P
Pacific												
Sunfola 68	100	..	N.A.	..	M	M	1	S	Black	Oil	OP	E
Hysun 11	123	5	N.A.	..	Q	MS	3	HR (I)	Black	Oil	H	E
Hysun 21	126	10	N.A.	..	MQ	M	4	R	Black	Oil	H	E
Hysun 22	N.A.	..	N.A.	..	MQ	S	4	N.A.	Black	Oil	H	P
Hysun 30	121	26	125	4	MS	M	4	HR (I)	Black	Oil	H	E
Hysun 31	148	9	N.A.	..	MS	MS	4	R	Black	Oil	H	P
Northrup King												
Sunbred 707 ..	124	5	N.A.	..	MQ	MS	2	N.A.	Black	Oil	H	N.A.
Sunbred 727 ..	130	5	N.A.	..	M	M	3	N.A.	Black	Oil	H	N.A.
Panorama												
Sunburst	106	12	144	..	M	MT	1	HR (I)	Black	Oil	H	E
Sungirl	114	5	137	..	M	M	2	R	Black	Oil	H	P
Sungirl 2	N.A.	..	N.A.	..	M	M	2	N.A.	Black	Oil	H	E/P
Cargill												
Cargill 205	135	5	143	..	Q	S	4	*S	Black	Oil	H	E
Sunace	143	15	148	3	MQ	M	2	R	Black	Oil	H	E
Sungold	144	21	143	4	M	M	3	R	Black	Oil	H	E
Sunking	135	5	137	..	S	M	4	HR (I)	Black	Oil	H	E
DeKalb												
DeKalb 500	120	..	N.A.	..	MS	S	4	N.A.	Black	Oil	H	E

Guide to Sunflower Characteristics—continued

Mean yield as percentage of Sunfola 68 up to and including 1979–80 trials

	Yield as % of Sunfola 68		Darling Downs Irrigated (up to & inc. 1978/79)		Maturity	Height	Uniformity	Reaction to Rust	Seed Colour	Use	Type	Head Inclination
	Yield %	No. of Trials	Yield %	No. of Trials								
Pioneer												
Lady	N.A.	..	N.A.	..	M	M	2	N.A.	Black	Oil	H	E/P
Flora	N.A.	..	N.A.	..	MS	M	2	N.A.	Black	Oil	H	E/P
Meggitt Ltd.												
MacQuarie	N.A.	..	N.A.	..	Q	S	3	N.A.	Black	Oil	H	P
Philip	N.A.	..	N.A.	..	Q	MS	2	N.A.	Black	Oil	H	P
Rocket	N.A.	..	N.A.	..	Q	S	3	S	B/St	Oil	S	P
Eureka	N.A.	..	N.A.	..	MQ	M	2	S	B/St	Oil	S	P

KEY

Maturity
Q = Quick
MQ = Medium-quick
M = Medium
MS = Medium-slow
S = Slow

Height
S = Short
MS = Medium-short
M = Medium
MT = Medium-tall

Uniformity
1. = Some tall plants
2. = Average
3. = Above average
4. = Very uniform

Seed colour
Black
B/St = Some seed may have slight light stripes.

Use
O = Oil

Type
H = Hybrid
OP = Open pollinated
S = Synthetic

Head inclination (refers in general to erect or pendulous type at maturity).
P = Pendulous
E = Erect to semi-erect
E/P = Semi pendulous

Disease (Rust)

HR (I) = Highly resistant or immune to strains of sunflower rust at present in Queensland. Presence of rust in these varieties, to date, indicates off-type plants.

R = Indicates that rust may develop late in the season if climatic conditions are suitable. Open pollinated varieties grown under the same conditions would be severely infected by rust.

S = Susceptible. Rust infection can cause severe yield reduction if rust develops to a high level.

* = This variety was severely affected by rust in the 1979/80 season hence the change in the rating. This variety appeared to behave differently in maturity from the 1978/79 season.

N.A. = Information is not available or the variety has not been fully tested in Departmental trials. Some hybrids are closely related and both may not have been tested in trials. In the comparison column the 'number of trials' shows the number of trials in which the particular hybrid and the variety Sunfola 68 both appeared. The trials have been conducted over a number of years and a range of soil types. The greater the number of trials used to calculate the average, the greater the reliability of results. The variety Sunfola 68 used in the comparison is an open pollinated variety susceptible to rust and has been sown in all Departmental trials.

Notes: * Yield information based on less than five trials or only one season should not be regarded as a true estimate of varietal performance.
* Quick maturing varieties should be sown at higher plant populations.

Insect pests of sunflower part 2

by R. H. Broadley and D. A. Ironside, Entomology Branch

SUNFLOWERS in Queensland are regularly attacked by a number of insect pests which are capable of causing large scale losses in crop production.

Infestations in sunflower plantings usually originate from other crops, weed hosts or plant residues in the soil.

Some post-establishment pests

Corn earworm and native budworm

Corn earworm and native budworm (*Heliothis armigera* (Hübner) and *H. punctigera* Wallengren respectively; Family Noctuidae) are the larvae of two closely related species of night-flying moths. The two insects are equally important as pests of sunflowers. During daylight hours, moths are often seen when they are disturbed from their sheltered resting sites within the crop.

LIFE HISTORY AND HABITS: The moths lay their eggs (singly) mainly on the upper surface of the apical leaves, on the upper stem and among the hairy leaf bracts enclosing the developing seed-head. The tiny, globular, pearly-white eggs hatch in 3 to 4 days under favourable conditions.

Newly-hatched larvae, 1 mm long with a dark head capsule and grey-white body colour, often conceal themselves among the leaf bracts of the bud. Larvae grow to approximately 30 mm in length and overall colouration of individuals may be fawn, brown, yellow, pink or green. During midsummer, larval development usually takes about 13 days. Fully-grown larvae move off the plant into the soil where they pupate. After 12 to 13 days in the pupal stage, the adults emerge to commence another life cycle. A single life cycle therefore takes about a month to complete in midsummer. During a cold winter, several months may be required before pupal development is completed.

DAMAGE: The larvae may feed on the foliage. This gives the plants a ragged appearance but most feeding is concentrated on the flower heads. They feed on the pithy tissue at the back of the head, leaf bracts, on developing seeds, ray florets and florets in the face of the seed-head. Many larvae feed in exposed sites, while others burrow and tunnel into the pithy tissue, particularly under the bracts at the back and sides of the head.

Plants are able to support a number of grubs without significant effect on crop yields. High populations of medium to large-sized larvae at budding, however, can cause deformation of the seed-head and sometimes actual loss of the seed-head by their chewing into its connection with the stem.

Soybean looper

The soybean looper is the larva of a night-flying moth (*Trichoplusia orichalcea* (Fabricius); Family Noctuidae). The female deposits its eggs singly on the underside of larger leaves. After 3 to 4 days, the eggs hatch and young larvae begin feeding. Larvae are green with white stripes and move with a looping gait. They occur predominantly on the leaves and it is rare to find one on the seed-head.

Fully-developed larvae are about 30 mm long and pupate on sheltered parts of the plant and in debris at the base of the plant. After an incubation period lasting about 2 weeks, adult moths with distinctive bronze-gold wing markings emerge from the pupae.

Injury from larval feeding increases markedly once the larvae are about 15 mm long. Large, irregular holes in the leaves usually coincide with the appearance of large larvae. Severe defoliation is very uncommon.

Green vegetable bug

The green vegetable bug (*Nezara viridula* (Linnaeus); Family Pentatomidae) is a serious pest of a number of crops such as soybeans, French beans and navy beans. Large numbers of the adult bugs may also move into and attack sunflowers. Breeding sometimes occurs on sunflowers and nymphs can be found congregating on individual plants.

This insect feeds by inserting its tubular mouth parts into the plant tissue and sucking the sap. The point of attachment of the stem to the head is a favoured feeding site and wilting of the head can result.

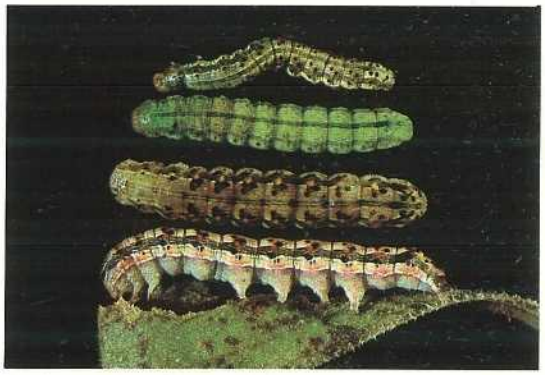
Feeding also causes malformation of the flowers, and possibly reduced seed setting.

Insect pests of

Native budworm moth resting on a sunflower leaf (x 3.5).

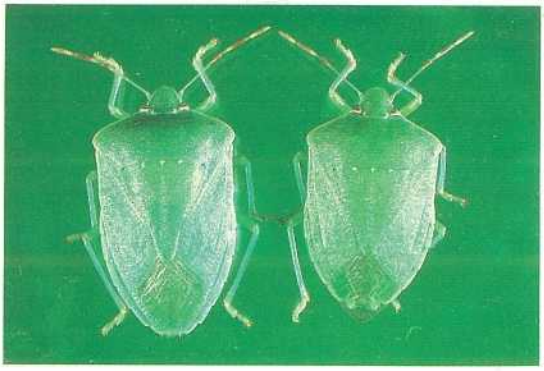
Eggs and young larvae of budworm (*Heliothis* spp.) on flower bracts and leaf (x 4.6).

Budworm (*Heliothis* spp.) larval damage to the pithy tissue and bracts on the back of a sunflower head (x 1.4).



Various colour forms of large budworm (*Heliothis* spp.) larvae (x 1.6).

A soybean looper larva (x 2).



Green vegetable bug adult female (left) and male (right) (x 2).

sunflower part 2

Vegetable jassid adults and nymphs and damage to a sunflower leaf (x 3).

Colony of greenhouse white-fly on the underside of sunflower leaves (x 3).

Adult cotton seed bugs (x 5).

The honey bee—the most important pollinator of sunflowers (x 1).

A common predatory spider (*Oxyopes* sp.) which feeds on sunflower pests (x 5).

Two species of predatory ladybird beetles (species not listed in text) from sunflowers (x 6).

Miscellaneous minor pests

Other bugs which may be found on the seed-heads include one, about the size of the Rutherglen bug, known as the cotton seed bug (*Oxycarenus luctuosus* (Montrouzier & Signoret); Family Lygaeidae). Recent information suggests that this insect feeds not only on the plant but also on other insect pests. The cotton stainer (*Dysdercus sidae* Montrouzier; Family Pyrrhocoridae) and *Spilostethus hospes* (Fabricius); Family Lygaeidae also feed on sunflower.

Leaf hoppers including the vegetable jassid (*Austroasca viridigrisea* (Paoli); Family Cicadellidae) and brown bugs (*Oliarus* spp.; Family Cixiidae) feed on sunflower leaves and stems. When high populations occur on seedlings or small plants suffering moisture stress, growth can be retarded, but generally leaf hopper numbers are low and plant injury is insignificant.

The greenhouse white-fly (*Trialeurodes vaporariorium* (Westwood); Family Aleyrodidae) which resembles a tiny, white moth feeds on the underside of sunflower leaves. Dense colonies of the scale-like immature stages and the white-winged adults are sometimes found in patches through a crop, particularly during dry periods.

During hot, dry conditions two-spotted mite (*Tetranychus urticae* (Koch); Family Tetranychidae) infestations may build up, especially on the underside of lower leaves. The damaged areas of the leaves become quite shiny in appearance.

Aphids which feed on sunflowers include cotton aphid (*Aphis gossypii* Glover), apple aphid (*A. spiraecola* Patch), green peach aphid (*Myzus persicae* (Sulzer), and tomato aphid (*Macrosiphum euphorbiae* (Thomas); Family Aphididae). Populations rarely assume pest proportions as parasite and predator activity reduce their numbers.

High populations of the cotton seedling thrips (*Thrips tabaci* Lindeman; Family Thripidae) on seedlings suffering moisture stress may severely retard growth, however, this is uncommon. The broad-winged thrips (*Desmothrips tenuicornis* (Bagnall); Family Aeolothripidae) is another species which occurs on seedling sunflowers and may also feed on young leaves. Feeding results in yellow stippling and even death of damaged leaf tissue. The plague thrips (*Thrips imaginis* Bagnall; Family Thripidae) invariably occurs in flowering heads.

Larvae of the sorghum head caterpillar (*Cryptoblabes adoceta* Turner; Family Pyralidae) occasionally feed on the maturing sunflower seeds.

Beneficial insects and spiders

Numerous species of beneficial insects have been recorded on sunflowers. There are those associated with pollination and those that are parasites or predators of pests.

Pollinators

Many sunflower varieties possess low levels of 'self compatibility', and therefore need to be pollinated. That is, pollen from one flower head must be transferred to another flower head for successful fertilization to occur. While hybrids have been developed with increased self compatibility, cross pollination is still regarded as necessary for best yields. Sunflowers usually have between 1 000 and 4 000 individual tiny florets within each head and each floret must be pollinated.

Honey bees (*Apis mellifera* Linnaeus; Family Apidae), are the main pollinators of sunflowers. Research in Queensland has indicated that an average of one bee per four sunflower heads is required for successful pollination. If there are fewer bees than this, hives may need to be introduced. In many areas, however, there are sufficient wild bees for pollination.

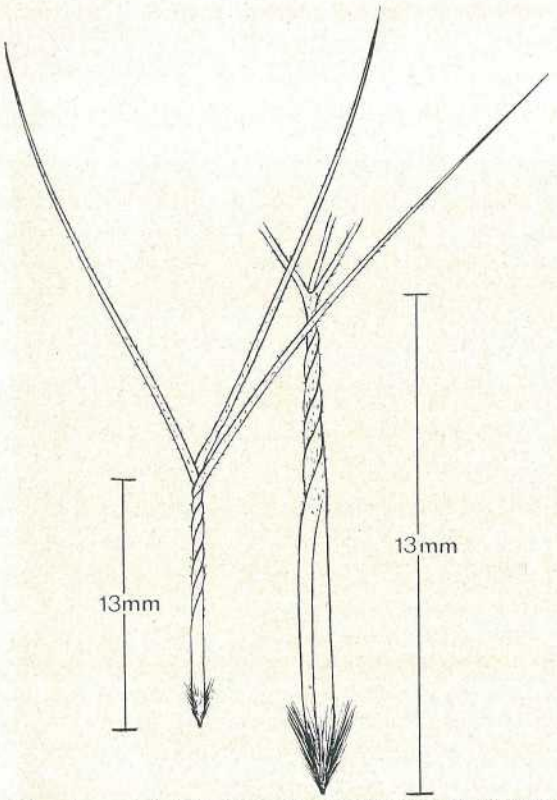
Crops grown for the purposes of hybrid seed production require special management procedures, and increased numbers of bees to transfer pollen from one parent line to another male sterile line. Individual seed companies should be consulted for particular pollination requirements.

