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COVER: *Podolepis monticola* is one of Queensland's many beautiful wildflowers. See 'The Podolepis of South-east Queensland' in this issue.

Photograph by M. F. Olsen.

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Contents

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Tea in

TEA is well adapted to the wet tropical coastal area of north Queensland and the wetter areas of the Atherton Tableland.

Isolated pockets of suitable land can also be found extending into N.S.W. Agronomically, there are no major problems in growing tea.

The successful mechanization of all aspects of tea growing has brought this traditionally labour intensive plantation crop into the sphere of Australian agriculture on both a plantation and farmer level.

Australia has enough land to produce most of its tea requirements. Excluding specialist teas and teas of unique characteristics, Australian teas could supply 90% of the market.

The Australian tea consumption is 27 to 30 m kg per year of black tea. The value of the tea landed into Australia in 1975 was $25 m, prices rose sharply in 1977 and the value increased to $50 m.

by F. R. Hobman, Agriculture Branch

Soil and climatic requirements

The physical composition of the soil can range from one containing a high proportion of sand (67%) to a soil containing a high proportion of clay (82%). The over-riding factor is that the soil should not be subject to waterlogging whether it is caused by surface flooding or by poor internal drainage of the soil.

Tea prefers an acid soil, pH 4·5 to 5·5, although it will grow satisfactorily at pH 4·0 to pH 6·5.

Atherton Tableland tea.

Queensland

Tea is successfully grown commercially in areas where the rainfall is as low as 1 200 mm per year with 1 000 mm of this falling in a 5 month period. In the remaining 7 months, evaporation exceeds rainfall. At the other end of the scale, tea is also grown where the rainfall is more than 3 800 mm per year with 3 150 mm falling in a 4 month period. In 6 of the remaining months, evaporation exceeds rainfall.

Temperatures vary between seasons and areas, for Nagrakata (India) and Thyolo (Africa) the range is from 19°C to 31°C mean monthly maximum and 10°C to 24°C mean monthly minimum. Daily temperatures drop to as low as 4°C and can soar over 38°C.

Tea is grown over a wide latitude band (40°N to 40°S). However, most of the tea plantations are within 30° of the equator. Daylength, which is associated with latitude, influences tea growth. When it is less than 11·75 hours, tea growth is reduced. This results in a semi-dormant period during winter, and this period of semi-dormancy increases with distance from the equator. At latitude 17° this period, because of daylength, varies from 2 to 4 weeks. A 2 month semi-dormant period can be expected at latitude 30°.

Annual yields do not differ in direct relationship with number of days above the critical daylength. There is, however, a tendency for the tea to yield at a higher rate during a shorter growing season.

In North Queensland alone, there are more than 29 000 ha (excluding land growing sugarcane) which are ideal for tea growing. This land lies in the wet tropical coastal areas and in the wetter areas of the Atherton Tableland.

South Johnstone tea (coastal).

TABLE 1

PHYSICAL ANALYSIS OF SOME TEA SOILS

Fraction	A	B	C	D	E	F	G	H	I
Coarse Sand	16	..	..	32	21	20	34	24	2
Fine Sand	34	7	17	18	20	19	33	39	4
Silt	27	33	43	28	25	36	22	29	11
Clay	17	11	28	5	20	25	10	6	82
Loss on Ignition	6	33	8	16	15	..	..	..	..

A—Brahmaputra alluvium, Assam, India.
B—Bheel soil, Surmah Valley, India.
C—Clay flat, Surmah Valley, India.
D—High range, S. India.
E—Nilgiris, S. India.
F—Central Province, Ceylon.
G—Uva Province, Ceylon.
H—Pengalengan Plateau, Java.
I—Kiamba, Kenya.

Agronomy and plantation management

Tea is a crop which has an economic life of at least 50 years. Many of the older tea areas in the world are over 100-years-old and still in production.

Because of this, it is necessary to plan the plantation layout thoroughly and carefully, well in advance of the initial plantings. Mistakes made in the early establishment period become progressively more difficult to correct as the plantation develops.

Topography

The upper limit of slope is set by the ability of the harvester to harvest (pluck) the tea in the sloping area during the wet season.

Tea is usually planted straight up and down the slopes. This eliminates the problem of side slip which would result if machines tried to work across the contour during wet weather.

The soil in a tea plantation is seldom disturbed after planting and this fact, together with the complete canopy provided by the tea reduces erosion to negligible proportions in mature tea plantations. In the immature tea stages (2 years), a ground cover should be sown to protect the soil.

Ground preparation

SCRUB CLEARING

Most of the potential tea growing areas have been cleared. Some small areas of heavy scrub (jungle) still remain in isolated pockets.

Where necessary, the land should be cleared by August in the year preceding planting. Where possible, trees should be pushed into ravines and gullies which are not to be planted to tea. The remaining trees should be burnt over as wide an area as possible. It is not advisable to push the trees into windrows and then burn them, as tea planted in these windrows does not thrive.

The area is next cutter-barred or ripped with a subsoiler to a depth of 45 cm. If there is a risk of erosion, use the subsoiler in preference to the cutter bar. Rip or cutter bar twice at right angles, and collect all large roots for removal from the area.

Subsequent operations are the same as for preparing grass paddocks for tea.

GRASS PADDOCKS

The area should be ploughed to 20 cm in early spring. Ploughing evens out the soil and helps break down the vegetation. Seedling weed growth is stimulated and this can be controlled by cultivation.

TABLE 2

AVERAGE MONTHLY AND YEARLY RAINFALL IN MM OF TWO TEA-GROWING AREAS

Area	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Nagrakata, Dooars, India	8·7	30·0	42·8	115·8	281·4	916·2	949·3	775·6	510·3	157·3	17·5	4·8	3 810
Thyolo, Malawi, Africa	227·1	187·5	209·0	116·6	26·9	22·9	32·0	18·5	8·9	18·5	62·2	285·0	1 215

TABLE 3

MONTHLY DEFICIT/SURPLUS IN MM (RAINFALL–EVAPORATION)

Area	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Nagrakata	−76	−72	−125	−63	+119	+796	+836	+668	+405	+42	−71	−79
Thyolo	+90	+60	+89	+5	−73	−69	−52	−97	−158	−213	−124	+135

View of Nerada.

Weeds can be a serious problem in newly-established tea areas and cultivations during spring should be carried out as required to minimize the weed problem.

Cultivations producing a bare fallow also reduce nematode populations. Both *Pratylenchus* spp. and *Meliodogyne* spp. in high concentrations can kill or seriously debilitate young tea.

A green manure crop should be planted in December to control erosion and protect the soil from the high intensity summer rains. At the end of the wet season, usually about April, the cover crop should be disced into the soil and a rough seedbed formed.

The final soil cultivation is best left until the day before planting. The choice of implement to use will depend on the soil texture. A fine, crumbly seedbed should be the result.

In some situations, ground preparation can be different from the method outlined above. The aim, however, is the same and that is to produce a weed-free seedbed.

A standardized procedure should be followed for soil sampling and analysis to determine the fertilizer requirements and to make interpretation of the results meaningful. More is being learnt and recorded all the time on the ability of different soils to make phosphorus unavailable. Professional advice should be sought on the soil sampling technique and interpretation of the results, then finesse can be added to the rough guide outlined:

If the soil phosphorus level is below 30 p.p.m., B.S.E.S. superphosphate should be applied. For every five points below 30 apply 125 kg superphosphate per ha. Potassium may also be required; 80 p.p.m.K is a desirable soil level. For every 25 p.p.m. below 80 p.p.m., apply 125 kg muriate of potash per ha.

Seed

There is more than one way to plant tea. However, in Australia, the best way at present is to plant ungerminated seed direct into the paddock.

Tea seed quickly loses its viability once it is mature, and fresh seed should be planted. If seed has to be kept for 2 to 3 months it should be stored in a cool room.

In order to determine the seed suitable for planting, fresh tea seed should be tipped into a trough of water and the 'floaters' removed. Other seed should be soaked for 1 to 4 days before removal of floaters. It is suggested that the seed for planting be treated in this way shortly before planting takes place. Heavy seed (sinkers) only should be used for planting. Small seed less than 12·5 mm in diameter should be sieved out and planted separately and then only if seed is in short supply. The amount of seed needed to plant 1 ha is 70 kg.

Seed garden

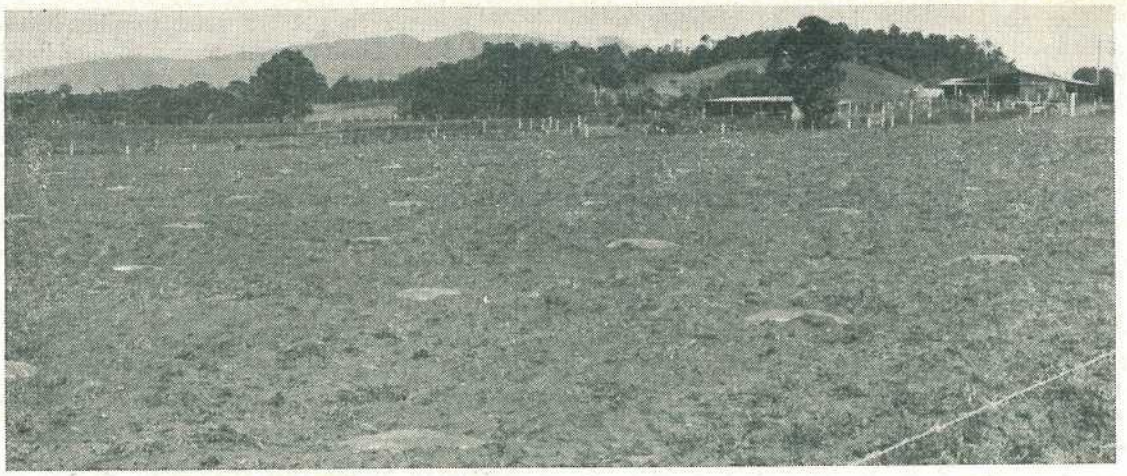
Seed can be imported only from tea growing countries where Blister blight (*Exobasidium vexans*) does not exist. It has become increasingly difficult to get tea seed supplies from Papua New Guinea and much of the seed used in Australia is collected from an estate near Innisfail. Seed production from this estate is sufficient to plant approximately 60 ha per annum.

To ensure a sufficient tea seed supply for plantings in 5 years time, a seed garden should be planted. A seed garden should produce at least 600 kg per ha.

In order to establish the seed garden, the most vigorous seedlings should be taken from the seed nursery when they are 6 to 9 months old. The plants should be spaced 2·25 m apart on a triangular pattern (see figure 1).

The area around the tea plants should be kept free from weeds. Gramoxone spraying is a cheap and effective method for weed control and the inter-row spaces are slashed when necessary.

Seed garden.



Seed garden establishment. Note the polythene circles around the tea seed.

Irrigation

Irrigation is needed to keep the plants growing as fast as possible.

Fertilizing

The fertilizer should be applied in a broad circle around each plant making sure the fertilizer does not come into contact with the plants, otherwise 'scorching' may occur.

The circle of application should be increased yearly until the plants are 5-years-old when the fertilizer is broadcast.

Seed harvesting

A small amount of seed should be harvested in year 5 with annual harvest reaching a maximum in year 10. A well-maintained seed garden should produce seed for at least 30 years.

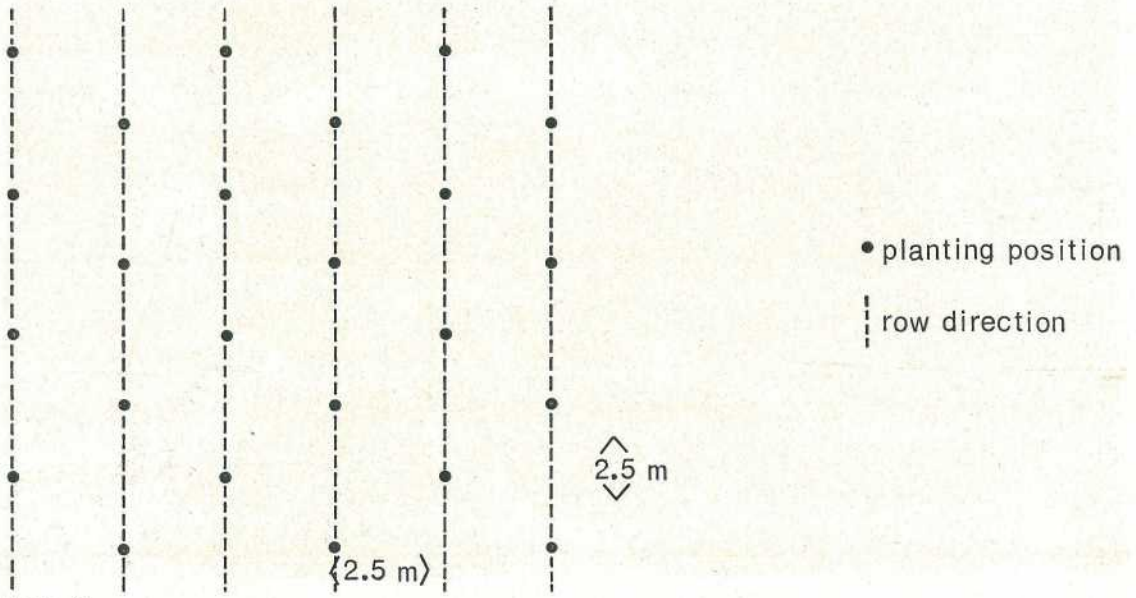


Figure 1.

Field planting

Field plantings should take place from late April to mid June in north Queensland. Earlier plantings are difficult to carry out due to the wet season and the few which have been attempted have been unsuccessful. Later plantings are difficult to establish before the hot, dry spring and the tea seedlings suffer.

In south Queensland and northern New South Wales, field planting times could be different. The aim, however, is the same—that is, to establish tea before adverse weather conditions occur.

Tea is planted 2·5 cm to 5 cm deep in rows either into bare ground or through polythene mulch.

Density and row spacing

A suitable density is 18 150 plants per ha. A twin row planting is suggested. The distance between the centres of adjacent twin rows can vary from 1·8 m to 2·4 m. The twin rows themselves can be 0·45 m to 0·90 m apart.

Tea bushes yield better at the bush centre (radius 0·45 m) than they do at the periphery. Any system which does not allow the bush to develop to a radius of 0·45 m on all sides and which has peripheral branches on some sides is not giving maximum yield for that planting density. An early yield of tea is very important to the economics of tea growing. A quick cover of tea is desirable and this is provided by evenly-spaced tea bushes.

In one experiment, single row centres were spaced 2·4 m apart. It took 5 years to obtain a complete cover of tea and potential tea yields were reduced during this period.

TABLE 5

Tea Yields at 2·4 m Centres, Double Row 0·45 m (plant density = 18 150 p per ha)

	Yield (kg per ha)
Start plucking. First year	1 505
Second year	1 855
Third year	2 424
Fourth year	2 845
Fifth year	3 094

In spite of this, yields were still very good. Whatever system is used, it should fit into the farming plan.

TABLE 4

Fertilizer Rates and Number of Applications

Year	Annual application/ha			No. of applications/yr	Amount of fertilizer per application kg/ha (lbs/ac.)		
	N	P	K		S.O.A.	Super	M.O.P.
1	20	10	10	4	100 (90)	100 (90)	20 (18)
2	40	20	20	4	200 (181)	200 (181)	40 (36)
3	60	20	30	4	300 (271)	200 (181)	60 (54)
4	80	20	30	4	400 (361)	200 (181)	60 (54)
5	100	20	30	4	500 (452)	200 (181)	60 (54)

S.O.A.—Sulphate of ammonia.
Super—Superphosphate.
M.O.P.—Muriate of potash.

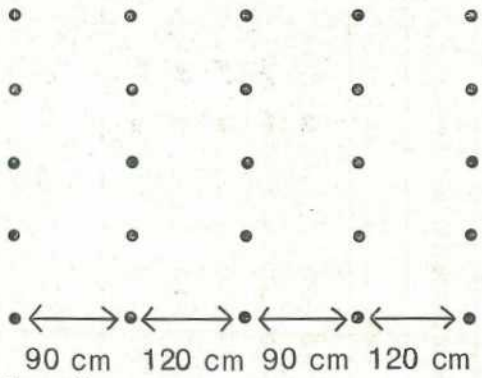


Figure 2.

In figure 2, the 120 cm rows will be the laneways for the harvester. Bush spread is limited to high-yielding centres and while there will be some intra-row competition, the tea forms a quick cover.

SEED PLANTED IN BARE GROUND

Tea seed can be planted by a peanut or maize planter, and either one or a number of planting units can be used on the same toolbar. With one planting unit, 3 ha a day can be planted. The seed should be planted at a planting density of 23 600 per ha. This makes a liberal allowance for a low seed germination in the field.


Tea seed planter.

SEED PLANTED THROUGH POLYTHENE MULCH

Holes 4 to 5 cm in diameter are punched at the required spacing prior to laying down the polythene mulch. Nerada Estate has developed a simple, effective machine for this job. The polythene mulch 0·9 m wide, is split into two strips where the twin rows are more than 0·6 m apart.

The strips to be covered with polythene are lightly rotovated and can be sprayed with diuron at 2·2 kg a.i. per ha if weed growth is expected to be prolific. The polythene mulch is then laid down by machine, and the edges are pressed into the soil and firmed down.

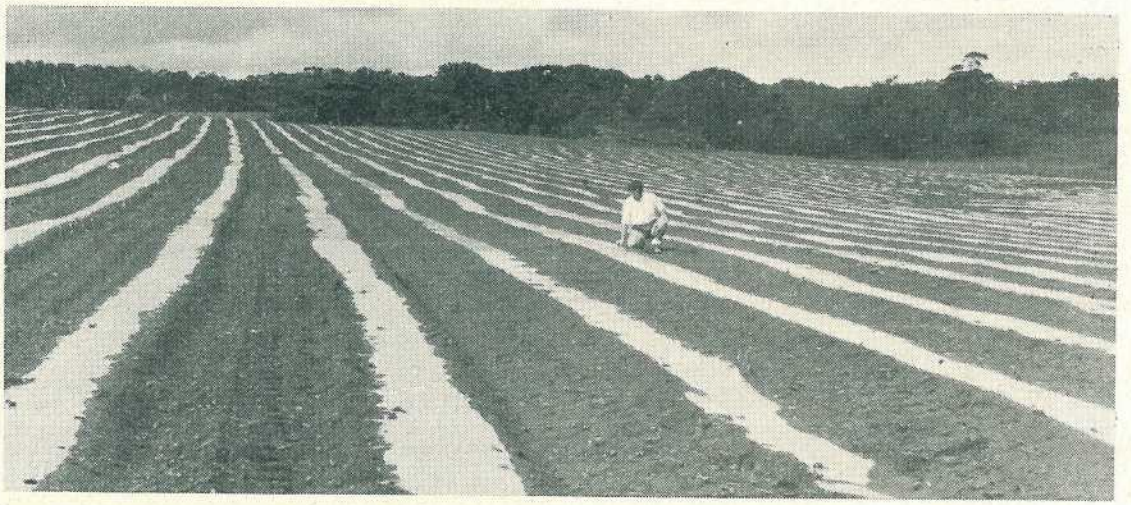
One good seed per hole is planted by hand. A low-wheeled toolbar frame fits on to the three-point linkage of a tractor. Seats are arranged on the frame directly above the planting strip, so that the planters can sit down close to the ground. Four people plus a tractor driver can plant 2 ha a day using this method.

Seed nursery

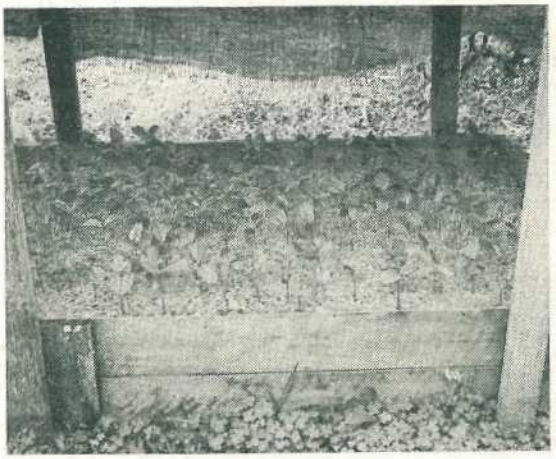
An even stand of tea is necessary for optimum tea production. It is therefore advisable to make provision to supply vacancies in the original planting. This is best done by infilling with plants of similar size to those in the field being supplied.

A nursery should be established at the same time as the field is direct planted to provide the necessary plants. 1 250 seeds should be planted in the nursery per ha of tea planted in the field.

Tea 6-months-old.



Polythene strips.



Tea nursery.

The seed can be planted in beds at 15 cm spacings or planted in polythene tubes 22 cm long by 10 cm diameter. The tubes can be open-ended or closed with perforations in the bottom 5 cm to ensure good drainage.

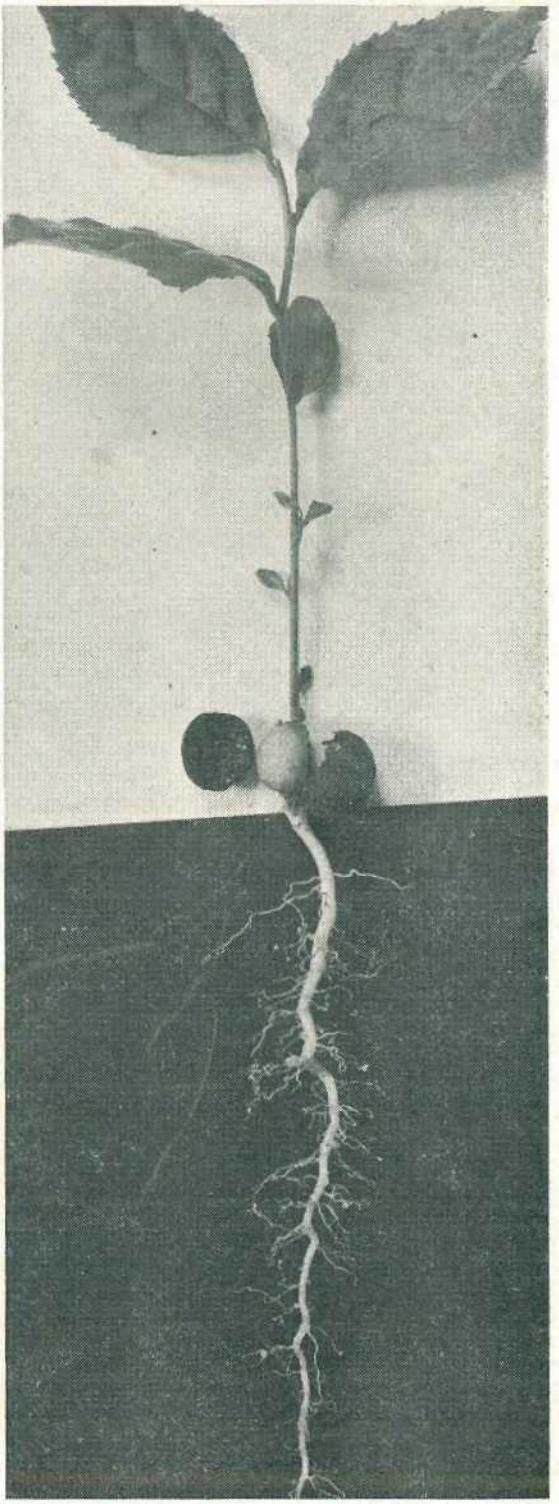
The cheapest method is to plant in beds. This method is preferred provided the seedlings can be dug out with a ball of soil attached to the roots when they are 6 to 12-months-old. The soil must be firm enough to stick to the roots after digging out and at the same time have good drainage properties.