Parasites and predators

Numerous natural enemies attack sunflower pests. These include many parasitic wasp species (Order Hymenoptera), parasitic and predatory flies (Families Tachinidae and Syrphidae), predatory lacewing larvae (Family Chrysopidae), various predatory bugs (Families Miridae, Pentatomidae and Reduviidae), predatory ladybirds (Family Coccinellidae) and numerous predatory spiders such as *Chiracanthium* spp. and *Oxyopes* spp. (Families Lycosidae and Oxyopidae respectively).

The feathertop problem in Mitchell grass pastures

by G. R. Lee, D. M. Orr and T. J. Hall, Agriculture Branch



The sharp-pointed, three-awned seed of feathertop (adapted from 'Flora of Western Australia' by C. A. Gardner).

MITCHELL grass *(Astrebla spp.)* pastures are the most extensive and productive native pastures of semi-arid western Queensland.

They support half of the State's sheep and one-tenth of the cattle population. Wool production from these grasslands is over 40% of the State's clip.

From time to time, the value of the wool clip has been lowered by heavy infestations of grass seed (shive) in the wool. Badly infested wool can be reduced in value by as much as 10% because additional processing, which could involve a carbonizing treatment, is required to remove the vegetable fault. This processing can reduce the strength of the wool fibres and also their suitability for dyeing.

Seed of feathertop grass (*Aristida latifolia*) is the main cause of vegetable fault in wool in the Mitchell grass country. Besides contaminating the wool the sharp-pointed, three-awned seeds can quickly penetrate the skin of sheep causing severe irritation and infected abscesses in subcutaneous tissues. Badly infested animals cease feeding and lose condition. Deaths, particularly in young sheep, can occur.

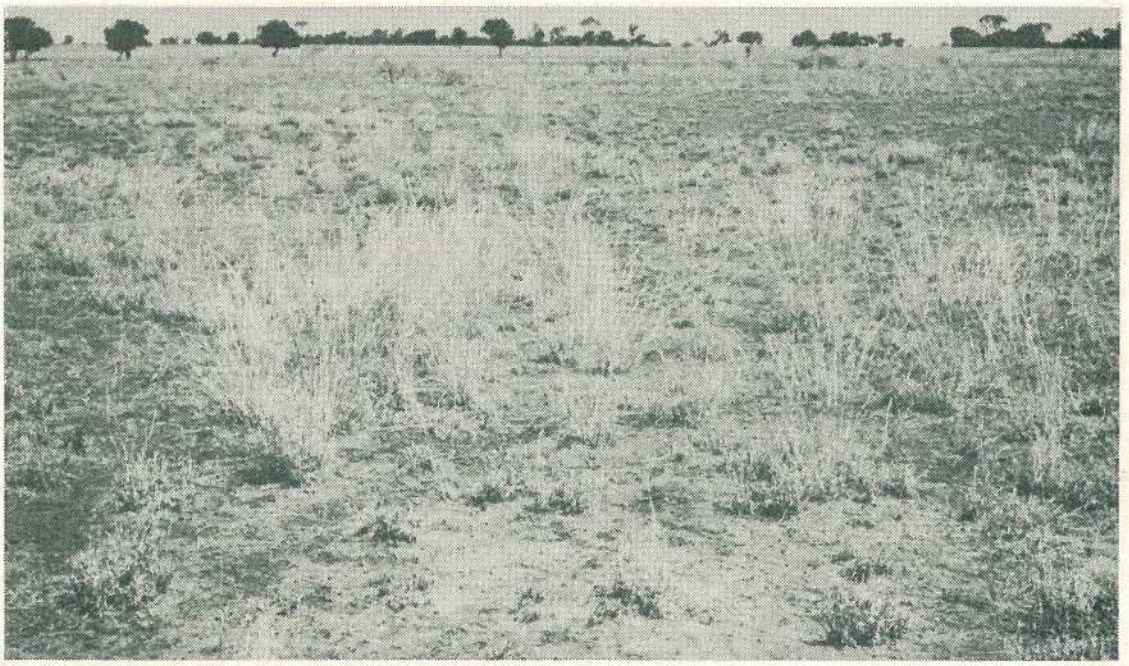
Observations and experiments suggest that grazing management can be used to prevent a feathertop build-up and thus reduce a grass seed problem.

Description and distribution

Feathertop, sometimes called feathertop wiregrass, is a perennial summer-growing tussock grass. Plants grow to a height of 40 to 100 cm and most leaves originate from the base. The leaves curl and bleach as the plant dries off in winter.

Feathertop is widespread in western Queensland, occurring from the Gulf country in the north to the New South Wales border in the south. It is most common on heavy cracking clay soils, particularly the Mitchell grass downs, and usually favours better watered locations such as run-on areas, depressions and gilgais, and areas which are periodically flooded. However, it cannot survive prolonged and deep flooding (7 days at up to 1·5 m).

A heavy infestation of feathertop in a Mitchell grass paddock (photograph courtesy of Dr P. J. Skerman, University of Queensland).



Ungrazed feathertop plants in a heavily grazed Mitchell grass paddock near Blackall.

In the south-west and central west, white spear grass (*Aristida leptopoda*) is also present in the pastures but this species does not occur to any extent in the north-west.

History

Feathertop has been recognized in the Mitchell grass pastures since late last century, but its incidence has fluctuated dramatically over the years.

Perhaps the first documented presence of feathertop was in Lord Casey's father's dairy for June 1890. In his book 'Australian Father and Son' (published by Collins in 1966) Lord Casey cites an extract from the diary: "A great deal of feathery grass (which has a nasty seed) has grown this year on 'Terrick' " (central-western Queensland, near Blackall). Lord Casey adds, "I am told that feathery grass is still liable to occur on Terrick but only during a good season". Although it cannot be confirmed, there is little doubt that the grass referred to was *Aristida latifolia.*

In 1927, N. A. R. Pollock an officer of the Department of Agriculture and Stock, reported "the spread of feathertop on the rolling downs is becoming a matter of some concern". In various reports on the Mitchell grass pastures in the 1930s and early 1940s feathertop was not mentioned, which suggests it was not abundant during that decade. This period was followed by a build-up of the grass during the 1950s and its disappearance during the drought years of the mid to late 1960s.

These fluctuations are supported by observations of a grazier in the Longreach district reported in the *Queensland Country Life* newspaper dated 23 June 1960. From 1920 to 1924 feathertop seed was bad on his property, but it disappeared during the drought years 1926 to 1930, only to return during the good seasons of 1950 to 1956. At Longreach, 1920 and 1921 were medium to good rainfall years which followed the dry year of 1919. Another outbreak occurred in the 1970s when a run of high rainfall years followed the drought of the late 1960s.

A common factor with these outbreaks is that feathertop became abundant only during a run of above average rainfall years. In drought periods and a run of below average rainfall years the problem disappeared due to widespread death of the plants.

Effects of grazing

Early reports indicated that the incidence of feathertop was also influenced by grazing management. Observations in the Blackall district in 1960 by the Government Botanist (Mr S. L. Everist) indicated that the heaviest infestations were on properties that had been lightly stocked for many years. It was not seen in quantity on any of the well-used stock routes, and horse paddocks showed less feathertop than paddocks stocked with sheep.

Results from a Department of Primary Industries' survey in the Blackall district in the 1970s confirmed that feathertop was rare in paddocks with a history of heavy continuous stocking with sheep, compared with paddocks that had been lightly stocked. In these cases, stocking rates had been around one sheep per ha at the heavy rate and one sheep per 1·66 ha at the light rate for the previous 15 to 20 years.

Observations suggest that grazing of mature feathertop by sheep at normal or light stocking rates is insignificant, but the situation could be different at heavy stocking rates and when the plants are young. Sheep normally avoid feathertop-infested areas when the plants are carrying mature seed (March to July) and only move into such areas if forced to by lack of forage elsewhere.

In an experiment on Toorak Field Station, near Julia Creek, heavy grazing of a Mitchell grass pasture with cattle prevented a build-up of feathertop. The pasture was grazed at one beast per ha in the dry season only, between 1971 and 1977. At commencement, the feathertop population was low and after 3 years there were only 4 000 feathertop plants per ha in this paddock compared with 35 000 per ha in the adjacent paddock which had been stocked lightly with sheep only in the dry season.

In the cattle paddock, Mitchell grass plants were grazed to a height of about 5 cm. These plants survived this heavy grazing but tussocks were broken-up into smaller plants and less forage was available from this pasture in the following wet seasons. The pasture also contained more Flinders grass and herbage than the adjacent sheep-grazed paddock, Cattle were losing weight by the end of each grazing period.

Control

From time to time, various attempts to eradicate or at least reduce feathertop have been made. It can be controlled by ploughing or deep ripping but this has virtually no application over the vast areas of Mitchell grass downs. Occasional mowing or burning, or application of nitrogen and phosphorus fertilizers had no deleterious effect on feathertop populations.

The observations and experiments mentioned previously suggest that grazing management can be used to prevent or at least minimize a feathertop problem. Following favourable summer rains, the expected population build-up of feathertop can be prevented or at least significantly reduced by a programme of heavy stocking. Such measures must be adopted before the problem becomes apparent. The question remains of how practical is this approach under the extensive grazing systems of western Queensland.

Some of the problems are:

- Insufficient animals to achieve the high stocking rates required.
- The need for lenient pasture use particularly after droughts to allow recovery of the Mitchell grasses, including establishment of seedlings.
- The risk of causing pasture decline with resulting loss of forage reserves.

It could be feasible to concentrate on one or two paddocks that have past histories of high feathertop populations. At Blackall, low feathertop populations have been maintained by continuous stocking with sheep at around one sheep per ha. A lower rate, around one sheep to 1·25 ha in the central-west might be more practical in the long term.

Feathertop populations would remain low, moderate reserves of forage would be maintained and moderate yields of annual grasses and herbage would be available following effective rain. At Toorak, the heavy stocking with cattle was followed by complete spelling during the wet and this successfully contained feathertop plant numbers.

The more difficult situation is how to deal with an existing feathertop infestation. Heavy grazing of infested areas with cattle might be effective but this approach has not been examined. In any case, if cattle were used in infested areas during winter they would trample the plants and cause seeds to fall, thus reducing the seed problem for sheep. Grading or slashing tracks into feathertop areas could further encourage cattle to move into these areas.

Time of shearing is another possible management strategy to reduce the shive problem. It appears that wool from sheep shorn in February has less feathertop seed than wool from sheep shorn in August/September. However, in the central west, fleece rot can become a problem during the wet season with sheep in full-wool, and the usual practice is to shear ewes before lambing in September/October.

Conclusion

Feathertop is a component of the Mitchell grass pastures which increases in good seasons and declines in poor seasons. Our observations and experiments suggest that stocking management can be an effective means to minimize the grass seed problem.

The management strategies outlined involve a degree of very heavy stocking, resulting in short term pasture abuse and possibly slightly reduced animal performance. However, when implemented judiciously, and allowing for pasture recovery in the wet season, feathertop populations have been kept at low levels with a minimum of undesirable effects.

Editor's note

Widespread deaths of feathertop plants have occurred this year in the Cunnamulla area as a result of the current drought which commenced in 1978. In experimental plots feathertop has disappeared after reaching a peak of 10% of the pasture composition in 1976.

Improving wheat cropping reliability in the Central Highlands

IN the Central Highlands, the area of wheat sown, wheat grain production and yields per ha have fluctuated dramatically depending on winter rainfall.

In table 1, statistics are given for the Shires of Bauhinia, Emerald, Peak Downs and Belyando which make up the Central Queensland Highlands. The main soils cropped are shallow open downs cracking clays and deeper brigalow cracking clays.

Wheat was one of the first crops grown on the Highlands. It has remained popular with some farmers particularly those who have come from more favourable wheat-growing areas further south. In Australia, the winter rainfall component of annual rainfall decreases markedly from south to north.

At the top of figure 1, weekly rainfalls averaged since 1894 have been plotted throughout the year. These averages drop from 22 mm in January to less than 4 mm in late April/early May, improving in mid-winter to a weekly average of 10 mm in June. The average then declines again in late winter/spring until the summer rains begin in late November.

Extreme variability is a feature of the rainfall in Central Queensland and the pattern in any one year differs greatly from the long term average. As an example, the open bars on figure 1 show the weekly totals in 1970, the driest winter since 1964. There was good rainfall in February but then no rain of any significance until 41 mm in late September.

by G. D. Keefer, Agriculture Branch

In the 1970 season, the Highlands produced 404 t of wheat from 8 600 ha whereas 2 years earlier in 1968 the production was 80 000 t from 56 000 ha. The rainfall variability resulting in extreme wheat production fluctuations lends one to question whether wheat should be maintained as a major crop of this district.

Why should we consider strategies to improve the reliability of wheat crops in the Central Highlands?

Good features of wheat

- Reduction in soil loss from rainfall erosion. Of the four major crops being grown in the Highlands (sunflower, sorghum, wheat, safflower) wheat stubble suitably managed gives the greatest protection from soil loss during the high intensity summer storms. This is a good argument for increasing the area planted to wheat as a means of ensuring the long term stability of farming in the Highlands.
- Few insect pests attack wheat.
- Varieties with resistance to main diseases including rust are available.
- Varieties better suited to Central Queensland conditions are becoming available from plant breeding programmes particularly from the Queensland Wheat Research Institute programme.
- Wheat is a relatively easy crop to plant and harvest while emergence is not as big a problem as it is with summer crops.
- Marketing is well organized—on world markets wheat prices dictate prices for all grains.
- Wheat provides a diversification in the predominantly summer cropping system of the Central Highlands and spreads utilization of machinery and labour.
- Rotation of summer and winter crops is one way of combating weed, insect and disease build-up in a paddock. At present, wheat and safflower are the only crops available for large scale winter planting.