Polythene-tubed seedlings are easier to handle but more expensive. The expense is incurred in filling the tubes, at the rate of 800 per man day.

Watering facilities are necessary to keep up an ample water supply during dry weather. The nursery area can be lightly shaded either by choosing a site in the scrub or by building an overhead shade. Shade is not so important if there is ample water.

Fertilizing

The maxim is a little and often. It is easy to over-fertilize and burn or kill the tea.



Right. A 3-month-old seedling.

Tea and grass in the background.

Fertilizer should be first applied when the seedlings are 10 cm high. A fertilizer mixture is easier to handle than the single nutrient fertilizers because of the small amounts involved.

A suitable mixture is 10.3.3, applied at the rate of 10 g per m^2. The fertilizer should be watered into the soil immediately after application so that any fertilizer on the plants will be washed off before it can 'burn'. The rate can be increased at later applications by increments of 2 g per m^2. It is recommended that fertilizer be applied every 2 months.

Yearly planting area

The area planted each year depends on the particular situation. In smaller commercial plantations, an annual planting of 10 ha could be in keeping with the resources available to the enterprise. As the enterprises become larger, annual plantings may be as large as 400 ha. In these situations, intense planning, high managerial skills and favourable seasonal conditions would be required for success.

From planting to 1-year-old tea

Tea seed may be slow to germinate and many weeks may elapse before emergence is completed.

Plantings in bare soil

Weed control and cover crop. Immediately after planting the tea seed, the area should be band-sprayed with diuron at 2·2 kg a.i. per ha. The rate of diuron can be increased by 30% for heavy soils containing large amounts of organic material.

Band spraying over the planting row to a width of 30 cm is less costly than a blanket spray. Diuron should keep the sprayed area free from weeds for 6 months. Any weeds which appear should be chipped out or sprayed with gramoxone. Weeds should not be allowed to become a problem in the sprayed area or an uncontrollable situation may result.

In the unsprayed areas (inter-rows) carpet grass (*Axonopus affinis*) could be planted. The seed should be cultivated lightly into the soil and the soil then lightly rolled. If the soil is dry, two irrigations 4 days apart should be sufficient to germinate the grass seed. Grass planting is best done any time after the tea planting up to the end of July. The inter-row areas should be mown when necessary as this encourages the grass to spread into a good ground cover.

Tea 4-months-old.

The planted tea strips should be resprayed (diuron/gramoxone, 2·2 kg a.i./ha diuron and 1 250 ml gramoxone in 450 L per ha) in December. Guards should be provided on the spraying equipment to prevent the tea plants from being sprayed. Slight spray drift on to the base of the tea plants will do little damage as the basal stem will have lignified by this time.

By the start of the wet season, the ground cover should be sufficient to stop erosion. The planted tea strips 30 cm wide are still kept weed free by gramoxone spraying and occasionally by chipping. If grasses which are hard to control by gramoxone are present, 2·2 D.P.A. at 5·5 kg per ha followed by gramoxone 10 days later should give good control. 2·2 D.P.A. should be carefully applied and should not be permitted to drift on to young tea.

There have been reports of excellent results being achieved from the application of a blanket spray of glyphosate to prolific growths of weeds covering tea.

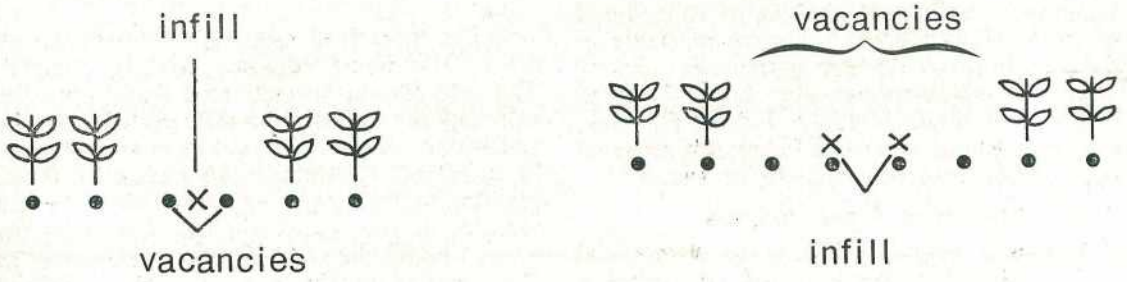


Figure 3.

FERTILIZER. Fertilizer should be applied in December, March and June. 28 kg nitrogen, 11 kg phosphorus, 22 kg potassium and 7 kg per ha magnesium should be applied at each time. A mixture is easier and cheaper to apply than straight nutrients and the fertilizer should be drilled in at a depth of 3 to 9 cm in bands 15 to 23 cm away from the tea rows.

PLANTED THROUGH POLYTHENE MULCH

WEED CONTROL AND COVER CROP. A major benefit of polythene mulch is that weeds are easier to manage than they are in the bare soil planting method. Weeds which grow through the planting holes should be removed when they are small if this job is not to assume mammoth proportions.

Carpet grass should be planted in the inter-rows using the method outlined.

FERTILIZER. Fertilizer should be applied in June.

The tea roots are not sufficiently developed to make use of fertilizer applied at the side of the polythene strip until they are about 1-year-old. Thereafter, the method and rate of application are the same as for tea planted in bare ground.

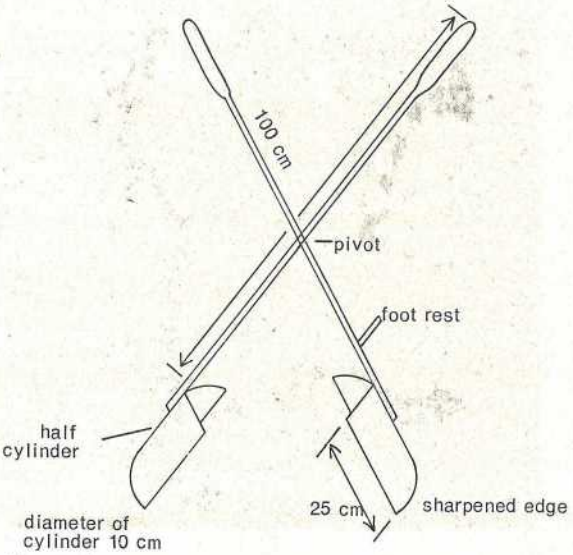


Figure 4.

A foliar fertilizer spray can be used to get nutrients to the tea plants. This spray should be applied directly over the tea rows.

BOTH PLANTING METHODS

INFILLING. Usually it is not necessary to fill single vacancies as the plants on either side will grow over the vacant area and there should be little loss of yield. Where there is a number of consecutive vacancies these should be infilled.

INFILL METHOD. If there are two vacancies, plant one seedling in the middle of the vacant strip. If there are three or more vacancies, plant them all except the end ones. See figure 3.

Successful infilling depends on many factors. Careful handling of seedlings is needed at all stages to avoid losses.

A simple piece of equipment which operates on the same principle as a pair of scissors can both dig the plants out and also make planting holes. See figure 4.

The cylinder is closed and inserted over the plant to a depth of 25 cm. The plant and a cylinder of soil are then withdrawn, and a ball of soil will remain attached to the tea roots.

The weather at planting and immediately following planting plays an important role. Infilling during dry, hot weather is frequently unsuccessful and irrigation is not the complete answer. Wet, overcast weather is ideal for infilling. This job is therefore best left until the wet season.

IRRIGATION. This is necessary only in the spring months on newly-planted tea. Seasonal conditions may turn out to be sufficiently favourable but it would be unfortunate if all the time and effort spent on planting were to be wasted because irrigation was not available in a dry spring.

An irrigation system should be capable of applying 25 mm of water per week to the young, newly-planted tea.

Irrigation water may be applied through overhead sprays with movable pipelines or by travelling irrigators. The travelling irrigator is more costly but requires less labour than the overhead spray system. The choice of irrigation system will depend on individual circumstances.

Tea 1-year-old.

PRUNING. This induces the tea to branch and form more potential plucking points which have a direct effect on yield.

Tea is first pruned when the plants are at least 15 cm high which is usually 6 to 9 months after planting. A reciprocating blade similar to a mower blade in design and action is tractor mounted and positioned to cut the seedlings at 10 cm. If there are no leaves below 10 cm, the cutting height should be raised until the remaining stem has at least two leaves. It should be remembered that the leaves are the factories of the plant. A young plant has limited food reserves and cannot afford to be completely stripped of leaves.

When the regrowth is 7·5 cm above the last pruning mark, 2·5 cm is again pruned off. This process continues until the tea is ready for plucking.

Tea 1 to 2-years-old

Management should now be routine. Pruning is continued at intervals and the tea hedge begins to take shape.

Weed control is less demanding as the tea grows and shades out the weeds. Grass cutting becomes less frequent due to the spread of the tea bushes. Herbicides can still be used, if necessary, but care should be taken to ensure that there is a 6-month interval between diuron applications.

FERTILIZER

Fertilizer should be applied in September, December, March and June.

The fertilizer is drilled in using the same method as for young tea. The rates per application in kg per ha are:

Nitrogen	Phosphorus	Potassium	Magnesium
33	7	14	4

Tea 2 to 3-years-old

After 2 years, the pruning system will have produced tea hedges 40 cm high and plucking can begin in spring when the tea is 2½-years-old.

Field operations excluding leaf harvesting and fertilizing are now minimal. Occasionally, some weed control may be necessary.