TABLE 1

Wheat Statistics Central Queensland Highlands 1964–1979

	Area (ha)					Production (t)					Yield
	Bauhinia	Emerald	Peak Downs	Belyando	Total	Bauhinia	Emerald	Peak Downs	Belyando	Total	t/ha
1964–65	5 542	5 251	13 285	4 699	28 777	2 746	1 412	7 244	3 058	14 460	0·5
1965–66	2 790	6 470	9 157	4 602	23 019	1 029	5 191	6 240	3 008	15 468	0·7
1966–67	1 934	2 049	4 077	2 801	10 861	3 671	2 346	3 472	2 917	12 406	1·1
1967–68	6 719	10 286	8 303	6 896	32 204	6 287	8 420	8 865	6 927	30 499	1·0
1968–69	13 413	14 698	19 179	9 087	56 377	24 635	16 388	25 980	12 774	79 777	1·4
1969–70	3 975	7 705	2 923	2 646	17 249	797	529	1 745	223	3 294	0·2
1970–71	1 332	7 048	304	Nil	8 684	4	335	65	Nil	404	0·05
1971–72	3 763	5 629	10 889	5 900	26 181	2 249	5 132	7 681	5 254	20 316	0·8
1972–73	1 113	2 773	6 762	3 944	14 592	843	368	3 507	3 200	7 918	0·5
1973–74	4 864	5 572	5 278	2 514	18 228	7 432	10 843	6 737	2 912	27 924	1·5
1974–75	7 245	6 922	6 972	4 914	26 053	10 921	8 644	10 573	6 697	36 835	1·4
1975–76	4 065	7 788	3 817	5 012	20 682	4 904	10 565	7 021	6 592	29 082	1·4
1976–77	3 847	5 240	6 816	3 640	19 543	3 438	5 714	6 179	2 949	18 280	0·9
1977–78	5 984	6 165	6 563	3 615	22 327	5 339	7 254	8 850	5 311	26 754	1·2
1978–79	8 076	10 355	7 997	5 393	31 821	18 098	23 853	16 246	9 545	67 742	2·1
1979–80*	10 000	10 000	400	400	20 800	6 000	6 000	320	320	12 640	0·6

*Estimated: Source—Australian Bureau of Statistics.

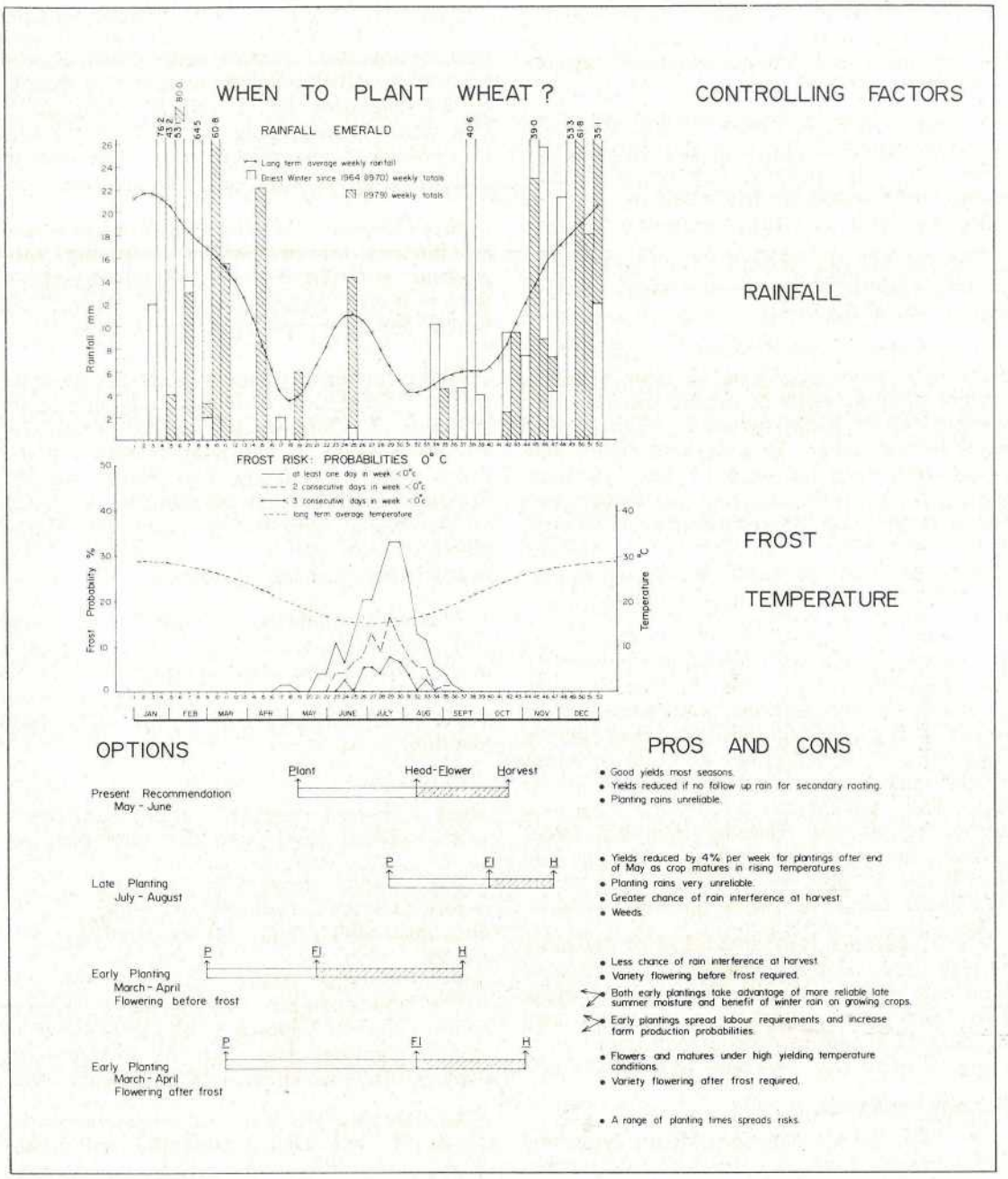

WHEN TO PLANT WHEAT ?
CONTROLLING FACTORS
RAINFALL EMERALD
Long term average weekly rainfall
Driest Winter since 1964 (1970) weekly totals
1979 weekly totals
Rainfall mm
RAINFALL
FROST RISK: PROBABILITIES 0° C
at least one day in week < 0°c
2 consecutive days in week < 0°c
3 consecutive days in week < 0°c
long term average temperature
Frost Probability %
Temperature °C
FROST
TEMPERATURE
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
OPTIONS
PROS AND CONS
Plant
Head-Flower
Harvest
Present Recommendation
May - June
• Good yields most seasons.
• Yields reduced if no follow up rain for secondary rooting.
• Planting rains unreliable.
P
Fl
H
Late Planting
July - August
• Yields reduced by 4% per week for plantings after end of May as crop matures in rising temperatures.
• Planting rains very unreliable.
• Greater chance of rain interference at harvest.
• Weeds.
Early Planting
March - April
Flowering before frost
• Less chance of rain interference at harvest.
• Variety flowering before frost required.
• Both early plantings take advantage of more reliable late summer moisture and benefit of winter rain on growing crops.
• Early plantings spread labour requirements and increase farm production probabilities.
Early Planting
March - April
Flowering after frost
• Flowers and matures under high yielding temperature conditions.
• Variety flowering after frost required.
• A range of planting times spreads risks.

Figure 1.

Improving the reliability of wheat cropping

As wheat has such an important role to play in the farming system of the Highlands, it seems logical to ask what can be done to improve its reliability of production—to level out the feast and famine situations referred to earlier.

Provided there is a good depth of subsoil moisture stored in the soil, the reliability of wheat cropping depends largely on suitable surface soil moisture for planting, and on follow-up rains to induce secondary rooting.

The advantages and disadvantages of the various planting options are summarized at the bottom of figure 1.

The present preference for May/June planting is based largely on 12 years of wheat time of planting trials at the Biloela Research Station. These trials included plantings from April to September. Best dryland yields were consistently obtained from a May planting. Some of the April plantings performed well but in many years they were affected by frost at flowering. The probability of frost and the severity of frost are much greater at Biloela than at centres in the Central Highlands.

Concern with frost is one of the factors that has restricted early planting of wheat in the Highlands. One rule of thumb often quoted by farmers is 'don't plant wheat before Anzac Day'. Yet the risk of frost in the Highlands is probably not as great as many of the other risks faced by farmers in the area. It is possible to reduce the frost risk further by selecting varieties that will flower outside the most frost-prone period in July (see figure 1) and by confining early plantings to the least frost-prone parts of the farm.

Early plantings take advantage of the more reliable late summer moisture and benefit from any winter rain on the growing crop. They also spread labour requirements and increase farm production probabilities.

Recent research

In 1976, the Central Queensland agronomy group began planning a research programme to determine the wheat varieties best suited to early planting and their likely yield potentials.

In 1977, the following varieties were grown under irrigation at Emerald: Mendos, Timgalen, Oxley, Tarsa, Festiquay and the experimental line W.W.15. These varieties covered a range of maturities and they had differing cold temperature requirement (vernalization response) and day-length requirement (photo period response) for flowering. Eight plantings were made ranging from March to July to provide information on development patterns from a range of planting times.

In 1978 and 1979, the Central Queensland agronomists co-operated in a similar programme directed by Mr David Woodruff, Senior Plant Physiologist at the Queensland Wheat Research Institute, Toowoomba.

The yield results from some of the varieties in the 1979 Emerald dryland trial are given in figure 2. The weekly rainfall totals for 1979 are shown as the hatched bars in figure 1. It was a relatively dry winter but the February planting had the benefit of 76 mm in March and both the February and March plantings received 22 mm in April. There was no frost damage in 1979.

The quick-maturity varieties Banks, Cook and Condor yielded 1·5 to 2·0 t per ha from mid April and mid May plantings. The yields from February and March plantings were on a par with the yields from the early June planting.

W.W.15 also is a quick-maturity wheat which followed a similar pattern but with a much reduced yield from the June planting.

The results from the medium-maturity variety Oxley are probably misleading due to stem rust which built up as plantings progressed.

The results suggest that the early planting option (March/April) is worth considering to spread planting risks and to increase the chances of some wheat production each year.

Mr Graham Hammer, an agronomist with the D.P.I., has used a computer programme to study the long-term rainfall records from Emerald. He determined the probabilities that a farmer could plant and establish a winter crop if he had his soil in planting condition

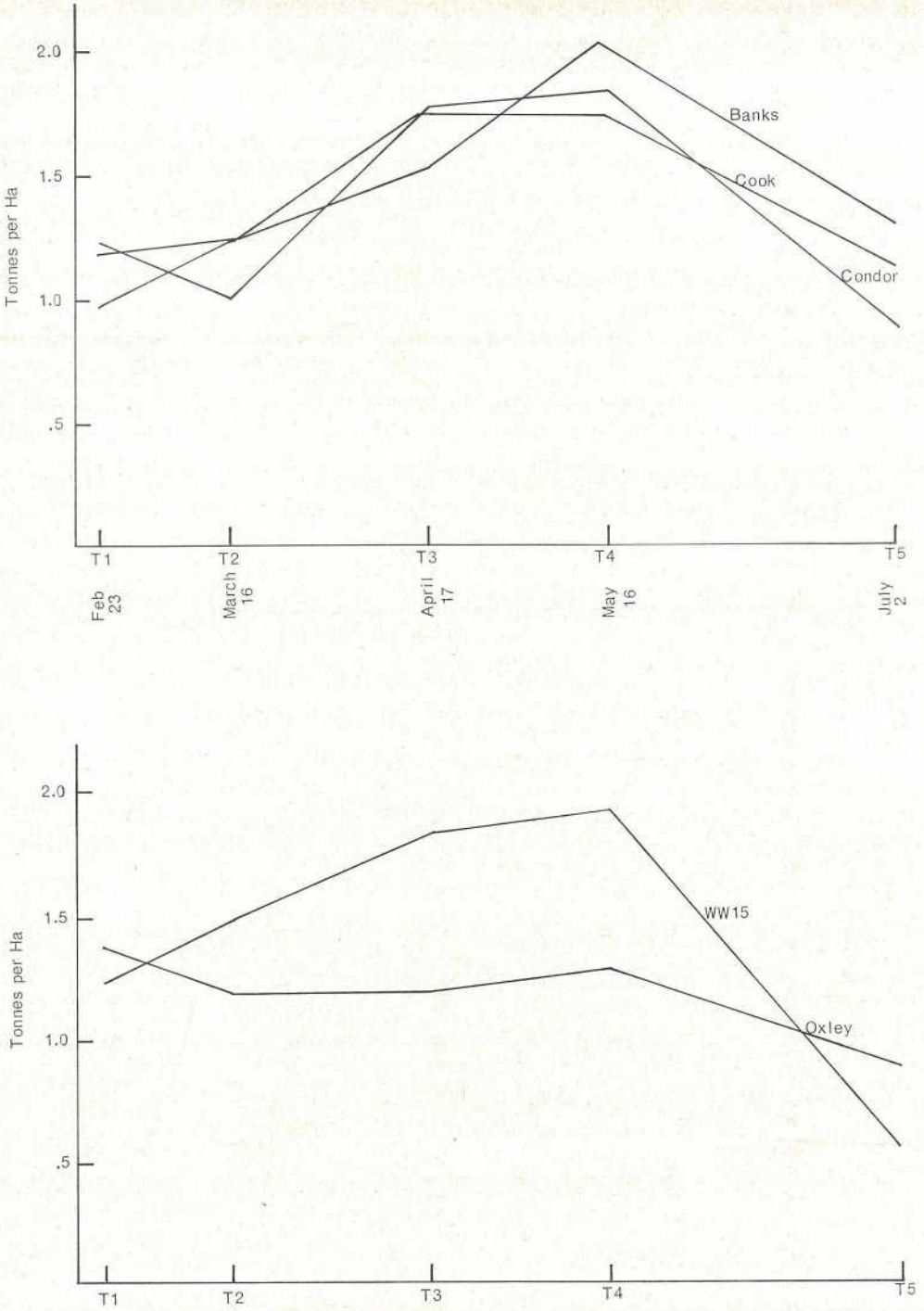


Figure 2. Wheat yields at Emerald 1979. Dryland time of planting trials.