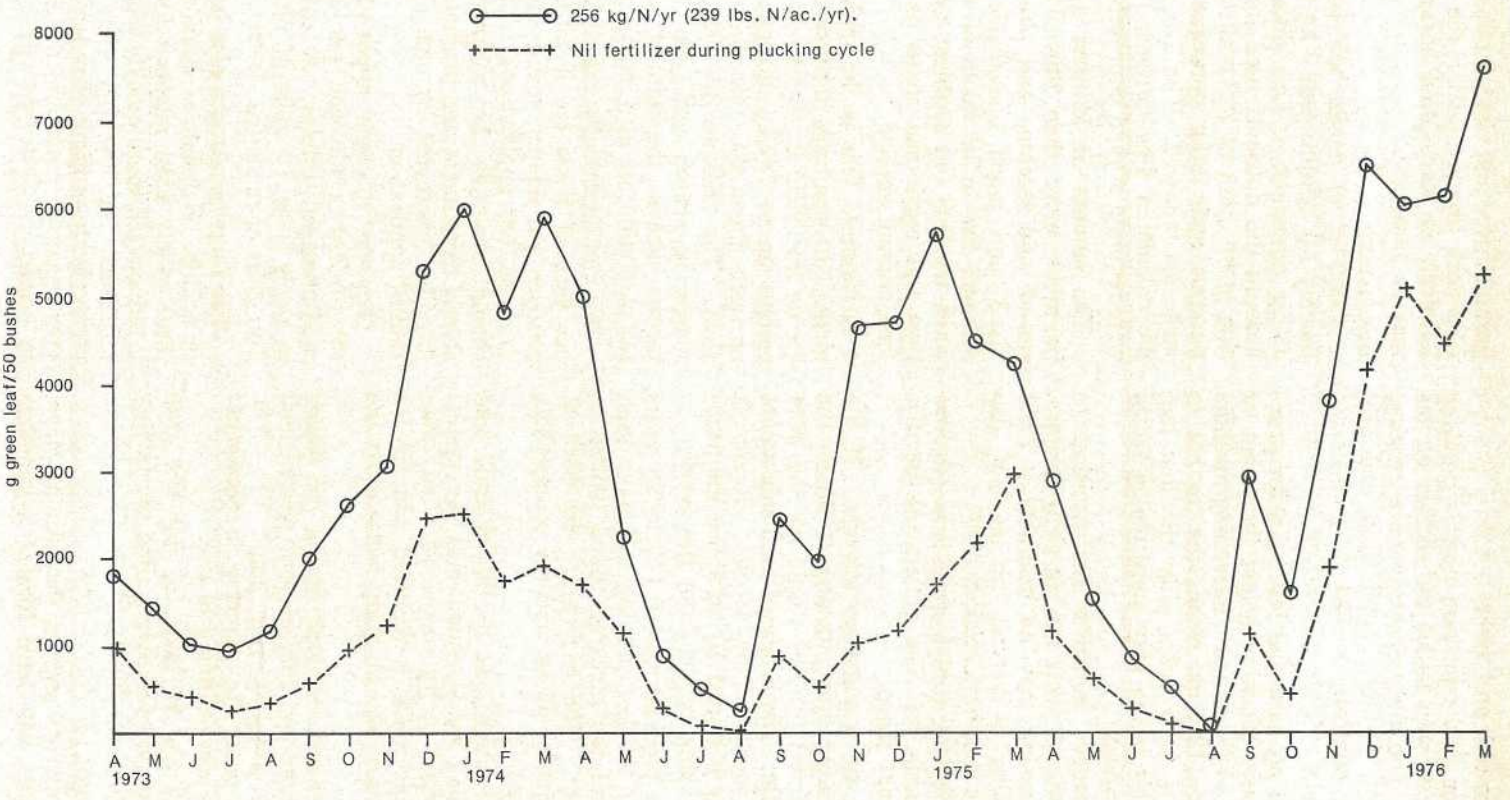
FERTILIZING

Fertilizer should be applied in August, November, February and May. The rates per application kg per ha are:

Nitrogen	Phosphorus	Potassium
40	7	14

Fertilizing has been brought forward 1 month to coincide with early spring growth in August and late autumn growth in May. This will extend the harvesting season. See graph 1.

A pruned tea field.


256 kg/N/yr (239 lbs. N/ac./yr).
Nil fertilizer during plucking cycle
g green leaf/50 bushes
8000
7000
6000
5000
4000
3000
2000
1000
A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M
1973
1974
1975
1976

Graph 1.

Tea 3-years-old and over

The major field operation now is plucking which is dealt with under the section on tea harvesting. The other operations are pruning, weed control, fertilizer application and pest and disease control.

PRUNING

There are no hard and fast rules for pruning. A yearly plucking height increment of 12·5 cm to 17·5 cm and a harvesting machine clearance of 112·5 cm means the tea has to be pruned 4 to 5 years after the first leaf harvest. This is the only constraining factor affecting pruning.

Yield changes influence the decision to prune. If after 3 years the tea yield declines, an early pruning may be desirable. Yield and the ability to harvest the tea leaf also influence the pruning decision.

A disc revolving at high speed is an effective way of pruning tea. The cutters on the disc should be kept sharp.

EXAMPLE OF A PRUNING SYSTEM. If the tea was brought into plucking at 50 cm the first post harvest pruning would cut the bush back to 40 cm. The height of each subsequent pruning is increased by 10 cm. Regrowth after pruning is tipped 10 cm above the pruning and plucking begins from this level.

After five plucking cycles (20 to 25 years in plucking) the last pruning will have been at 70 cm and the plucking round limited to 2 to 3 years. The bushes are cut back at the next prune to 45 cm and the prune/pluck cycle starts again.

There are variations to this method and annual skiffing incorporated into the system has advantages. A little more (2·5 cm) than the yearly increment is removed and the tea is brought back into plucking 5 cm above the skiff level.

Pruning should be done during the winter months of June and July in north Queensland when yields are low (see graph 1). The tea will be ready for plucking in September when yields are beginning to rise.

Advantage can be taken of this low crop production period for overhauling the factory and harvesting machinery.

WEED CONTROL

By the time tea reaches the pruning stage, the tea bushes will have formed a complete ground cover and shaded out all but the most persistent weeds. After the tea is pruned, however, an occasional spraying or mowing may be necessary.

FERTILIZER

1 000 kg of made tea contains approximately 50 kg nitrogen, 4 kg phosphorus and 17 kg potassium. This does not take into account the nutrients used for wood production in the bush of 25 kg nitrogen, 4 kg phosphorous and 19 kg potassium per tonne of made tea removed. The Tea Research Institute calculated 8 kg nitrogen per 100 kg crop were required if yield improvement was sought.

The amount of fertilizer applied needs to be much more than this. Losses occur by run-off and leaching and phosphorus can be 'fixed' and made unavailable to the plant. Account has to be taken of all these factors when working out fertilizer applications. Soil type and nutritional status also influence the final amount applied.

NITROGEN. This is the major fertilizer element. Nitrogen trials in north Queensland have shown that yield increases with nitrogen applications up to 182 kg nitrogen per ha. Extra nitrogen above this rate did not increase the yield. The response to nitrogen varies from season to season and year to year. Other factors such as the cultural conditions of the tea plantation are also important.

We can confidently expect 2 200 kg per ha per year of made tea if nitrogen at 182 kg nitrogen per ha per year is applied split into three or four applications. Although this rate should generally be adequate, the farmer should experiment and evaluate yield and profitability differences by changing the nitrogen rate of application.

Overseas nitrogen applications vary from 90 to 290 kg nitrogen per ha per year on well-managed estates. A rule of thumb is to apply 8 to 10 units of nitrogen for every 100 units of made tea.

The form of nitrogen also influences soil pH or acidity. Sulphate of ammonia has been the most widely used nitrogen fertilizer although it reduces pH more quickly than other nitrogen fertilizers. A low pH (less than 4·5) is conducive to nutrient disorders and deficiencies (for example, potassium deficiency) are likely to occur.

An experimental harvester.

Urea can be used instead of sulphate of ammonia if the pH is low. The urea should either be placed in the soil or watered in if applied on the soil surface in order to reduce the nitrogen loss to the atmosphere. Sulphate of ammonia does not lose nitrogen in this manner.

PHOSPHORUS. No yield response to phosphorus has been recorded in tea in North Queensland. World-wide, the response varies from place to place and usually take a number of years to appear.

In the absence of any conclusive data to date, a maintenance level of phosphorus is recommended (for example, 14·8 kg phosphorous per ha per year). If potassium levels are low or the soil is very acid, it is preferable to use ammonium phosphate instead of single superphosphate.

POTASSIUM. This has a beneficial effect on the quality of made tea. Trial results on the response of tea yields to potassium have not yet given any clear cut answer. Long term experiments elsewhere have shown some response to potassium and a maintenance level is recommended (37·9 kg potassium per ha per year).

MINOR AND TRACE ELEMENTS. Deficiencies of minor or trace elements will produce visible symptoms in the plant. When these symptoms appear, the appropriate trace element should be applied.

Yields

Tea yields increase for several years from the first harvest and then tend to reach a plateau.

Plucking starts when the tea is 2½-years-old. Yields which may be expected in north Queensland are:

Year	Experimental (N.Q.) kg/ha	Commercial Estate kg/ha
1	1 500	800
2	1 850	1 200
3	2 400	1 600
4	2 850	2 000
5	3 100	2 000
6	3 000–4 000	2 000
7	3 000–4 000	2 000
8	3 000–4 000	2 000
9	3 000–4 000	2 000

The experimental yields have been heavily discounted in calculating anticipated commercial yields. This conservative move should cover crop losses due to farmer inexperience, poor seasonal conditions, etc.

Some of the tea growing areas in Africa are averaging more than 2 000 kg per ha of made tea under less than ideal conditions. From June 1977 to June 1978, Nerada Estate in north Queensland also achieved more than 2 000 kg per ha of made tea.

Irrigation has a beneficial effect on tea yield during hot, dry weather but may reduce the quality of made tea. Also, distribution of leaf is more uniform under irrigated conditions and this facilitates field and factory operations.

At South Johnstone, irrigation is estimated to increase crop yield by an average of 500 kg per ha per year above a nil irrigation yield of 3 000 kg per ha per year. In one particularly dry year, the yield increase was 1 000 kg per ha.

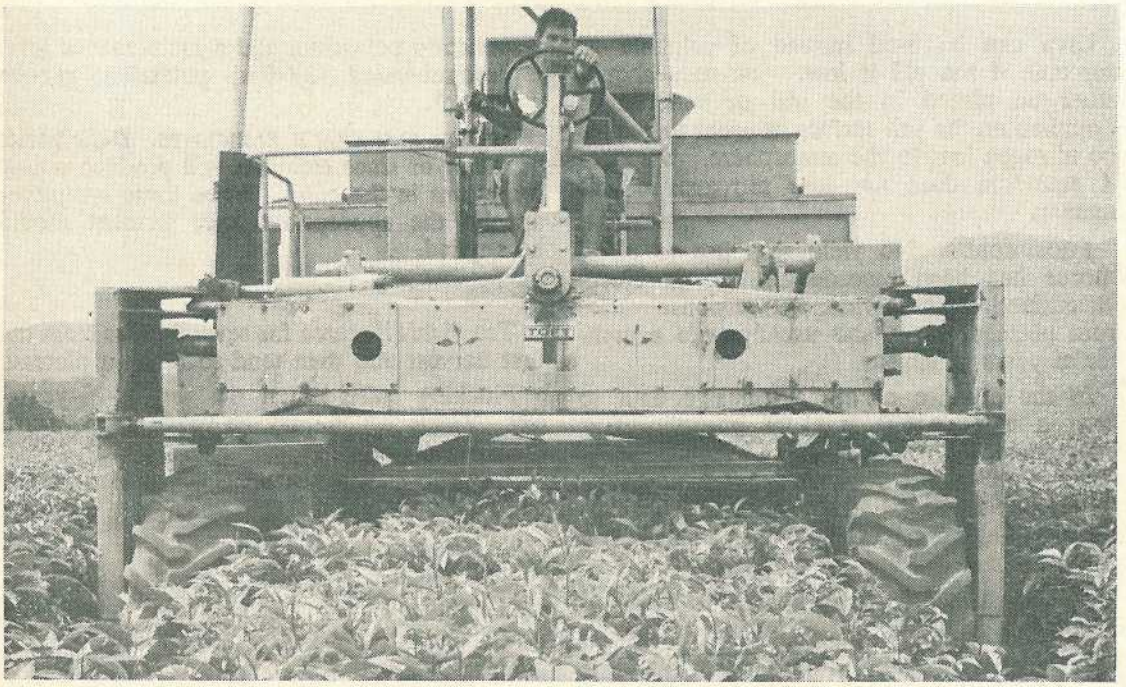
Pests and diseases

These have caused no problems to date, but Australia has a wide range of pests and diseases which can attack tea. Chemical and cultural control methods available are capable of dealing with the recognised tea pests and diseases.

Tea harvesting

Harvesting and plucking are synonymous. Harvesting requires the most skill and precision of all field operations. Poor harvesting limits yield, and the qaulity of made tea. The plucking height is raised by 6 to 12 mm at each plucking by adjusting the plucking head on the tea harvester.

Rows are plucked the same way at each harvest. The effect of uneven ground on the plucking height at any position does not then vary between plucking rounds and good leaf can be harvested.



A tea harvester.

The decision on the standard of plucking to adopt is one which should be influenced by market requirements, cost of manufacture, factory space, manufacturing capabilities, and price (that is, overall profitability).

Fine plucking implies leaf consisting mainly of two leaves and a terminal bud. This type of leaf is of good quality and contains little stalk and coarse leaf. It is, therefore, capable of being evenly withered and its chemical constituents are such that good quality teas can be manufactured from it. There is, however, the possibility that yield will be reduced if too much immature bud is removed from the bush during the harvesting operation. In a mechanical plucking situation, the optimum point at which to harvest will be determined by trial and error on individual plantations.

Coarse plucking implies leaf consisting mainly of three leaves and a terminal bud. This type of leaf contains more stalk and coarse leaf and it is difficult to wither evenly. The chemical constituents of the leaf are not in the proper proportions for the production of good quality teas. There is, however, less chance of removing immature buds and reducing yields. More stalk and fibre will require to be removed from the made teas.

Individual plantation managers will have to decide which plucking method will be most applicable to their plantations in order to obtain the best possible profit.

Tea manufacturing

Biochemical and physical changes take place immediately the green leaf is plucked. The secret of tea manufacture is to control and manipulate these processes so that the full potential of the leaf is realised in the made tea.

It is difficult, although not impossible, to control these processes in the field and in transit to the factory. Tea leaf should generally be in the factory within 4 hours of being plucked. Plucked leaf stored in the field must be shaded and spread no thicker than 30 cm to permit free movement of air through it. In transit, the plucked leaf should be loosely packed to permit free air movement. Where transit times are extended, special provisions such as smaller loads or sophisticated tray packing systems should be made to reduce compaction and permit free air movement.

Tea factories are of nearly as many designs as there are tea plantations. Any factory in Australia must be designed to minimize labour requirements. This is done by a flow-through system where the tea is carried by conveyor from one process to the next.

Briefly, what happens to the plucked leaf is:

- The tea is withered—loses water.
- The tea is crushed, torn and cut—rotovane and C.T.C.
- Fermented—major chemical changes—endless belt fermenter.
- Dried—chemical and biochemical changes stopped dramatically by heat and removal of moisture—drier.
- Graded—reciprocating sifter with different sized sieves.
- Cleaned—removal of fibre and stalk.

Withering

Tea leaf is spread evenly in withering troughs. A good even wither is obtained when the depth of leaf does not exceed 25 cm. Temperature and air flow through the leaf are controlled to give the required wither. In a 'hard' wither the moisture content of the withered leaf is about 50%, in a soft wither it is about 60%.

The normal period taken to achieve a satisfactory wither is from 16 to 24 hours depending on atmospheric conditions. Withering temperatures exceeding 28° C may have a detrimental effect on the quality of the made tea. At the start of withering, the tea leaf is turgid, at the end it is flaccid. As well as the removal of water, chemical changes take place in the leaf during withering.

Rotovane/crushing, tearing, cutting machine (C.T.C.)

This is one of a number of methods of treating tea leaf. Leaf is fed into the rotovane by conveyor, and from the rotovane to the C.T.C. by conveyor. It also leaves the C.T.C. on a conveyor.

The rotovane/C.T.C. machines crush, tear and cut the leaf. The colour of the tea leaf changes to a dull green. Chemical and biochemical changes now proceed at an accelerated rate.

Fermenter

The tea leaf is passed through a ball breaker and fed on to the endless belt fermenter. The thickness of spread, length of time on the fermenter, temperature and humidity are all under the operator's control. The most important chemical change is the oxidation of the polyphenols. The art of tea making is knowing when to stop this process when the optimum amount of oxidation has taken place. Insufficient oxidation produces light coloured liquor while too much oxidation produces dull liquors.

At a temperature of 25° C the fermentation period may be 2 to 2½ hours. The tea leaf is a bright coppery-brown colour when fermentation is complete.

Drier

The tea leaf is fed directly into the drier. The aim is to reduce the moisture content of the tea to 2 to 4%.

Hot air is used for drying. The inlet temperature varies according to the type of manufacture but as a rule of thumb, the temperature should be in the range of 82 to 90° C. The exhaust temperature is 49 to 54° C.

These temperatures can be maintained by adjusting the amount of heat input, the rate of air flow, the depth of the leaf, and the tray speed. A drying time of 20 to 25 minutes should produce tea which is neither stewed (too slow removal of water) or baked (too high a temperature).

There are many variations on the finer points of drying tea leaf and these are worked out by trial and error on each plantation.

Sieving or grading

Tea leaf from the drier consists of small pieces of tea stalk as well as different sized pieces of leaf. The aim of grading is to separate the pieces of leaf into grades of even sizes and remove as much of the stalk as possible.

The tea leaf from the drier is passed over a bank of reciprocating sieves of different meshes. The mesh sizes are determined by the grades of tea it is planned to make. The first sieve has a large mesh to separate over-size tea which is cut or crushed and re-sieved.

The area of the sieve and the type of mesh used are of importance in selecting mesh sizes. A large sieving surface requires a smaller mesh than a smaller sieving surface to extract tea of a particular size. A flat-punched aluminium sieve, which presents little resistance to the passage of the tea, requires a larger mesh than a wire sieve to extract tea of the same size.

Large stalks can usually be removed in the first large meshed sieve if care is taken not to crush the stalks during the crushing of the over-sized leaf.

Smaller stalks can be removed by passing the tea leaf through an electrostatic stalk extractor. The charge on the extractor attracts the stalks but not the tea. These machines work best when the tea being passed through them is even in size.

The teas forming a grade are then carefully bulked and packed for despatch.

Marketing

Australian consumption is 27 to 29 million kg per annum and this extensive market is open to local producers. In the event of Australian production exceeding Australian consumption the surplus would need to be placed on the world market in competition with other tea-producing countries. The industry at present is a long way from supplying the Australian requirement.

Tea blenders in Australia have assessed Australian teas for over 20 years. They are comparable with medium-grown imported teas and should find a ready market. The tea can be sold to established tea merchants who will use it in their tea blends. The bulk of the world's tea is sold in this way.

Australian made teas can also be sold direct to normal retail outlets but this side of the tea enterprise requires business skills rather than farming skills for its success.

Machinery

The Australian tea enterprise has been developed as a mechanized undertaking and no mechanization problems of significance remain to be solved.

Further reading

Annual Technical Reports. Tea Research Institute of Sri Lanka. St. Coombs, Talawakele, Sri Lanka.

The Tea Quarterly. Tea Research Institute of Sri Lanka. St. Coombs, Talawakele, Sri Lanka.

Two and a bud. Tea Research Association, Tocklai Experimental Station, Jorhat. 785008, Assam.

Annual Scientific Report. Tea Research Association, Tocklai Experimental Station, Jorhat. 785008, Assam.

Eden, T. (1965)—Tea. Longmans, Green and Co. Ltd. 48 Grosvenor Street, London, W.1.

Hobman, F. R. and Nimmo, R. G. (1972)—Economics of Tea Growing. Queensland Agricultural Journal, April.

Hobman, F. R. (1973)—Tea Growing. Queensland Agricultural Journal, May.

Quarterly Newsletter No. 47 July 1977, The Tea Research Foundation of Central Africa.

Tea Growers Handbook 1969. Tea Research Institute of East Africa.

Rutherglen bug control in sunflowers

by R. H. Broadley and P. D. Rossiter, Entomology Branch.

TWO species of almost identical appearance, the Rutherglen bug and the grey cluster bug, are major sunflower pests.

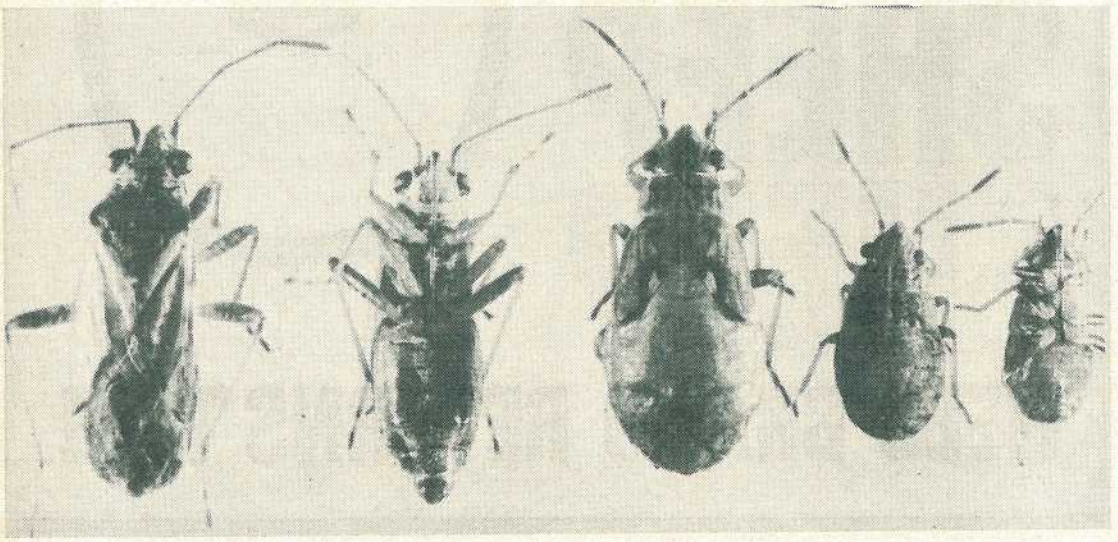
As Rutherglen bug is normally the dominant pest in south Queensland, especially during the critical maturation periods of early planted crops, it alone will be referred to in this article. However, information on control will generally be equally applicable to both species.

The 1978-79 season saw unusually high populations damage early-planted sunflower crops on the Darling Downs and in the Fassifern Valley, areas where Rutherglen bugs are usually only sporadically active. Diminishing soil moisture levels aggravated the dehydrating effects of the bugs in some districts. The most likely reason for the build-up in Rutherglen bug populations was abundant rainfall in late winter-early spring, which promoted weed growth. These weeds were probably utilized as breeding sites for the bugs, which subsequently moved into sunflower crops.