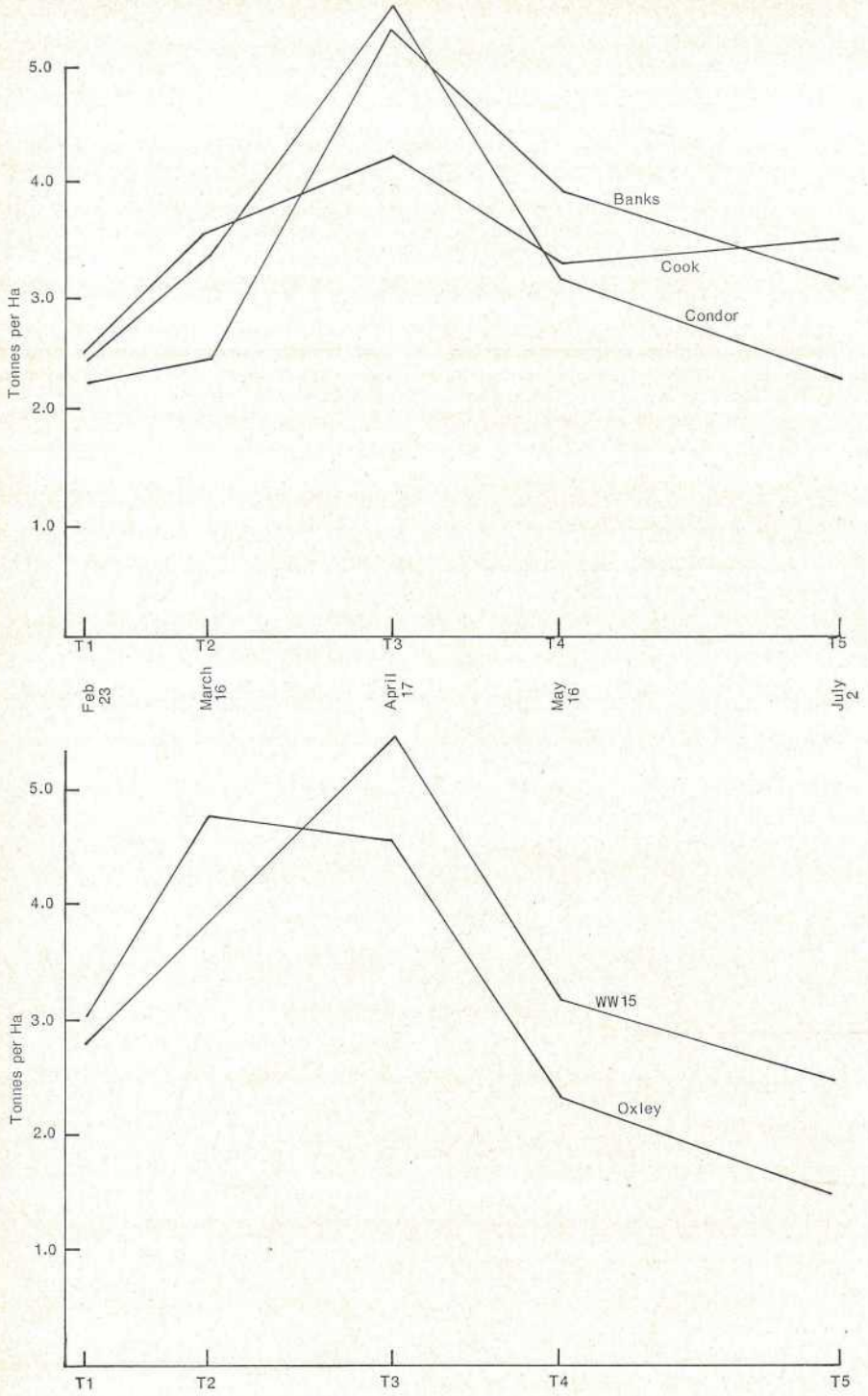


Figure 3. Wheat yields at Emerald 1979. Irrigated time of planting trials.

at specified dates. The probabilities calculated included both the need for a planting rain and the need for the soil surface to dry following the rain to allow planting to proceed.

The study showed that if the land was prepared for planting by the beginning of March, there is:

60% probability of planting by May 1.
85% probability of planting by August 1.

On the other hand, if the land was prepared for planting no earlier than May 1, there is only a 65% probability that the crop could be planted by August 1. Hence a decision not to plant before May considerably reduces the chances of a successful wheat crop.

Farmer experience in the Central Highlands

In recent years, some farmers have been planting part of their commercial crop early. In 1979, Mr George Foster at Capella harvested 1·4 t per ha from Oxley and 1·0 t per ha from Shortim, both planted in the last week of March. Some other varieties did not get their secondary roots down and lodged badly.

In the same season, Mr Lou Brimblecombe of Capella and Mr Bob Wotton of Orion reported yields of around 2 to 2·5 t per ha from April plantings. Mr Brimblecombe prefers medium to slow-maturity wheats such as Oxley and Shortim for early plantings.

Irrigated wheat

Wheat is also an attractive irrigated crop in the Central Highlands (see the March–April 1977 and March–April 1978 issues of the *Queensland Agricultural Journal*).

The 1979 time of planting results under irrigated conditions are shown in figure 3. Highest yields were obtained from the mid April planting. Oxley performed well in the March planting but again rust reduced yields of Oxley in later plantings.

Mr Woodruff is analysing the detailed data collected from irrigated and dryland trials at the various centres. With these results, it will be possible for plant breeders to select varieties of wheat suitable for a range of planting time options for the Central Highlands as well as for other parts of Queensland.

This work is an important step forward in improving the reliability of wheat cropping in the Central Queensland Highlands.

Butter Marketing Board changes

There will be two new members representing manufacturers of butter on the Butter Marketing Board as from 1 January 1981.

The Minister for Primary Industries, Mr Mike Ahern, said Messrs W. R. Drynan and H. J. Mahoney had not stood for re-election and a postal ballot of butter manufacturers had elected Messrs W. G. Keys of Proston and G. H. Horrocks of Grantham to replace them.

The four other sitting members, Mr C. A. Littleton (Crows Nest), W. N. Wedge (Ubobo), L. G. Weier (Talgai) and L. G. Zabel (Rosewood) were re-elected and with Messrs Keys and Horrocks and the Director of Marketing in the D.P.I. will constitute the new Board.

The new Board members will serve a 3-year term.

Goats fail to control hopbush

Feral goats in the 4-ha paddock during the experiment.

HOPBUSH is one of several woody weeds which are becoming a problem in parts of Queensland's sheep country.

In the south-west at 'Nimboy', Cooladdi, feral goats were used in an experiment to see whether hopbush could be controlled by heavy grazing.

Goats have been used with mixed success in Australia and overseas for some years in efforts to control unwanted weeds. Evidence was available from CSIRO that goats heavily browsed a New South Wales species of hopbush (*Dodonaea viscosa*) and most bushes died. The trial at Nimboy was carried out to test their effectiveness against the local species, *Dodonaea adenophora*.

One hundred feral goats were caught and placed in a 4-ha paddock covered almost entirely by hopbush. Other shrubs present were Ellangowan poison bush (*Myoporum deserti*); sandalwood (*Eremophila mitchellii*); green turkey bush (*Eremophila gilesii*) and firebush (*Cassia pleurocarpa*). The heavy stocking rate used is approximately 100 times that recommended for sheep.

The goats were contained by an electric fence and watered from part of an earth tank. After 20 days in the area, they were in poor condition and were removed. Their overall effect on the hopbush was minimal though some bushes had been browsed.

Using goats to control such a dense stand of hopbush was therefore not successful and could not be recommended.

by D. R. Niven, Sheep and Wool Branch, K. J. Lehane, Agriculture Branch and L. W. Landsberg, 'Nimboy', Cooladdi

Soybean varietal guide 1980-81

Compiled by S. R. Walsh, formerly of Agriculture Branch

SOYBEAN varieties recommended for planting in Queensland in the 1980–81 season are listed in this guide.

December is the main planting time but in some districts and 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. To compensate for these factors, the planting rate should be increased and the row width reduced in late sown crops.

The planting rate should aim at establishing a plant stand of 250 000 to 350 000 plants per ha for rain-grown crops. The rate should be increased when sown under irrigation to 400 000 to 450 000 plants per ha.

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

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

Semstar is susceptible to bacterial pustule and wildfire; these diseases may cause reductions in yield. Semstar may also be severely affected by root rot disease particularly on heavy soils and irrigated areas and is therefore not recommended.

Canapolis, a slow maturing variety, is more suited to the central and northern Queensland regions. It was introduced from Brazil by a private seed company.

Fitzroy, a medium-slow maturing variety, was developed and released by Queensland University in 1979.

Forrest, introduced through the U.S.D.A. is a quick-medium maturing variety suitable for sowing in the Moreton and Southern Darling Downs area. It may be sown on a trial basis for this season.

Region	Planting Time	Varieties
Far North Queensland		
Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Hinchinbrook Shires	Dec.–mid Jan.	Fitzroy, Canapolis, Ross
North Queensland		
Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires	Dec.–mid Jan.	Canapolis Ross, Gilbert
	For trial: Dec.–mid Jan.	Fitzroy
Capricornia		
Livingstone, Fitzroy, Calliope, Broadsound Shires ..	Dec.–early Jan.	Davis, Fitzroy, Canapolis
Pioneer, Mirani, Sarina Shires	Dec.–early Jan.	Davis, Fitzroy, Canapolis
Emerald Shire	*Irrigated*: early Dec.–mid Jan mid Dec.–end Jan.	Flegler, Davis, Wills Fitzroy, Canapolis
	Rain-grown: not recommended	
Banana, Duaringa Shires	*Irrigated and Rain-grown:* mid Dec. late Dec.–Jan.	Davis, Flegler Canapolis, Davis Flegler
	For trial: late Dec.–Jan.	Fitzroy
Burnett		
Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, Biggenden, Hervey Bay, part Tiaro, Woocoo Shires	Dec.–early Jan. *For trial:* Dec.–early Jan.	Davis, Bragg, Wills, Flegler Canapolis
Gayndah, Mundubbera Shires	Dec. early Jan. *For trial:* Dec.–early Jan.	Davis, Semstar, Flegler, Bragg Davis, Fitzroy Canapolis

Region	Planting Time	Varieties
Burnett—continued		
Monto, Eidsvold Shires	Dec.	Bragg, Davis
	Jan.	Davis, Fitzroy, Flegler
	late Jan.–early Feb.	Canapolis, Fitzroy, Davis
South Burnett		
Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	Dec.	Davis, Bragg, Semstar, Flegler
	early Jan.	Davis, Semstar
	For trial:	
	Dec.–early Jan.	Fitzroy
Near North Coast		
Widgee, Noosa, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires	late Nov.–late Dec.	Wills, Bragg, Flegler
	late Nov.–end Jan.	Davis
	mid Dec.–Jan.	Fitzroy
Moreton		
Caboolture, Pine Rivers, Redlands, Albert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley, Beaudesert Shires	*Irrigated and rain-grown:*	
	mid Nov.–mid Jan.	Davis, Bragg, Wills, Collee, Flegler
	mid Dec.–Jan.	Fitzroy
	mid Jan.–late Jan.	Davis
	For trial:	
	mid Nov.–mid Jan.	Forrest
Darling Downs		
Wambo, Chinchilla Shires	*Irrigated:*	
	Nov.–Dec.	Davis, Bragg, Collee, Flegler
	Dec.–Jan.	Fitzroy
	Jan.	Davis
	Rain-grown:	
	Nov.–Dec.	Collee, Fitzroy
Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie, Cambooya Shires	*Irrigated:*	
	Nov.–Dec.	Davis, Bragg, Flegler
	Dec.–early Jan.	Fitzroy
	early Jan.	Davis
	Rain-grown:	
	Nov.–Dec.	Collee
	Dec.–early Jan.	Fitzroy
Clifton, Allora, Rosenthal, Glengallan Shires ..	*Irrigated:*	
	late Nov.–Dec.	Davis, Bragg, Collee, Flegler
	Rain-grown:	
	late Nov.–Dec.	Davis, Bragg, Collee, Flegler
	early Jan.	Davis
	For trial:	
	late Nov.–Dec.	Forrest
Fitzroy is not recommended for the heavy clay soils.		
Stanthorpe Shire	Nov.	Davis, Wills, Collee
	Dec.	Davis, Collee
Inglewood Shire	*Irrigated:*	
	late Nov.–Dec.	Davis, Bragg, Collee, Flegler
	early Jan.	Collee
	For trial:	
	mid Dec.–early Jan.	Fitzroy, Forrest
	Rain-grown:	Not recommended
Near South-West		
Balonne Shire	*Irrigated:*	
	Nov.–early Jan.	Davis, Wills, Flegler
	For trial:	
	mid Dec.–early Jan.	Fitzroy
(Planting rate Balonne Shire) Plant population/ha 250 000–350 000 irrigated row crop. 400 000–450 000 solid plant and irrigated.		
	Rain-grown:	Not recommended

SOYBEAN YIELDS SHOWN AS PERCENTAGE OF DAVIS YIELD

	Darling Downs				St. George		W. Moreton		S. Burnett		Kingaroy late planted		Monto		C. Queensland	
	Irrigated		Rain-grown		Irrigated		Irrigated		Rain-grown		Rain-grown		Irrigated		Irrigated	
	%	No. of Trials	%	No. of Trials	%	No. of Trials	%	No. of Trials	%	No. of Trials	%	No. of Trials	%	No. of Trials	%	No. of Trials
Davis	100·0	30	100·0	28	100·0	8	100·0	26	100·0	20	100·0	7	100·0	7	100·0	19
Bragg	103·6	30	100·2	28	112·8	8	98·7	25	94·3	19	86·1	7	90·7	7	91·8	19
Wills	96·6	28	94·4	25	119·2	8	97·6	26	94·0	19	87·3	7	90·7	7	96·7	19
Semstar	98·3	27	103·1	28	108·2	8	92·6	26	98·0	20	86·7	7	94·4	7	91·1	19
Collee	89·6	22	95·9	18	93·3	7	93·1	20	88·7	17	81·1	7	84·5	4	85·0	13
Flegler	103·1	22	98·3	18	104·0	8	107·5	20	99·9	15	87·4	7	93·5	6	105·5	16
Fitzroy	90·5	13	96·1	8	110·1	5	96·3	11	97·7	13	86·7	4	105·5	3	98·5	13
Canapolis	..	..	..	..	..	..	..	..	..	..	..	..	96·7	4	101·5	12
Forrest	108·1	3	129·4	2	104·5	1	124·5	2	115·8	2	66·9	1	..	..	..	..

This table provides a comparison of yield performance in the main districts where soybeans are grown.

The yields are shown as a percentage of the yield of the variety Davis in trials in which both Davis and the particular variety appeared. The greater the number of trials used to calculate the average, the greater the reliability of the results.

The table should be used in conjunction with the guide to varietal characteristics.

SUMMARY OF SOYBEAN VARIETAL CHARACTERISTICS

Characteristics	Davis	Bragg	Wills	Semstar	Collee	Flegler	Hill	Ross	Improved Pelican	Daintree	Gilbert	Fitzroy	Canapolis	Forrest
Maturity Rating	6	6	8	7	5	7	5	9	9	9	9	8–9	9	5
Growth Habit	Erect	Erect	Erect	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	Fair	V. Good	Good
Average Height (cm)	75	75	85	90	70	75	70	70	100	70	70	100	90	75
Average Height to Lowest Pods (cm)	12	10	16	13	8	12	10	10	12	10	10	12	12	10
Flower Colour	White	White	Purple	White	Purple	Purple	White	Purple	Purple	Purple	Purple	Purple	White	White
Pod Hairs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pod Hair Colour	Grey	Tawny	Tawny	Grey	Tawny	Tawny	Tawny	Tawny	Grey	Tawny	Grey	Grey	Tawny	Tawny
Resistance to Bacterial Pustule (**)	Yes	Yes	Yes	No	Yes	Yes	Yes	LL	No	Yes	Yes	Yes	Yes	Yes
Seed Colour	Straw Yellow	Yellow	Yellow	Straw Yellow	Straw Yellow	Dark Yellow	Straw Yellow	Mottled Yellow	Light Yellow	Mottle Yellow	Mottled Yellow	Straw Yellow	Dark Yellow	Yellow
Hila Colour	Buff	Black	Black	Buff	Black	Black	Brown	Brown	Brown	Black and Brown	Brown	Imperfect Black	Brown	Large Black
Plant Growth Habit (*)	D	D	D	ID	D	D	D	D	ID	D	D	ID	D	D
Pod Shattering	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	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	5 700	6 000	5 700

* D = Determinate.

ID = Indeterminate.

Varietal descriptions relate to the district of recommendation.

** LL = Low Level.

Maturity rating: These are based on the U.S.A. maturity groups. The lower the maturity group number, the earlier the variety matures.

Aquatic plants of Queensland part 5

THREE species of *Vallisneria* occur in Queensland. They are submerged, rooted perennials which belong to the family Hydrocharitaceae. All three species are native to Australia.

Ribbon weed *(Vallisneria spiralis)*

This is a common submerged aquatic recognized by its long ribbon-like leaves and spirally-coiled fruit stalks.

DESCRIPTION. The leaves and roots occur in tufts at intervals along slender, creeping stems. Each leaf is green and strap-shaped with a rounded or pointed tip. They may be several metres long and up to about 5 cm broad but are usually less than 1 m long and 0·5 to 2·5 cm broad, or occasionally only 2 to 4 mm broad.

Male and female flowers are produced on different plants. The female flowers are 1·5 to 2·5 cm long and about 5 mm across. Each is enclosed in membranous tissue called a spathe and borne on a long, thin stalk. The male flowers are usually less than 1 mm long and broad and are clustered together on a central axis, the whole enclosed in a spathe. This flowering structure is 1 to 2 cm long. The stalk under the male inflorescence may be up to 7 cm long. Fruits of this species are narrowly cylindrical, up to 10 cm long, and are partially enclosed in the persistent spathe. The spirally-coiled stalks under the fruits may be up to 60 cm long.

For fertilization to occur, the stalk of the female flower elongates to carry the flower to the surface of the water. Individual male flowers become detached from the central axis and float to the surface. Pollination occurs when a floating male flower contacts a female flower. After pollination, the stalk of the fertilized female flower coils spirally and pulls the flower underwater. The fruit then develops underwater.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Ribbon weed is found in still to fairly fast-flowing fresh water in ponds, dams, rivers and streams. This species can tolerate a very wide range of water temperatures. In areas with very cold winters, the leaves may die but the rootstock survives to recommence growth the following season. Maximum growth occurs in midsummer when the water temperature is at its highest. The rootstock can survive in mud for some time after a drop in water level.

Vallisneria spiralis is found in all Australian States, including the Northern Territory and is also known from Europe, Africa, Asia and New Zealand. In Queensland, it is widespread and is common in the areas where it does occur. It is found in eastern areas of the State to as far west as Cunnamulla and Longreach and in northern areas to as far south as Mt. Isa.

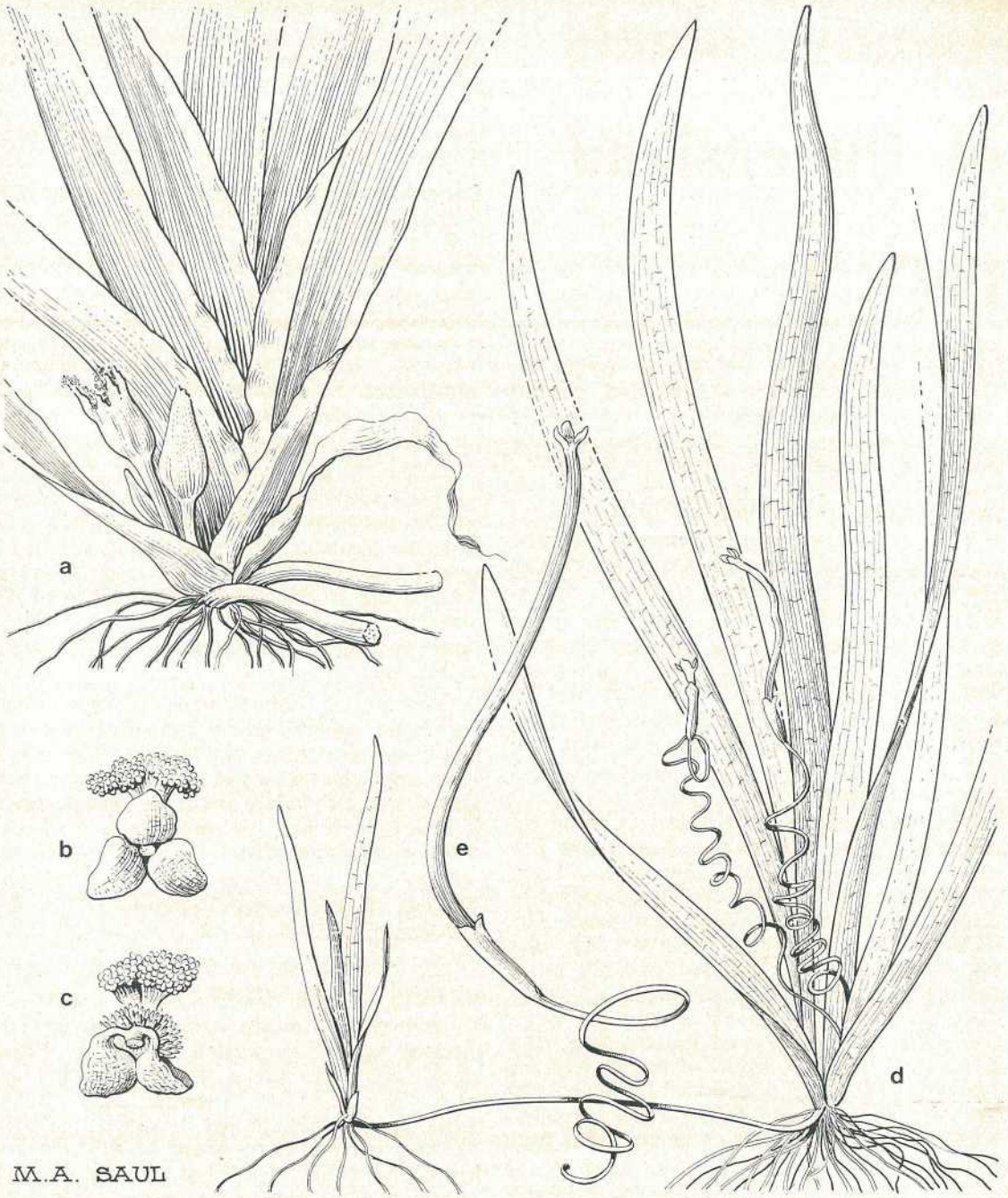
IMPORTANCE. Ribbon weed is capable of very rapid growth and can be a pest in irrigation systems, streams and ponds. The forms with small leaves make excellent aquarium plants and are widely used for this purpose. It is a food source for some water fowl and other aquatic animals.

Stalked ribbon weed *(Vallisneria caulescens)*

This distinctive species has its leaves arranged along an upright stem.

DESCRIPTION. Upright stems are produced at intervals along a creeping rootstock. These stems are up to about 45 cm long and are usually branched in the upper part. Leaves at the base of the stem are translucent, ribbon-like and can be up to about 40 cm long and up to 2 cm broad. The basal leaves apparently disintegrate as the plant ages, leaving the lower stem free of leaves for several centimetres. Leaves towards the top of the stem are usually partially stem-clasping, tapered at both ends and usually less than 8 cm long and less than 1·5 cm broad.

by T. D. Stanley, Botany Branch



Vallisneria spiralis. a—base of male plant showing male inflorescence x 1; b and c—male flower x 25; d—female plant with fertilized flowers x $\frac{2}{3}$; e—fruit x 1.

Vallisneria caulescens. a—habit; b—fruit; c—upper part of female plant showing fruit and spirally-coiled peduncles.

Male and female flowers are produced on different plants. Individual female flowers are enclosed in a spathe, the whole structure being up to about 1·5 cm long. The flowers are attached to the plant by thread-like stalks which arise in the leaf axils. Male flowers are less than 1 mm broad and are clustered together along a central axis. The whole male inflorescence is up to about 1 cm long and is solitary on a short peduncle in the leaf axil.

Fruits of this species are membranous and can be up to 6 cm long. Each is bordered on either side by a membranous wing which can be up to 3 mm wide. The fruit stalks are spirally-coiled.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. This species is found in freshwater lagoons and waterholes and in very slow-flowing streams.

It is known only from the northern part of the Northern Territory and Western Australia and in Queensland from coastal areas around the Gulf of Carpentaria from the Northern Territory border, to the Mitchell River.

IMPORTANCE. It is of no known economic importance.

Vallisneria gracilis

This species resembles small fine-leaved plants of *Vallisneria spiralis*. Further research may show that plants called *Vallisneria gracilis* are in fact only a form of *Vallisneria spiralis*.

DESCRIPTION. The leaves and roots occur in tufts at intervals along slender, creeping stems. Each leaf tapers to a fine point, is 1 mm or less broad and is usually less than 10 cm long, though some may reach 30 cm in length. Flowers are unknown. Fruits are narrowly cylindrical, and about 5 to 8 mm long.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. The species is known only from the fresh water part of the Mulgrave River between Cairns and Innisfail.

IMPORTANCE. It is of no known economic importance.

The three species can be separated using the following key.

1. Leaves arranged along upright, leafy stems ..... *V. caulescens*
   Leaves in tufts, the plants lacking upright stems 2
2. Leaves 2 mm or more broad ..... *V. spiralis*
   Leaves 1 mm or less broad ..... *V. gracilis*

1980 Queensland Pocket Year Book

THE 1980 Pocket Year Book is now available from the Australian Bureau of Statistics, Ground Floor, Statistics House, 345 Ann Street, Brisbane and from the main bookstores at a cost of $1.10 per copy.

For postal orders, the charges are: one copy, $1.50; two copies, $2.90; three copies, $4.10; and four copies, $5.20.

The Queensland Pocket Year Book is a 112 page ready-reference book on the more important social and economic statistics of the State. Accordingly, it has been found to be a useful and compact permanent record by persons travelling overseas or elsewhere, students, researchers, or by people seeking a concise book of knowledge of Queensland.

Exotic diseases of animals

by N. I. Paull, Veterinary Services Branch

AN exotic disease is, by definition, a disease which does not normally occur in Australia.

Examples include Foot and Mouth Disease and African Swine Fever.

It is very important that owners and occupiers of grazing properties and poultry and pig establishments be aware of the proper steps to be taken when an exotic disease is suspected. A series of articles on exotic diseases of livestock and procedures is therefore planned for this Journal.

Overseas aircraft traffic into Australia continues to increase, as does contact with our near northern neighbours via fishing boats and illegal small ship movements. Australia has consequently become even more vulnerable to the introduction of exotic diseases than in the past. Changes in the world distribution of certain serious diseases of livestock add to the seriousness of the situation.

Many graziers and farmers are greatly concerned at the possibility of an exotic disease incursion, and are pleased that coastal surveillance and quarantine staffing have been upgraded—particularly in the North.

Reporting the disease

An owner of a property could well be the first person to see and report on sickness or deaths suggesting an exotic disease in his stock.

This report should first be made directly to the Government Veterinary Officer in the district or to an Inspector of Stock or to another Department of Primary Industries' Veterinary Services officer. These officers are situated in Cairns, Townsville, Rockhampton, Maryborough, Brisbane, Toowoomba, Roma and Mt. Isa.

A veterinary practitioner would also report any suspicious symptoms observed when examining sick animals at the request of the farmer or grazier, or performing autopsies on animals dead from an unknown cause. A first report could also result from the examination of specimens sent to a laboratory.

Whatever the source of the first report, any suspicion of an exotic disease should be viewed with the greatest concern. Every precaution should be taken by the property owner to prevent the spread of the disease.

What the property owner can do

Telephone the nearest officer of the Division of Animal Industry of the D.P.I. immediately with the following information:

- The name and occupation of the person calling.
- The name of the occupier/owner of the property and its location.
- The signs and lesions observed should be described, as well as the length of time since the signs were first observed.
- The number of deaths (if any).
- The number and kind of animals affected and the number, classes and description of all animals in the herd or flock.
- The area of the property and/or description of the land (for example, Downs—no timber). The real property description (for example, Portion 45, Parish of Marsden) is also very useful.

Details of stock, products, vehicles and people movements to and from the property in the previous 21 days should be collated as quickly as is possible.

If there is no telephone on the property, change into clean clothes after showering and drive to the nearest public or private telephone.

It is most important that people, vehicles and stock do not leave the property until the situation has been investigated and quarantine of the property has been established. As far as possible, all livestock should be confined in yards or in paddocks away from the boundaries of the property and someone posted at the main entrance to prevent anyone entering before the veterinary authorities.