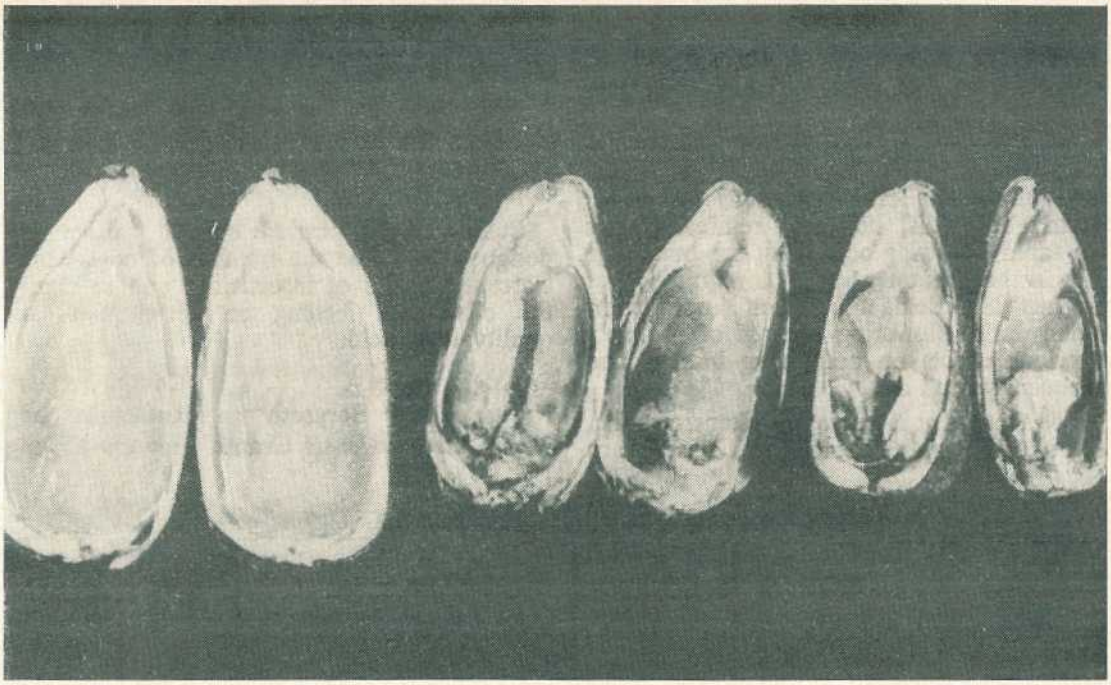
Life cycle

The Rutherglen bug passes through the egg, nymphal (juvenile), and adult stages. Nymphs resemble the adult in general appearance, but differ from them in that they do not possess wings, are not capable of breeding, are pear-shaped and are often reddish in colour. Nymphs feed in the same manner as the adults, by inserting tube-like sucking mouthparts into the plant. The life cycle at 30°C, from egg to egg, can be completed in about 22 days. Thus this pest can breed-up very rapidly.

It is important to realize that seeds or flowers are a requirement for breeding in Rutherglen bugs. This explains why young bugs are rarely found on plants prior to termination of flowering, and commencement of seed development.



Adult and juvenile Rutherglen bugs. Note the absence of fully-formed wings and the pear shape of the three juveniles on the right of the picture.



Sectioned sunflower seeds damaged by Rutherglen bug feeding. Note shrivelling of the endosperm and growth of secondary rot organisms. The seed on the left has not been damaged by Rutherglen bug.

The typical pattern of Rutherglen bug infestation in a sunflower crop is as follows. Up to bud formation small numbers of adult bugs are present in the crop. At budding, a dramatic increase in adult bug populations occurs, and these usually reach a peak about the end of the flowering period. Breeding takes place thereafter, with small, white, sausage-shaped eggs being deposited between seeds and dead flowers. Nymphs hatch from these eggs, and feed on the exposed, upper sections (broad end) of the seeds. Both nymphs and adults can be found simultaneously on the plants at this stage, and nymphs are capable of completing their development on seed alone.

It is common to record high bug populations in maturing heads—40 adult bugs per plant at completion of flowering can give rise to about 1 200 nymphs per plant near harvesting.

An important characteristic of Rutherglen bugs is the ability of adults to disperse from crop to crop. This is probably a result of their adaptation to annual weed hosts. For example, as the weeds 'dry off' the bugs are forced to move to other hosts. Migration out of a sunflower crop usually involves sexually immature females. It can occur in drying crops or green crops, and by night or day. Mature females and males are also capable of short distance flights, therefore a sprayed crop can rapidly be reinfested by adult bugs.

Damage

Damage is possible at any stage during sunflower crop growth, but the critical periods are at budding and after seed formation. Rutherglen bugs congregate on the upper stems at budding, and if populations are high enough, can cause collapse of the head. This is most common in rain-grown crops which are subject to moisture stress. The other problem period occurs when large numbers of adults and nymphs feed on the seed. Yield, oil quality and germination can be affected.

Control

Insecticides recommended for control of Rutherglen and grey cluster bug in sunflowers are shown in table 1.

For best results, applications should be made when excessive populations are experienced during the critical periods discussed. Despite good kills, however, reinfestation is often rapid following control at the bud stage and a further treatment may be required after flowering. Insecticide application is not recommended during flowering because of probable deleterious effects on pollinating insects, and consequently seed set.

When treatment is necessary after flowering, it should be applied before the heads turn down. Trials during 1978–79 demonstrated that pest kills during that stage are most difficult to obtain.

Any delay in treating infestations after flowering increases the possibility that seed germination, oil quality and yield may be impaired.

Studies being carried out at present are designed to define the number of bugs which warrant the use of insecticides and to clarify the effects of feeding on germination, oil quality and yield.

Scientific name	*Common name*
Nysius vinitor Bergroth	Rutherglen bug
Nysius clevelandensis Evans	grey cluster bug

TABLE 1

INSECTICIDES FOR CONTROL OF RUTHERGLEN AND GREY CLUSTER BUGS

Insecticide	Some Trade Names	Rate (Active Ingredient) per Hectare)	Amount Product (per Hectare)	Withholding Period (Days)	Approximate Costs (per Hectare) ** (Aug. 1979)
Maldison U.L.V.*	Malathion U.L.V.*	..	450 ml of 118% product ..	1	$2.58
Methidathion ..	Supracide ..	400 g	1·0 litre of 40% product ..	3	$9.70
Endosulfan ..	Thiodan .. .. Endosan Endosulfan	750 g	2·1 litres of 35% product ..	28	$14.32

* Apply from aircraft only.

** Aerial application costs must be added to this total.

External teaching of farm management at UNE

STARTING in 1981, the University of New England will offer courses in farm management to students enrolled externally in the University.

The UNE's Department of Agricultural Economics and Business Management will teach the courses.

The head of the Department, Associate Professor Brian Hardaker, said: 'In the light of experience gained in external teaching, the Department has now decided to offer its introductory farm management course, Farm Management A, to external students, starting in 1981. More advanced courses may be available later.'

The chief market for the course is expected to be students enrolled externally in the postgraduate Diploma in Agricultural Economics.

Because of the applied orientation of Farm Management A, admission to the course will be confined to students who have agricultural backgrounds and who have access to commercial farms that can be used for case studies related to the course.

Further information about the Department's external teaching programme, including the farm management component, can be obtained by contacting Associate Professor Brian Hardaker, Head, Department of Agricultural Economics, University of New England, 2351.

Causes of lamb deaths and some practical ways of reducing them

NUMEROUS studies and observations on lamb survival have reported the magnitude of lamb losses and stages in the reproduction cycle where these losses occur.

Continued low lamb-marking percentages in recent years suggest that the sheep industry is still in need of practical solutions to improve reproduction efficiency.

The studies reported in this article were carried out at the Toorak Research Station in north-west Queensland over the past 5 years. Constraints were placed on the design of experiments to mimic on-property situations to ensure that the results obtained could easily be integrated into existing management practices.

It is understood that management changes or strategies to improve lamb survival can be more easily undertaken on some properties than on others. Also, in some cases, property resources which could increase reproduction efficiency have already been fully exploited.

The following studies are set out as experiments. Results relating to heat stress are applicable not only to the north-west tropics but also to the shadeless areas of the central and south-west. Nutrition and husbandry factors relate to the whole of the sheep industry throughout Queensland.

by R. G. A. Stephenson, J. C. Edwards and M. S. Pratt, Sheep and Wool Branch.

Experiment 1

Effects of Heat Stress on Foetal Development and Lamb Birth Weight

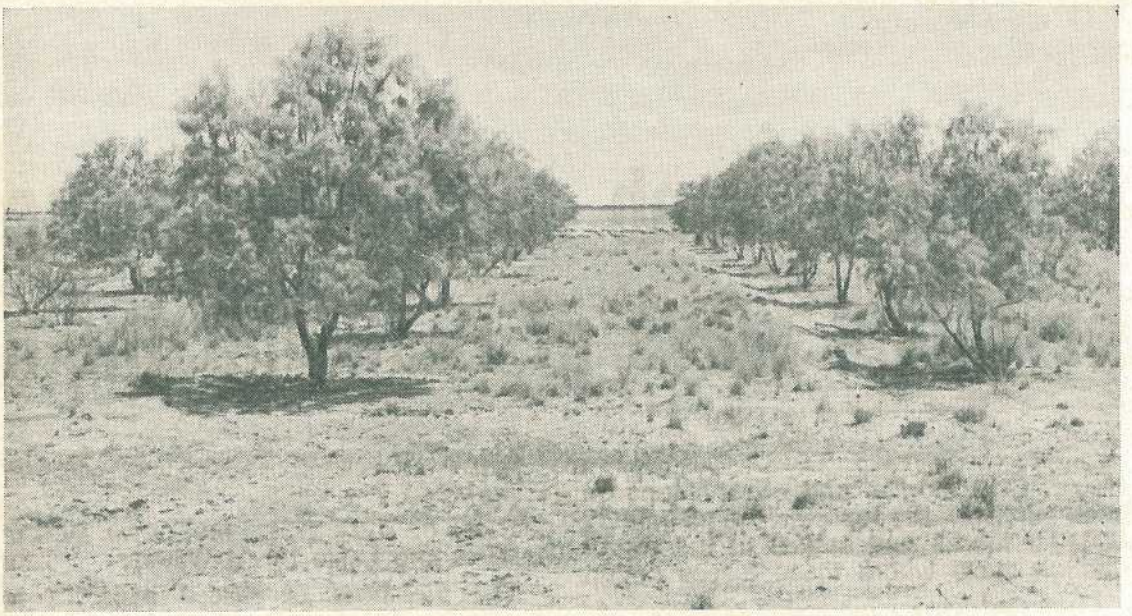
The usefulness of shaded paddocks to prevent foetal retardation and the birth of lightweight lambs was tested in a number of paddock studies. In the first study, ewes were joined in a naturally shaded creek paddock for 3 weeks in October. Immediately after joining, the group was divided equally. One-half was placed in an adjacent treeless paddock and the remainder kept in the shaded paddock.

The weights of unborn lambs were recorded at 10 weeks of age from representative ewes in each mob. The remaining ewes subsequently lambed and birth weights were recorded.

A second group of ewes was joined during winter. Half of the group was exposed to heat stress (unshaded conditions) for 5 weeks before lambing in early summer while the remaining half suffered no heat stress.

Where natural shade is not available, the usefulness of propagating shade trees was tested. An Athel pine plot of 60 trees was planted in 1975. In the last 3 years, ewes were joined and subsequently lambed in the paddock with the tree plot. Lamb survival was compared with a similar group of ewes lambing in an unshaded adjacent paddock.

The results shown in table 1 indicate the differences which can occur between unshaded and shaded groups. They demonstrate the vulnerability of the unborn lamb when the ewe is exposed to high ambient temperatures during any period of pregnancy.



A glen of 5-year-old Athel pines planted to provide shade for sheep.