What happens next?

If the report requires further and immediate investigation, the veterinary officer will take the following action:

He will brief his head office on the situation, assemble a protective clothing kit, spraying equipment and a supply of disinfectant and will travel to the property as quickly as possible.

On his arrival, he will leave his vehicle at the boundary of the property, where he will be met by a property vehicle, change into protective clothing and examine the suspected animals. If his examination suggests that an exotic disease may be present, he will immediately contact Head Office. An alert to Animal Health authorities in all States will be issued urgently by the Australian Bureau of Animal Health in Canberra.

The property will be placed in quarantine, and all gateways to the property will be secured. Movements on and off the property will be restricted by placing responsible people with disinfection equipment at the entrances.

The following precautions would be taken:

- Any protective clothing (if worn) is left on the property and fresh clothing changed into at the entrance. The clothing worn on the property while inspecting or handling animals is left in plastic bags or bins on the property. This clothing should be washed, disinfected or dry cleaned as soon as possible.
- Footwear should be thoroughly cleansed and disinfected on the property and any soil or manure carefully disposed of by burning or thorough soaking in disinfectant.
- Vehicles should be thoroughly cleansed and disinfected before leaving the boundary of the property.
- Hands should be thoroughly cleansed and disinfected with suitable disinfectant such as washing soda or citric acid.

All neighbours are contacted (by phone if possible) and made aware of the situation. They will also be required to keep their stock away from the boundaries and not to move any stock from their properties.

A fully-equipped diagnostic team will be conveyed to the property as quickly as possible for in-depth investigation and the collection of specimens for laboratory study.

Examination and testing of specimens collected to confirm the diagnosis area will, of course, be given the highest laboratory priority. In some cases, for instance Foot and Mouth Disease, specimens are flown overseas for confirmatory testing.

Until negative results are to hand, 'stand-still' conditions apply to the property and the surrounding risk area.

CHANGING YOUR ADDRESS?

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

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

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

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

Maize planting guide 1980–81 season

Compiled by S. R. Walsh, formerly of Agriculture Branch

MAIZE hybrids recommended for planting in the 1980–81 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 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 ha. The rate should be increased to establish about 50 000 plants per ha 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 the seed count per kg on the container.

Disease

The main diseases affecting maize are illustrated in the *Handbook of Plant Diseases, Volume* 2, published by the Queensland Department of Primary Industries.

The following summary of the more important diseases has been extracted from that publication.

Maydis leaf blight—may be serious in North Queensland, but is not a problem in South Queensland.

Turcica leaf blight—may be serious in susceptible hybrids.

Common rust—common but minor.

Maize dwarf mosaic—major in susceptible hybrids.

Wallaby ear—major in late coastal crops.

Head smut—may be serious in susceptible hybrids in North Queensland; minor in South Queensland.

Diplodia rots—ear rot may be serious in North Queensland.

Gibberella rots—may be serious in North Queensland, moderate in South Queensland.

A number of other stalk and ear rots have been recorded; the infection is usually minor but may vary in intensity between districts and seasons.

A brief description of the more common diseases is as follows:

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.

Maydis leaf blight—

Maydis leaf blight (*Drechslera maydis*) is restricted to North Queensland. The change by seed producers from 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 infested soil.

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.

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.

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.

A summary of the characteristics of maize hybrids is shown in the guide.

Varietal Planting Guide

Region	Planting Time	Hybrids
Far Northern		
Cook, Mareeba, Atherton, Eacham, Herberton, Mulgrave, Johnstone, Cardwell, Douglas, Etheridge, Hinchinbrook Shires	Dec.–mid Feb.	S : QK690, QK694, QK231 QK217 MS: QK487 (QK231, QK217 should not be sown in head smut areas)
Northern		
Dalrymple, Thuringowa, Ayr, Bowen, Proserpine Shires	*Irrigated* Mar.–July	MS: XL99, XL399 M : XL81, Sergeant
	For trial Mar.–July	M : P74
Capricornia		
Livingstone, Fitzroy, Calliope, Broadsound Shires ..	Dec.–Jan. end Dec.–end Jan.	M : XL81, Sergeant S : GH390 MS: XL99 M : XL81, Sergeant
	For trial Dec.–Jan.	M : Captain, GH5004
Burnett		
Miriam Vale, Kolan, Gooburrum, Woongarra, Isis, Perry, part Biggenden, Hervey Bay, part Tiaro, Woocoo Shires	late Aug.–early Sept.	S : GH128, GH390 MS: XL99 M : XL81, GH5004, Sergeant
Gayndah, Mundubbera, part Biggenden Shires ..	mid Nov.–early Jan.	MS: Major M : Sergeant GH5004
	For trial mid Nov.–early Jan.	M : MH695, MH777, RX204
Eidsvold, Monto Shires	mid Nov.–early Jan.	MS: XL99, XL399, Major M : XL81, Sergeant GH5004
	For trial mid Nov.–early Jan.	M : Captain, M : MH695, MH777, RX204
South Burnett		
Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	mid Nov.–Dec.	MS: XL99, Major M : XL81, Sergeant
	For trial mid Nov.–Dec.	M : GH5004, MH695, MH777

Region	Planting Time	Hybrids
Near North Coast		
Widgee, Noosa, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires	Nov.–Jan.	S : GH390 MS: XL399, Major M : XL81, Sergeant, GH5004
	For trial Nov.–Jan.	M : MH777, GH5006
Moreton		
Caboolture, Pine Rivers, Redlands, Albert, Beaudesert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires	Sept.–Dec.	S : GH390, GH128 MS: XL99, XL399 M : XL81
	For trial Sept.–Dec.	M : Sergeant, Captain, GH5004
Darling Downs		
Wambo, Chinchilla Shires	Sept.–Nov.	MS: XL99, XL399 M : XL81, Sergeant
	Oct.–Dec.	M : XL81
Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie Shires	Oct.–Dec.	MS: XL99, XL399 M : XL81, Sergeant
	For trial Oct.–Dec.	Q : XL66
Clifton, Allora, Cambooya, Rosenthal, Glengallan Shires	Oct.–Dec.	MS: XL99, XL399 M : XL81, Sergeant
	For trial Oct.–Dec.	Q : XL66
Stanthorpe Shire	Nov.–Dec.	M : XL81, Sergeant
Irrigated—All Shires	Oct.–Dec.	MS: XL99, XL399 M : XL81, Sergeant
	For trial Oct.–Dec.	M : Captain, GH5004 MQ: XL77 Q : XL66
Inglewood	Oct.–Dec.	M : XL81, Sergeant
Near South-West		
Balonne Shire	*Irrigated only* Oct.–Dec.	M : XL81, Sergeant

Guide to Maize Characteristics

	Maturity	Plant Height	Cob Height	Suckering	Number of Cobs	Husk Cover	Reaction to				
	Sown Oct.–Nov.						Turcica leaf blight	Maydis leaf blight Race O	Head smut	Maize dwarf mosaic	Wallaby ear
Annand Robinson & Co.											
RX220	M	M	M	M–H	M	L	N.A.	N.A.	N.A.	N.A.	N.A.
RX204	M	M	M	M	M	T	N.A.	S	N.A.	MR	R
DeKalb Seed Co.											
XL45	Q	S	S	L	S	O	S	S	N.A.	S	S
XL66	Q	MS	MS	N	S	L	N.A.	N.A	N.A.	S	N.A.
XL361	MQ	MS	MS	N	S	L	S	S	N.A.	S	R
XL77	MQ	M	M	N	S	L	I–MR	I	N.A.	MR	R
XL81	M	M	M	N	S	T	*I–MR	I	MR	MR	R
XL99	MS	MT	MT	L	S	T	R	MR	MR	HR	S
XL399	MS	MT	M	L	S	T	HR	I	MR	MR	I
Northrup King											
PX48	MQ	M	M	L	S	T	N.A.	N.A.	N.A.	N.A.	N.A.
PX74	M	MT	M	L	S	T	N.A.	N.A.	N.A.	N.A.	N.A.
Pioneer											
Colonel	Q	S	M	N	S–M	L	N.A.	N.A.	N.A.	S	R
Sergeant ..	MQ	M	M	L	M	L	R	S	MR	MR	S
Captain	M	M	M	L	M	T	HR	N.A.	R	MR	R
Major	MS	M	M	N	M	L	R	N.A.	MR	MR	I
QK Groups											
QK217	S	T	T	L	S	T	I–MR	S	**HS	HR	N.A.
QK231	S	T	T	L	S	T	MR	MR	S	HR	N.A.
QK413	VS	VT	VT	N	S	T	R	MR	HR	N.A.	N.A.
QK487	MS	MT	MT	L	S	L	MR	HS	R	S	N.A.
QK690	S	T	T	L	S–M	T	R	MR	MR	N.A.	N.A.
QK694	S	MT	MT	L	S–M	T	R	R	MR	N.A.	N.A.

Guide to Maize Characteristics—continued

	Maturity	Plant Height	Cob Height	Suckering	Number of Cobs	Husk Cover	Reaction to				
	Sown Oct.–Nov.						Turcica leaf blight	Maydis leaf blight Race O	Head smut	Maize dwarf mosaic	Wallaby ear
GH Group											
GH128	S	T	T	L	S	T	R	I	R	HR	I
GH390	S	T	T	L	S	T	R	I	S	MR	I
GH5004 ..	M	M	M	M	S	M–T	HR	R	N.A.	HR	R

Maturity

Q	=	Quick
MQ	=	Medium-quick
M	=	Medium
MS	=	Medium-slow
S	=	Slow

Plant Height & Cob Height

T	=	Tall
MT	=	Medium-tall
M	=	Medium
MS	=	Medium-short
S	=	Short

Suckering

N	=	Nil
L	=	Light
M	=	Medium
H	=	Heavy

Number of Cobs

S	=	Single
M	=	Multiple
S–M	=	Single, some multiple

Reaction to Disease

HR	=	Highly resistant
R	=	Resistant
MR	=	Moderately resistant
I	=	Intermediate
S	=	Susceptible
HS	=	Highly susceptible
N.A.	=	No information available

* XL81 contains the Hooker gene resistance and was previously resistant to the common race of turcica leaf light. A new race which has overcome this resistance is now found in South-East Queensland. This loss of resistance may not seriously reduce yields in all circumstances.

** Reaction of some hybrids may vary with the location (e.g. QK 217 is susceptible in N. Queensland but resistant in S. Queensland.)

South Queensland grain sorghum planting guide 1980-81 season

GRAIN sorghum hybrids recommended for planting in South Queensland in the 1980–81 season are listed in this guide. The hybrids have not been ranked in order of preference.

There are a number of hybrids offered for sale this season. Many have not been tested in Departmental trials and others have only been tested for a limited period. Some are showing promise of high yields and desirable characteristics but could not 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 show a phytotoxic reaction to insecticides particularly monocrotophos which may be used to control sorghum midge. The severity of the reaction to insecticides varies with the growth stage of the plant. A number of new hybrids released to the market have not been tested for their reaction to the insecticides and growers should be cautious when spraying. If in doubt, a small area should be sprayed first to test for any reaction or advice should be sought from the appropriate seed company.

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

Compiled by S. R. Walsh, formerly of Agriculture Branch

Planting rates

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

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 but seed size varies. Generally it is in the range of 20 000 to 40 000 seeds per kg.

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 is that which follows moisture stress during the grain filling period. Under such conditions, all grain sorghum hybrids will lodge. Lodging can also be associated with conditions other than moisture stress and hybrids relatively resistant to one type of lodging may be more susceptible to other forms.

This year, varietal recommendations have been made for lodging soils and other soils. Varying soil types will occur on each individual farm and growers would be aware of the differing qualities and reactions of their soils.

Trial data and farmer experience have enabled classification of some hybrids as to their lodging resistance. Only lodging resistant hybrids are recommended for areas where lodging is known to be a problem. Other characteristics, particularly grain yield and disease resistance, determine the recommendations for areas where lodging is usually not important.

Lodging is not usually important in fully irrigated crops. However, it can occur in well-grown irrigated crops which experience moisture stress during grain filling.

Crop maturity

The hybrids have been given maturity ratings. However, maturity is governed largely by temperature and to a lesser extent by day length. Hybrids which flower in 60 to 65 days when sown in October in south Queensland could be expected to flower in 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. Highly susceptible (HS) hybrids should not be sown early in areas where this disease has occurred.

Sugarcane mosaic virus (SCMV)

A Johnson grass strain of sugarcane mosaic virus commonly infects grain sorghum in southern and central Queensland. Three distinct symptoms occur depending on the hybrid and weather conditions.

The mosaic symptom (M) develops in most of the recommended hybrids and under field conditions the grain yield of mosaic reactors is generally little affected.

The red leaf symptom occurs in infected plants of specific hybrids following cool weather. The mosaic symptoms develop into red spots, streaks and areas of dead tissue. If severe red leaf disease occurs, substantial yield loss will result.

Red stripe reactors produce a conspicuous red striping. Early infection causes severe stunting and a high level of this disease results in a substantial yield reduction.

Several hybrids completely resistant to the virus are now available. These hybrids do not produce any of the three symptoms mentioned above and were developed from resistant breeding lines recently released by the Department. Resistant hybrids are designated R in the guide to hybrid characteristics.

Rust

Sorghum rust occurs in most districts throughout the State but is more prevalent in late sown crops. Severe rust infection in highly susceptible 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 1980–81 Season

A number of hybrids commercially available have not been fully tested in Departmental trials and are not included in the list of recommendations; many have shown promise under very limited commercial experience.