TABLE 1

EFFECTS OF HEAT STRESS ON FOETAL DEVELOPMENT AND LAMB BIRTH WEIGHT

Attribute	Group	
	Unshaded ewes	Shaded ewes
Heat stress in early pregnancy—		
Foetal weight at 10 weeks (g)	38	47
Lamb birth weight (kg)	2·58	2.73
Heat stress in late pregnancy—		
Lamb birth weight (kg)	2·50	3·00
Lamb survival (%)	55	67

Note: One 4 to 8 m tree can shade 50 to 100 sheep.

These results suggest that shaded paddocks should be provided for pregnant ewes. The value of the Athel pine plot at 'Toorak' is well demonstrated by the survival rate differences between the groups.

Experiment 2

EFFECTS OF BIRTH WEIGHT AND AMBIENT TEMPERATURE ON LAMB SURVIVAL

This report describes the results of ewes' lambing in unshaded pens when two distinct periods of maximum ambient temperature occurred consecutively. The effect of lamb birth weight and ambient temperature on the survival rate of 51 pen-born lambs was recorded during a period of moderate (mean 28°C) and a period of high (mean 36°C) ambient temperatures.

Most ewes were observed to lamb during the early morning. Lambs were exposed to shadeless conditions immediately after birth. Table 2 shows the difference in birth weight between survivors and non-survivors.

TABLE 2

THE EFFECTS OF BIRTH WEIGHT AND AMBIENT TEMPERATURES ON LAMB SURVIVAL

Attribute	Ambient temperature period	
	Moderate (28°C)	High (36°C)
Survivors—		
Birth weight (kg)	3·19	3·14
Number	21	17
Non-survivors—		
Birth weight (kg)	2·54	2·56
Number	4	9

Small lambs were observed to be less effective in their teat-seeking ability. This was measured by the time taken to reach the udder, and the time taken to effectively suck milk. The lambs' ability to feed had obviously been further affected by ambient temperatures. This experiment and experiment 1 demonstrate the wisdom of using paddocks containing natural shade or propagated shade trees for pregnant ewes and new-born lambs.

Experiment 3

UREA SUPPLEMENTATION FOR EWES LAMBING ON DRY PASTURES

Results reported in this experiment are based on trials carried out over a number of years. Initial work was conducted in pens where lambing ewes could be closely monitored. Four paddock experiments were subsequently conducted.

Urea supplementation increases milk production of ewes grazing poor pasture. Benefits arising from this principle are an increase in lamb growth rate (80 to 100%) because of increased milk intake, and a consequent increase in lamb survival (10 to 25%).

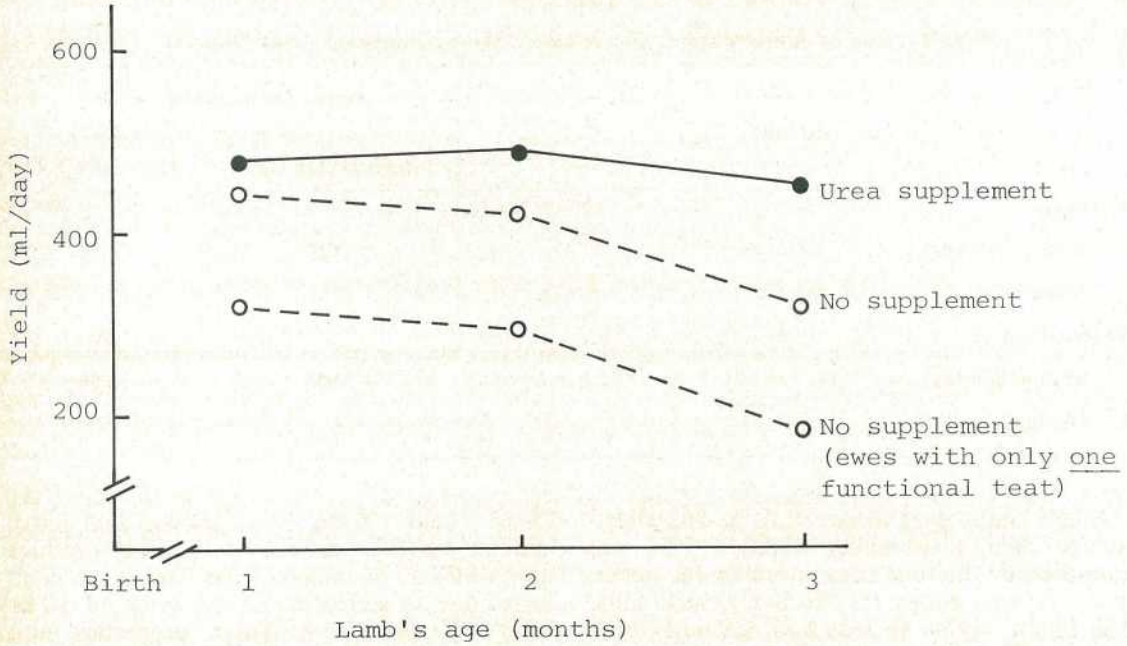
GENERAL DESCRIPTION

The nutrition of lambing ewes is an important factor affecting lamb-marking percentages. Protein and energy requirements for optimum milk production cannot be met when ewes are lambing on dry pastures. In general, pregnant ewes not gaining weight prior to lambing have poor milk yields and large lamb losses occur. Data have shown that ewes lambing on dry pastures at 'Toorak' produce only 400 mL of milk per day and incur lamb losses due to starvation in the order of 10 to 30%. Results from mulga properties also reveal inadequate milk yields.

Urea (45% nitrogen) supplemented to pregnant ewes in store condition will markedly improve milk production (figure 1). The consequent improvement in lamb growth rate and survival is directly related to the increased milk production (figure 2).

Tropical sheep usually graze dry feed during winter and spring. Dry seasons or ineffective rain which can spoil standing pasture also occur periodically elsewhere in the State. These conditions can result in catastrophic ewe and lamb losses. It is in these situations that urea supplementation is indicated. This form of supplementation is easy to initiate and does not need major management or monetary inputs as is the case for other forms of drought feeding. Figure 3 highlights the extent to which urea supplementation of ewes increases lamb growth. Response is far greater than that from daily supplementation with 400 g of sorghum.

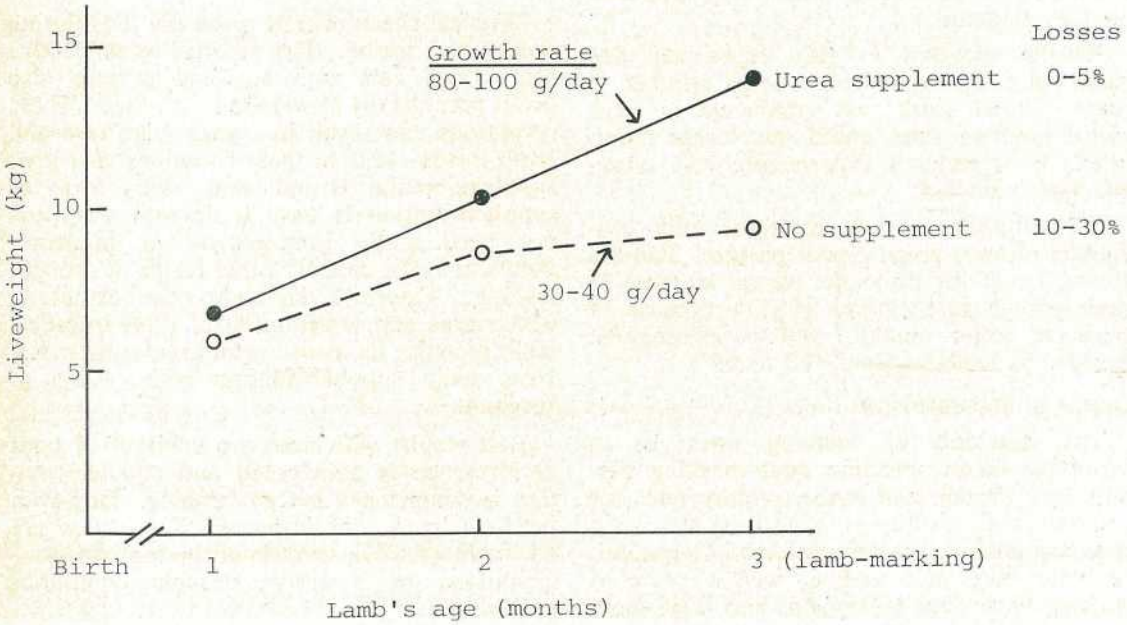
Best results with urea are achieved if poor performance is anticipated and supplementation is commenced before lambing. However, productivity is not improved if pastures are adequate (that is, ewes lamb in forward store condition) or if severe drought conditions prevail.



Above. Figure 1. The effects of urea supplementation and teat damage on the milk yield of ewes.

Below. Figure 2. The effects of urea supplementation on lamb growth and survival.

Figures 1 and 2 demonstrate the importance of adequate milk production to ensure lamb growth and survival. These paddock results occurred over a number of years during dry seasons.



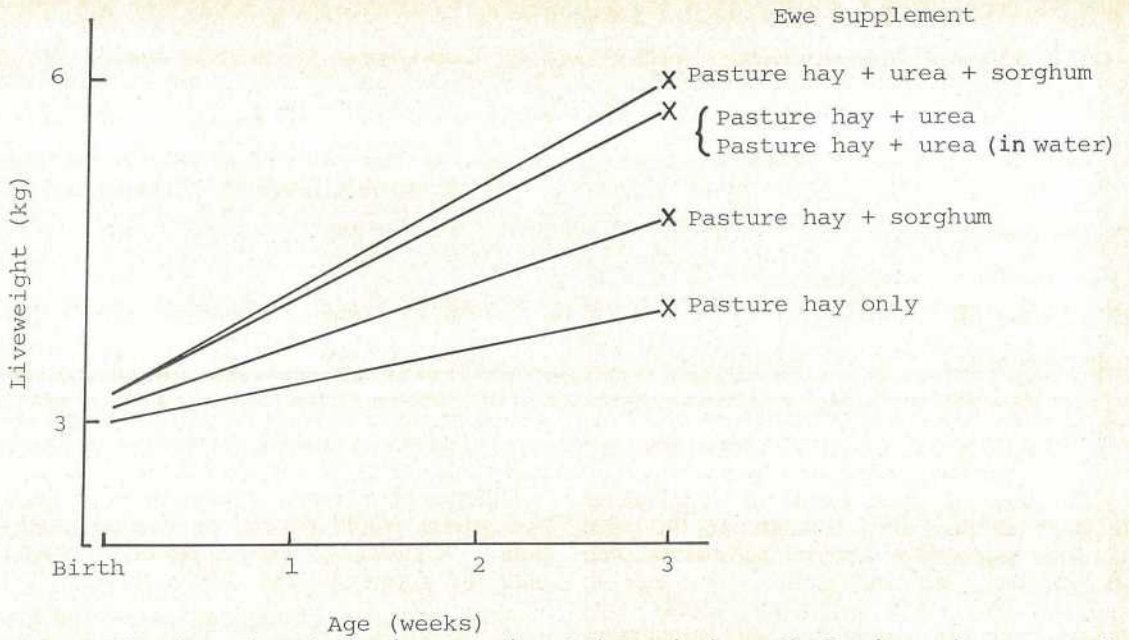


Figure 3. The effects of sorghum and urea supplementation on lamb growth. Results are from comparative pen feeding studies.

Survival of lambs at marking and weaning is dependent on liveweight and growth rate. Lambs with a low liveweight and growth rate are more prone to mismothering and death. 'Toorak' results show that lambs from urea-supplemented ewes incur fewer losses at lamb-marking and weaning (0 to 5%) than lambs from non-supplemented ewes (10 to 30%). See figure 2.