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 MS: E57 M : SM8 **For trial** MS: Dorado MQ: Goldrush
Monto, Eidsvold Shires	Nov.–Jan.	MS: Dorado, Leader 1, E57 M : SM8 MQ: Goldrush Q : NK006, Nugget **For trial** MS: Sundowner
	late Jan.–early Feb. (Planting rate 100 000 plants/ha)	

Region and Shires	Planting Time	Recommended Hybrids
Burnett—continued		
Gayndah, Mundubbera, part Biggenden Shires ..	Nov.–Jan.	S : F64a MS: E57, Dorado, Leader 1 M : SM8 MQ: Goldrush **For trial** MS: Sundowner MQ: Gem
South Burnett		**All Soils**
Kingaroy, Nanango, Wondai, Murgon, part Kilkivan, part Rosalie Shires	mid Nov.–Dec.	MS: E57, Q5161, Sunlover I, Leader 1 M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner **Non-Lodging Soils** (additional varieties)
	mid Nov.–Dec.	S : Big Red MS: Dorado
Near North Coast		
Noosa, Widgee, part Tiaro, Maroochy, Landsborough, part Kilkivan Shires	mid Nov.–end Jan.	S : Big Red MS: E57, Sunlover I, Leader 1, Dorado M : Pride, SM8 MQ: Yates 233, Goldfinger, Dorado E
Moreton		**Irrigated and Rain-grown**
Caboolture, Pine Rivers, Redlands, Albert, Beaudesert, Moreton, Esk, Kilcoy, Boonah, Gatton, Laidley Shires	Sept.–mid Jan. (Aug.–Sept. planting preferred)	MS: E57, Dorado, Leader 1 MQ: Yates 233, Goldfinger, Dorado E
Darling Downs		**Lodging Soils**
Wambo, Chinchilla Shires	Oct.–Jan.	MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** Q : Nugget, Gem **Other Soils** M : Texas 610SR, Pride, SM8, Pacific 710 MQ: Yates 233, Goldfinger, Dorado E
Pittsworth, Millmerran, Jondaryan, Crows Nest, part Rosalie Shires	Oct.–early Nov.	**Lodging Soils** MS: E57, Q5161, Sunlover I, Dorado M : Pride, SM8 MQ: Goldrush **For trial** Q : Nugget
	Oct.–early Nov.	**Other Soils** (additional varieties) M : Texas 610SR, Pacific 710, C43 MQ: Yates 233, Goldfinger, Dorado E
Clifton, Allora, Rosenthal, Glengallan, Cambooya Shires	Oct.–mid Nov.	MS: E57, Dorado M : Texas 610SR, Pride, Pacific 710, SM8 MQ: Yates 233, Goldfinger, Dorado E **For trial** S : Big Red

Region and Shires	Planting Time	Recommended Hybrids
Darling Downs—continued		
Stanthorpe Shire	Nov.–mid Dec.	MS: E57, Q5161, Sunlover I, Dorado M : SM8 MQ: Goldrush
Inglewood Shire	Sept.–Oct.	S : F64a MS: E57, Q5161, Sunlover I, Dorado M : SM8 MQ: Goldrush **Irrigated**
All Shires	Oct.–early Nov.	S : F64a, Big Red, Texas 671 MS: E55e, Dorado M : Texas 610SR, Pride, SM8, Pacific 710 MQ: Yates 233, Goldfinger, Dorado E **For trial**
	Oct.–early Nov.	MS: SM10
Near South-west		
Waggamba Shire	Sept.–Oct.	MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush
	late Dec.–Jan.	MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner **Rain-grown**
Balonne Shire	late Dec.–Jan.	MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner **Irrigated**
	late Dec.–Jan.	S : Big Red, Texas 671 MS: E57, Dorado, E55e M : Texas 610SR, Pride, SM8 MQ: Yates 233, Goldfinger, Dorado E
Murilla, Tara, Taroom Shires	late Sept.–Oct.	S : F64a MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner
	late Dec.–Jan.	S : F64a MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner
Bungil, Bendemere, Warroo, Booringa Shires ..	late Dec.–Jan.	MS: E57, Q5161, Sunlover I M : Pride, SM8 MQ: Goldrush **For trial** MS: Sundowner

KEY

S = slow maturity; MS = medium-slow maturity; M = medium maturity; MQ = medium-quick maturity; Q = quick maturity.

For further information on varietal performance in your own district, consult your Agricultural Extension Officer.

Grain Sorghum Comparative Yields

Compiled by R. G. Henzell and D. S. Fletcher

Mean Yield as % of Texas 610SR and % of Mean of Texas 610SR, Pride and E57 1974–75 to and including 1979–80 trials (Mean yield comparisons indicated by % x 3)

Seed Company	Hybrid	Eastern Downs				Central Downs				Northern Downs				South Burnett			
		Yield % Texas 610SR	No. of Trials	Yield % x–3	No. of Trials	Yield % Texas 610SR	No. of Trials	Yield % x–3	No. of Trials	Yield % Texas 610SR	No. of Trials	Yield % x–3	No. of Trials	Yield % Texas 910SR	No. of Trials	Yield % x–3	No. of Trials
Asgrow ..	Dorado E	96	4	N.A.	..	102	5	107	5	108	9	94	6	95	10	90	5
	Dorado A	109	3	104	3	101	4	114	4	98	4	106	4	111	2	120	2
	Dorado ..	108	4	105	4	90	5	92	5	95	9	93	9	90	13	99	13
DeKalb ..	B17 ..	75	2	N.A.	..	76	3	N.A.	..	86	3	N.A.	..	93	2	N.A.	..
	C42t ..	94	4	92	4	86	4	97	4	92	7	94	7	96	5	90	5
	C43 ..	90	2	N.A.	..	103	3	102	3	99	7	95	7	97	10	94	10
	X5065 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	103	3	98	3	N.A.	..	N.A.	..
	E55e ..	94	4	92	4	75	4	85	4	86	4	93	4	89	9	95	9
	E57 ..	108	4	105	4	92	6	96	6	93	10	93	10	100	15	100	15
	F64a ..	97	4	95	4	69	5	70	5	75	9	73	9	98	8	92	8
Northrup King	NK006 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	103	3	98	3	N.A.	..	N.A.	..
	NK150 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	108	3	102	3	N.A.	..	N.A.	..
	NK250 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	107	3	101	3	N.A.	..	N.A.	..
	NK280 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	117	3	111	3	N.A.	..	N.A.	..
	NK350 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..
Pacific Seeds ..	Nugget ..	N.A.	..	N.A.	..	106	2	100	2	116	5	111	5	88	9	84	6
	Goldfinger	94	4	N.A.	..	94	5	99	5	103	8	98	5	96	15	86	10
	Goldrush	91	4	91	2	89	6	92	3	102	9	105	6	94	17	99	13
	Pac 710 ..	99	2	99	2	103	3	102	3	110	6	106	6	98	3	85	3
	Sundowner	N.A.	..	N.A.	..	N.A.	..	N.A.	..	99	5	92	5	101	8	99	8
	Tropic ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	132	2	117	2
Pioneer ..	Gem ..	93	2	N.A.	..	110	2	103	2	112	6	105	6	95	7	94	5
	Pride ..	99	4	97	4	95	6	100	6	107	10	107	10	100	15	100	15
	Sunlover 1	101	4	99	4	107	4	101	4	94	8	96	8	111	13	99	13
	Leader 1 ..	101	4	99	4	85	6	89	6	89	10	89	10	109	12	105	12
	Solo ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	96	5	89	5	70	8	69	8
	Big Red ..	109	4	106	4	90	4	91	4	94	8	93	8	100	10	98	10
	Trump ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..
Yates	Yates 233	92	4	N.A.	..	93	4	N.A.	..	90	3	N.A.	..	100	5	N.A.	..
	Yates 212	95	4	93	4	94	6	99	6	89	9	90	9	93	7	94	7
	Yates SM5	110	4	108	4	N.A.	..	N.A.	..	112	3	106	3	119	4	103	4
	Yates SM8	105	4	102	4	101	3	100	3	105	7	101	7	104	12	104	12
	Yates SM9	103	3	102	3	N.A.	..	N.A.	..	97	3	92	3	103	2	95	2
	Yates 266	99	4	97	4	82	4	93	4	86	4	93	4	104	10	102	10
	Yates SM10	100	3	100	3	87	2	82	2	81	7	78	7	98	7	95	7
	Yates 275	101	2	97	2	81	2	97	2	79	2	82	2	104	2	91	2
Hylan	Texas 626	97	4	95	4	94	4	99	4	92	4	96	4	90	3	92	3
	Texas 610SR	100	All	97	4	100	All	105	6	100	All	100	10	100	All	100	15
	Star ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	103	3	97	3	95	2	97	2
	Trojan 1 ..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	103	3	97	3	82	4	88	4
	Q5161 ..	101	4	99	4	105	5	113	5	98	9	98	9	102	15	102	15
	Hylan 4x8	N.A.	..	N.A.	..	N.A.	..	N.A.	..	106	3	101	3	102	4	103	4
	Texas 671	101	2	98	2	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..	N.A.	..
Open Pollinated Variety ..	Alpha ..	83	3	79	3	76	3	84	3	76	2	81	2	80	3	82	3

Guide to Grain Sorghum Characteristics

Seed Company	Hybrid	Time of Flowering	Height	Head	Grain Colour	Reaction to				Stand-ability or Resistance to Lodging
						Head Smut Race 1	S.C.M. Virus	Rust (*Puccinia purpurea*)	Leaf Blight (*Drechslera turcica*)	
Asgrow	Dorado E	MQ	MT	Semi-open ..	Bronze ..	R	Red Stripe	R	S	**
	Dorado A	M	MT	Semi-open ..	Bronze ..	R	M	S	S	*
	Dorado ..	S	S	Open ..	Bronze ..	R	M	S	R	***
DeKalb	B17 ..	VQ	M	Semi-open ..	Red ..	HS	M	HS	S	*
	C42t ..	M	S	Semi-compact	Bronze ..	R	M	HS	S	***
	C43 ..	M	MT	Open ..	Bronze ..	R	M	S	S	**
	X5065 ..	M	MT	Open ..	Red ..	R	M	S	N.A.	***
	E55e ..	MS	MS	Semi-compact	Red ..	R	M	S	S	**
	E57 ..	MS	MT	Open ..	Bronze ..	R	M	S	S	****
	F64a ..	S	T	Open ..	Bronze ..	R	M	R	R	****
Northrup King ..	NK006 ..	Q	MS	Open ..	Red ..	R	M	R	S	**
	NK150 ..	Q	MS	Open ..	Bronze ..	R	M	N.A.	HR	**
	NK250 ..	MQ	M	Semi-open ..	Bronze ..	R	M	R	NA.	**
	NK280 ..	M	M	Semi-open ..	Light-red ..	R	M	R	N.A.	**
	NK350 ..	MS	M	Semi-open ..	Bronze ..	R	M	S	N.A.	N.A.
Pacific Seeds	Nugget ..	Q	S	Open ..	Red ..	S	M	R	S	***
	Goldfinger	MQ	T	Semi-open ..	Bronze ..	R	M	S	R	**
	Goldrush	MQ	MT	Semi-open ..	Red ..	S	M	S	R	***
	Pac710 ..	M	MT	Compact ..	Red ..	R	M	R	HR	**
	Sundowner	MS	MS	Semi-open ..	Bronze ..	S	R	R	N.A.	****
	Tropic ..	S	T	Semi-open ..	Bronze ..	R	M	S	S	**
	Monsoon	VS	T	Open ..	Red ..	R	M	N.A.	N.A.	**
Pioneer	Gem ..	MQ	MS	Semi-open ..	Light-red ..	R	M	HS	S	**
	Pride ..	M	S	Semi-open ..	Bronze ..	R	M	S	S	***
	Trump ..	M	MT	Semi-open ..	Bronze ..	R	M	S	N.A.	N.A.
	Leader 1 ..	MS	MS	Open ..	Bronze ..	R	M	S	S	***
	Sunlover 1	MS	MS	Semi-compact	Bronze ..	HS	Red Leaf	R	R	****
	Solo ..	S	M	Open ..	Bronze ..	R	R	R	R	****
	Big Red ..	S	M	Semi-compact	Bronze ..	R	M	S	S	**
Yates	Yates 233	MQ	M	Semi-open ..	Bronze ..	R	M	S	R	**
	Yates 212	M	MS	Semi-compact	Red ..	R	M	S	S	**
	SM5 ..	M	MS	Open ..	Bronze ..	R	M	S	R	***
	SM8 ..	M	MS	Semi-open ..	Bronze ..	S	M	R	R	****
	SM9 ..	MS	M	Open ..	Bronze ..	R	N.A.	S	R	*
	Yates 266	MS	M	Semi-open ..	Bronze ..	R	M	S	R	**
	SM10 ..	S	MT	Semi-compact	Bronze ..	S	M	R	S	**
	Yates 275	S	M	Semi-compact	Red ..	R	M	S	HS	**

Guide to Grain Sorghum Characteristics—continued

Seed Company	Hybrid	Time of Flowering	Height	Head	Grain Colour	Reaction to				Stand-ability or Resistance to Lodging
						Head Smut Race 1	S.C.M. Virus	Rust (*Puccincia purpurea*)	Leaf Blight (*Drechslera turcica*)	
Hylan	Texas 626	M	M	Compact ..	Red ..	R	M	S	S	**
	Texas 610SR	M	M	Compact ..	Red ..	R	M	S	S	**
	Star ..	M	M	Compact ..	Red ..	S	R	R	R	**
	Trojan 1 ..	MS	M	Semi-open ..	Bronze ..	S	R	R	N.A.	****
	Q5161 ..	MS	M	Compact	Bronze ..	HS	Red Leaf	R	HR	****
	Hylan 4x8	MS	M	Semi-open	Bronze ..	S	R	R	N.A.	***
	Texas 671	S	M	Compact ..	Red ..	R	M	S	S	**
Panorama	New Red SR	M	M	Compact ..	Red ..	R	M	N.A.	S	**
	ViR-Res 610	M	M	Compact ..	Red ..	S	R	N.A.	N.A.	**
	VR5161 ..	MS	M	Compact ..	Bronze ..	S	R	N.A.	N.A.	N.A.
Open Pollinated Variety	Alpha ..	S	MS	Semi-compact	Red ..	S	M	HS	R	****

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

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

Sugarcane mosaic virus reaction

M = Mosaic
Red Stripe
Red Leaf
R = Resistant

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.

N.A.: Information is not available or the variety has not been fully tested in Departmental trials.

The table of yield data is a summary of data collected from the Department's grain sorghum hybrid testing program in Southern Queensland. The data has been separated into four groups—Eastern Downs (comprising the Shires of Glengallan, Rosenthal, Allora, Clifton, Cambooya), Central Downs (comprising the Shires of Jondaryan, Pittsworth, Millmerran, Crows Nest, part Rosalie), Northern Downs (comprising the Shires of Wamba and Chinchilla), and South Burnett. Most trials in the Eastern Downs, Central Downs, Northern Downs and South Burnett have been grown at Hermitage Research Station, Bongeen, Jimbour and the J. Bjelke-Peterson Field Station respectively.

In previous years, the yield of particular hybrids has been expressed as a percentage of the Texas 610SR's yield. This has been continued but in addition a hybrid's yield as the percentage of the mean yield of three hybrids (Texas 610SR, Pride and E57) has been presented. Using a mean may help to overcome situations where a single reference hybrid (for example Texas 610SR) may be affected (adversely or beneficially) by a set of conditions which may specifically affect that hybrid. The yield figure expressed as a percentage of the mean of the three hybrids is the most reliable.

As has been pointed out previously, hybrids (and indeed varieties of any crop) vary in performance relative to one another both from location to location and year to year. For this reason, this yield data becomes more reliable as more trials are grown and this should be noted when examining the data. This type of data should be used only as a guide but should help in conjunction with the 'Guide to Grain Sorghum Characteristics' chart when grain growers are making their hybrid selection.

Grain sorghum planting guide for Central Queensland 1980-1981

THIS planting guide refers to Livingstone, Fitzroy, Calliope, Nebo, Broadsound, Banana, Duaringa, Emerald, Peak Downs, Belyando and Bauhinia Shires.

The grain sorghum hybrids recommended for planting in these Shires are listed in table 1. They have not been listed in order of preference. The hybrids recommended have been well tested in regional trials over a number of years, and are proven performers in commercial situations.

The hybrids listed 'for trial' should be planted in smaller areas on a trial basis if they are unknown to the grower. The yield should be measured and compared with yields obtained from proven hybrids. A large proportion of the cropped area should not be sown with a new hybrid unless its performance has been equal to, or better than, established hybrids for at least 3 years.

Other relevant hybrids are listed in the guide to grain sorghum characteristics (table 2).

In order to reduce risk, it is always advisable to plant more than one hybrid. This allows the grower to assess a wider range of material under his own conditions.

Plant populations

Plant populations for rain-grown crops should range from 50 000 to 90 000 plants per ha. It is important to have an even plant distribution particularly when populations are below 75 000 plants per ha.

In an irrigated situation, up to 250 000 plants per ha, in relatively narrow row spacings, may be used. A maximum of 175 000 plants per ha is recommended for early-planted ratoon sorghum.

Compiled by C. J. Paull, R. L. Brengman and J. W. Foreman.

The planting rate will vary according to:

- The plant population required.
- The seed quality. Grain sorghum seed sold by major seed companies is of high quality and must have a germination of at least 70%. Seed test results can be obtained from retailers—good seed has a germination of around 90%.
- The number of seeds per kg. Seed size varies but generally is from 20 000 to 40 000 seeds per kg. The seed size is usually on the label.
- The expected emergence in the paddock. This depends on available soil moisture, efficiency of planting equipment and soil type.
- The amount of soil moisture likely to be available during the growing period.

$$\text{Seed required per ha} = \frac{\text{desired plant population} \times 10\,000}{\text{no. of seeds per kg} \times \% \text{ germination} \times \% \text{ emergence}}$$

Use the following table as a guide:

APPROXIMATE PLANTING RATE FOR GRAIN SORGHUM 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

Hybrid characteristics

Important characteristics of a wide range of hybrids are given in table 2. The hybrids included are those which are commercially significant or are showing good potential in Central Queensland.

When selecting a hybrid, the most important characteristics are yield, resistance to lodging (rain-grown crops only), and resistance to leaf diseases. Factors such as maturity, plant height, head characteristics and reaction to insecticides should also be considered.

- MATURITY. Differences between hybrids in time to flowering are not as great in Central Queensland as in southern areas, because of the later planting time and higher temperatures. The differences between slow-maturing and quick-maturing hybrids are even less in late plantings.

  Slow-maturing hybrids have a higher yield potential than quick-maturing ones. Quick-maturing hybrids have a role very early or very late in the season and are more efficient in their use of moisture. However, if it is anticipated that the amount of moisture available to the crop will be limited, it is generally best to plant a slow-maturing hybrid at a lower plant population. This is because slow-maturing hybrids are less prone to lodging, and are capable of producing higher yields if unusually good rainfall is received.

- INSECTS. Sorghum midge is more likely to be a problem in hybrids which have an extended flowering period. Heliothis and sorghum head caterpillars are more likely to cause yield reductions in intensive cropping areas and in varieties with compact heads. Heads of open-headed hybrids dry more rapidly and make insect control easier. Most sorghums are able to compensate for some grain loss by increasing grain size under favourable growing conditions.

- LEAF DISEASES can be severe in wet seasons and coastal areas, and may reduce yield.

- RESISTANCE TO LODGING may be advantageous, particularly in more marginal situations or where harvesting is likely to be delayed after maturity.

- YIELD INDEX. This is only a guide to relative yield. A particular yield index is regarded as reasonably reliable when the hybrid has been in at least 16 trials over three seasons.

TABLE 1

GRAIN SORGHUM GUIDE 1980–81

Situation	Planting Time	Recommended Hybrids
Rain-grown crops (all Shires)	mid Dec.–mid Feb.	E57, F64, Leader 1 (see note below) *For trial* Sundowner, SM8
Irrigated crops (all Shires)	September (ratoon sorghum) mid Dec.–late Jan.	Goldrush E57, F64a *For trial* Sundowner, Big Red, Leader 1 Dorado, Y101 (similar) SM10

NOTE: ' Leader 1 ' was marketed as ' Leader ' in previous seasons.

This guide has been compiled mainly from information collected in D.P.I. trials in Central Queensland. It is basic information only. For further details contact your Shire Agricultural Extension Officer.

TABLE 2

GUIDE TO GRAIN SORGHUM CHARACTERISTICS CENTRAL QUEENSLAND 1980

Seed Company	Hybrid	Time of flowering	Height	Head	Grain colour	Reaction to			Stand-ability or resistance to lodging	Mean Yield as % of (Texas 610 SR, E57, Pride)		Number of years in trials
						S.C.M. Virus	Rust (*Puccinia purpurea*)	Leaf blight (*Drechslera turcica*)		Central Queensland Yield %	Central Queensland No. of Trials	
Asgrow	Dorado	MS	M	semi-open	bronze	M	S	R	**	103	26	7
DeKalb	C43	M	MT	open	bronze	M	S	S	**	110	5	2
	E57	MS	M	open	bronze	M	S	S	****	104	26	7
	F64a	S	T	open	bronze	M	R	R	****	100	25	7
	X5065	MS	MT	open	red	M	S	NA	***	103	8	2
Hylan	Trojan 1	MS	M	semi-open	bronze	R	R	NA	****	105	8	2
	4 x 8	MS	M	semi-open	bronze	R	R	NA	***	103	8	2
	Q5161	MS	M	compact	bronze	red leaf	R	HR	****	92	24	7
	Texas 610 SR	M	M	compact	red	M	S	S	**	96	26	7
Northrup King	NK006	MQ	M	open	red	M	R	S	**	100	8	2
	NK150	Q	MS	open	bronze	M	NA	HR	**	93	10	3
	NK250	MQ	M	semi-open	bronze	M	R	NA	**	78	8	2
	NK280	M	M	semi-open	light red	M	R	NA	**	95	7	1
	NK350	MS	M	semi-open	bronze	M	S	NA	NA	NA	0	0
Pacific Seeds	Goldrush	Q	MT	semi-open	red	M	R	S	***	93	24	7
	Nugget	Q	S	open	red	M	R	S	***	92	13	3
	Sundowner	MS	M	semi-open	bronze	R	R	NA	****	110	10	2
	Y101	MS	M	semi-open	bronze	M	S	R	**	100	18	4
	Tropic	S	T	semi-open	bronze	red leaf	S	S	**	104	3	3
Pioneer	Big Red	S	M	semi-compact	bronze	M	S	S	**	101	19	4
	Gem	Q	MS	semi-compact	light red	M	HS	S	**	102	10	4
	Leader 1	MS	MS	semi-open	bronze	M	R	S	***	102	21	7
	Leader S	MS	MS	semi-open	bronze	M	NA	NA	NA	95	7	1
	Leader SR	MS	MS	semi-open	bronze	M	NA	NA	NA	109	4	1
	Pride	MQ	MS	semi-compact	bronze	M	S	S	***	99	22	7
	Solo	MS	M	open	bronze	R	R	R	****	104	11	3
	Solo H	MS	M	open	bronze	R	NA	NA	NA	103	8	2
	Sunlover 1	MS	MS	semi-compact	bronze	red leaf	R	R	****	91	23	7
	Trump	M	MT	semi-open	bronze	M	S	NA	NA	NA	1	1
Yates	SM5	MS	MS	semi-open	bronze	M	S	R	***	101	5	4
	SM8	M	MS	semi-open	bronze	M	R	R	****	99	18	5
	SM9	M	M	open	bronze	NA	S	R	*	86	9	3
	SM10	S	MT	semi-open	bronze	M	R	S	**	101	16	5
Open Pollinated Variety	Alpha	S	MS	semi-compact	red	M	HS	R	****	75	12	5

KEY

Time to flowering: Q–quick; MQ–Medium-quick; M–medium; MS–medium-slow; S–slow.
Height: T–tall; MT–Medium-tall; M–medium; MS–Medium-short; S–short.
Head type: Open; Semi-open; Semi-compact; compact.
Leaf rust: HR—highly resistant; R—resistant; S—susceptible; HS—highly susceptible.
Sugarcane mosaic virus reaction: R—resistant; M—mosaic; red leaf.
Leaf blight: HR—highly resistant; R—resistant; S—susceptible.
Standability or resistance to lodging: *below average; **average; ***above average; ****very good standability.
Average yield index: The average yield of the variety as a percentage of the average of three hybrids. (Texas 610 SR, E57 and Pride.)
NA—Sufficient information is not available or the hybrid has not been tested in Departmental trials.
Number of trials—The number of trials in which the reference hybrids and the particular hybrids occurred. The greater the number of trials used to calculate the average, the greater the reliability of the results.
Number of years—The number of years the particular hybrid was tested in trials since 1974.

Subject index to volume 106 (1980)

index to pages and parts

Guide to pages

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Heifers and steers . . . what is the difference?

by K. Maynard, Slaughtering and Meat Inspection Branch

MEAT from both heifers and steers will be of the same quality if sex is the only difference.

The yield of saleable meat from both sexes will be the same, provided the comparison is made between carcasses:

- Of the same weight
- Of the same fat cover
- Which have been dressed with internal fats out, udder and cod fat off

However, the argument persists that heifer beef is inferior to steer beef in yield.

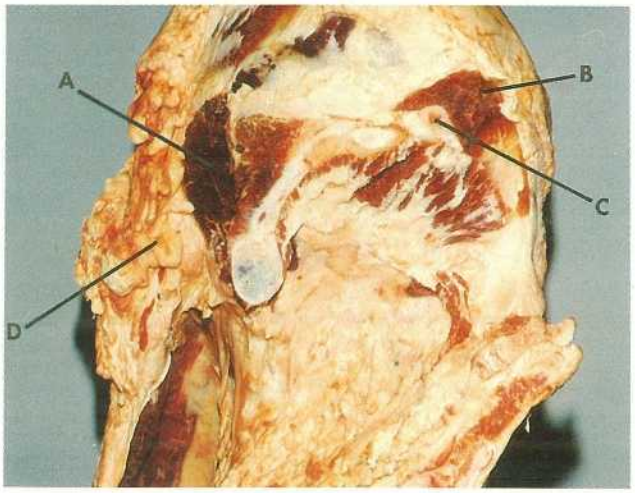
When steers and heifers are growing, the heifers lay on fat earlier. So at the same age and weight, their carcasses tend to be fatter.

If heifers were marketed a little earlier than steers they would be a little light but have less fat.

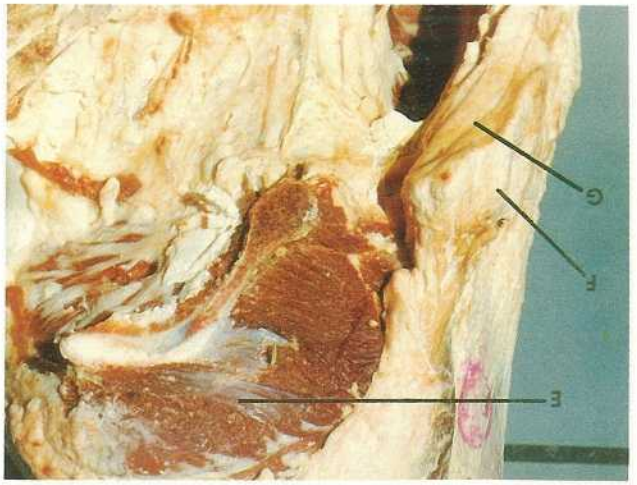
There is a large range of fat levels in both male and female carcasses available from wholesalers. When the fatter carcasses are broken up and trimmed for retail sale they yield less whether they are heifers or steers.

Remember, fat is the factor not sex.

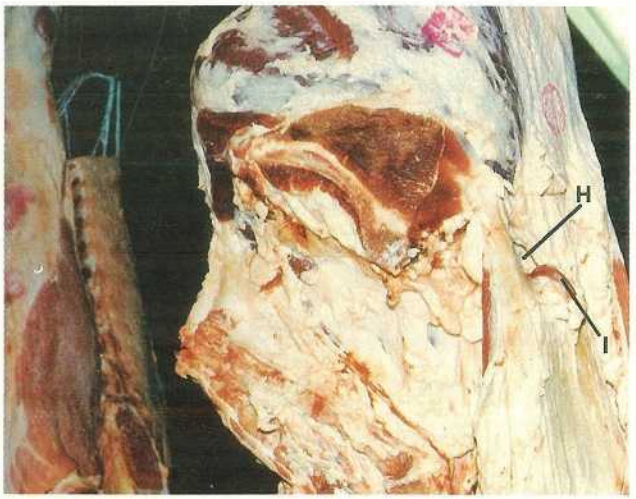
Heifers and steers—what is the difference?



LEFT. The exposed part of the topside muscle of the steer is roughly triangular (A). There is also a group of dark muscles (the erector muscles) (B), surrounding the butt of the pizzle (C). If cod fat is left on, it forms a rough, knobbly mass (D).



RIGHT. The topside muscle of the heifer is bean-shaped (E). There are no erector muscles or pizzle butt. If udder fat is left on, it forms a smooth mass (F) and brownish mammary tissue may be visible on the cut surface (G).



LEFT. If the steer's cod fat has been removed, there will be an opening in the underlying abdominal wall (the inguinal canal) (H). In this canal, you may find a muscular cord (I) which is the remnant of the spermatic cord.

Photographs by K. C. Beaumont, Slaughtering and Meat Inspection Branch