Economics

Administration of granular urea via drinking water is the cheapest, most effective method of supplementing urea as no carrier substances are required and intake is compulsory and regular. Intake is regulated by controlling the urea concentration in drinking water.

The quantity of water consumed is dependent on average ambient temperatures. The cost of urea (purchase and freight) over a 10 week supplementation period is $160 per 1 000 ewes (1980 prices). If a 10% increase in survival rate occurs, these extra 100 lambs per 1 000 ewes would be obtained at a cost of $1.60 per head.

The value of licks and blocks containing urea depends on the percentage of sheep in the mob utilizing the supplement as well as the regularity and the degree of variability of intake. Older sheep are difficult to train. However, sheep exposed to blocks and licks as young sheep will more readily accept and utilize supplements at a later date.

A urea dispenser designed to provide supplement in the drinking water.

TABLE 3

EFFECT OF MUTILATED UDDERS ON MILK YIELD AND LAMB GROWTH AND SURVIVAL RATE

Attribute	Group	
	Mutilated udder	Intact udder
Ewe milk yield (mL/day)	264	420
Lamb liveweight at 6 weeks (kg)	6·2	9·1
Growth rate (g/d)	76	145
Lamb survival (%)	42	53

The cost of these forms of supplements depends on their urea content and the price of other ingredients (carrier substances such as molasses, salt and grain). In general, supplementation with proprietary blocks costs three to four times more than supplementation via drinking water.

Current values for wool and sale sheep will influence the economic considerations of this type of supplementation. Home-made urea blocks and licks are, in general, economic to produce. However, the increased labour and risks of toxicity are disadvantages.

Experiment 4

EFFECT OF MUTILATED UDDERS ON MILK YIELD AND LAMB GROWTH AND SURVIVAL RATE

In this experiment, a study was made on the effect of mutilated udders on ewe milk yield and consequent lamb growth and survival.

A group of 40 pregnant ewes with only one functional teat was allowed to lamb with a similar number of ewes with an intact udder. Lambs from each group were identified together with ewes that had lost their lamb. Table 3 shows the difference in lamb growth rates and survival.

Lamb survival after marking and weaning was not recorded. However, the slow (sub-optimal) growth rates of lambs from the mutilated group could be expected to result in mortalities. See figure 2.

Differences in lamb survival between these two groups would depend on pasture conditions. Extremely poor pastures would naturally accentuate the difference.

A recent survey throughout Queensland has revealed a high percentage of teat damage in ewes. Damage ranged from 7% (a stud paying double shearing rates) to 17% in 6-year-old ewes at Blackall. An exception was a group of full mouth ewes with a 2% incidence where the owner closely and critically supervises shearing and has apparently been able to ensure that care is taken in this important aspect of sheep husbandry.

Experiment 5

EFFECTS OF SHADELESS CONDITIONS ON EWE PERFORMANCE AND LAMB FLUID REQUIREMENTS

This experiment reports a number of studies (pen and paddock) carried out during summer to measure the impact of environment on ewes and lambs. The results of these studies which revealed the total fluid requirements (milk and water) of unshaded and shaded lambs are presented in table 4.

The high water intake of unshaded (heat-stressed) lambs demonstrates the importance of adequate water facilities in lambing paddocks. Troughs need to be low to allow access by lambs. Surprisingly, unshaded (heat-stressed) ewes yielded the same amount of milk as their shaded counterparts. Nutrition rather than heat stress is the critical factor affecting total milk yield in ewes. This has been a consistent finding in all studies.

TABLE 4

EFFECTS OF SHADELESS CONDITIONS ON EWE AND LAMB PERFORMANCE

Attribute	Group	
	Unshaded (heat-stressed)	Shaded
Lamb temperature (°c)	40·9	39·6
Supplementary water intake (mL/day)	1 050	500
Ewe milk yield (mL/day)	300	320
Supplementary water intake of paddock lambs (mL/day)	1 150	

Note:—Supplementary water comprised between 62 and 83% of total fluid requirements of lambs at 5 to 6 weeks of age.

Experiment 6

PADDOCK STRATEGIES FOR WEANERS

Simple paddock management techniques were investigated to measure weaner performance during the dry season and also during drought situations. Earlier studies have revealed that poor nutrition rather than deficiencies (vitamin or mineral) or parasites can be the biggest single factor affecting weaner performance.

For these reasons, lambs were weaned in late July and divided equally into three paddocks (farmed, ungrazed, pregrazed). The farmed paddock had 24 ha of Flinders grass cut and baled earlier in the year and had subsequently been closed to sheep. Obvious regrowth of Mitchell and Flinders grasses as well as broad-leaved plants occurred on the harvested area.

The ungrazed paddock had remained closed to stock since the last rainfall in March and a whole mature pasture sward was available. The pregrazed paddock had been normally stocked. All three paddocks were stocked in this study at one weaner to 2 ha and the experiment continued until the first summer rainfall in December.

The results shown in table 5 demonstrate that growth rate and survival rate of weaners was superior in the farmed paddock. Production and survival was also better in the ungrazed compared to the pregrazed paddock. This study indicates that lambs should be weaned into a previously ungrazed paddock.

Preferential treatment of weaners is warranted for three reasons—weaners are a small component of the whole flock and should be easily managed for specific treatment; they are potentially the most valuable component of the flock with a productive life expectancy of 5 to 6 years; mortalities are minimal in young sheep after the initial weaning period of 2 to 4 months.

TABLE 5

PADDOCK STRATEGIES FOR WEANERS

Attribute	Paddock management		
	Farmed	Ungrazed	Pregrazed
Weaner growth rate (g/d)	93	46	29
Weaner mortality (%)	0	1	12

Experiment 7

MISCELLANEOUS EXPERIMENTS INVESTIGATING FACTORS AFFECTING LAMB SURVIVAL

These experiments have been conducted as a part of the overall research programme into factors affecting lamb survival. Consideration of results would be useful in some sheep-breeding enterprises.

- In 1975 and 1976, an intensive programme was carried out to isolate and identify infectious organisms which might be responsible for the very low lamb-marking percentages occurring at that time. Blood and other samples were taken from pregnant ewes and foetuses and tested for viral and bacterial infections. Work was commenced before the onset of the wet season and continued through the season when possible insect vector populations were high. No organisms were isolated at any stage over the 4-month period. Other studies into surveys concerning cattle ephemeral fever (3-day sickness) report no agents likely to affect pregnant ewes or new-born lambs.

- The effect on ewe and lamb performance of diet (grass versus ephemerals) fed during the last 5 weeks of pregnancy was measured in a pen experiment. Two groups of pregnant ewes were fed either Flinders grass or broad-leaved annual plants (ephemerals). Lamb birth weights and subsequent growth rates in the group fed ephemerals were greater than those in the group fed Flinders grass. The higher protein content and superior digestibility of the ephemerals probably explain this superior performance. The results demonstrate the wisdom of utilizing paddocks with a mixed pasture containing ephemerals at lambing time.

- Management strategies previously reported are also important considerations to ensure maximum lamb survival. The use of iodine (3 mg per ewe per day) in trough or bore drain water has been beneficial during hot, dry seasons. Lamb survival, wool follicle maturation and ewe wool production were improved following supplementation with iodine.

Forage crop harvesting and water harvesting have been evaluated as methods for supplementing young sheep during the first 6 to 8 weeks after weaning. During the dry season in the north-west sheep area, effective improvement in performance of weaners is practical if they are allowed to strip graze a forage crop or are given access to fair to good quality Flinders/legume hay.

Post-marking survival rates indicate no differences between the three lamb-marking methods tested—knife, elastrator rings, bardizzo. However, age and weight at lamb-marking are critical. Studies showed that 7% of lambs marked were not weaned; and the low growth rate of another 14% indicated that they failed to mother-up. Almost all of the lambs which died or failed to mother-up were less than 6 weeks of age and weighed less than 8 kg. No differences occurred between males or females.

Conclusions

These results can form the basis of property management changes to exploit ways of maximizing lamb survival. They are options which can be used to advantage depending on individual property situations, intra-property differences and personal preference. It is not presupposed that all strategies should or could be adopted. Furthermore, other methods are probably being utilized or developed which achieve the same result.

The effect of predators on reproduction efficiency, although not discussed, should be given every consideration at lambing. The new concept of grain baits and the higher prices for feral pig meat and fox skins should allow more effective and economic control programmes to be routinely carried out.

Sheep and Wool Advisers can provide producers with more detailed information on all aspects of studies reported. Most of this information is also presented in extension booklets and Farm Notes which are available on request.

Acknowledgement

This work was supported by grants from the Wool Research Trust Fund on the recommendation of the Australian Wool Corporation.

The Podolepis of South-eastern Queensland

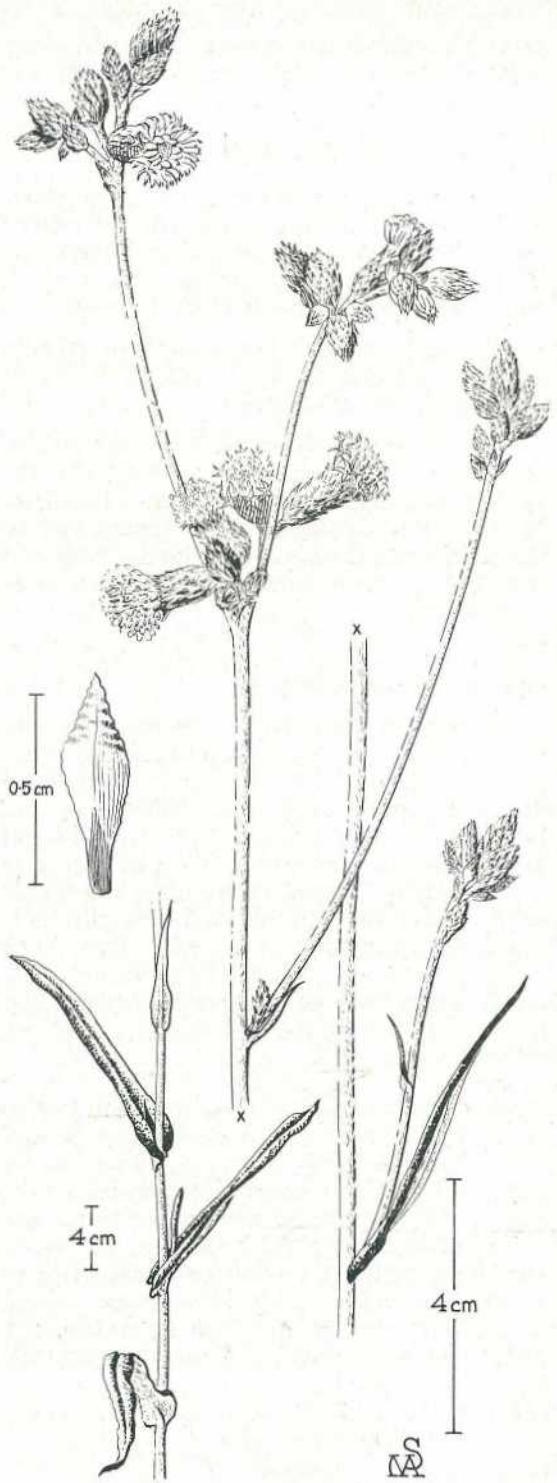
by Beryl A. Lebler, formerly of Botany Branch

LATE in the eighteenth century a French expedition in search of a missing explorer, La Perouse, visited Western Australia.

Jacques Labillardiere was the naturalist with this expedition. Among the many new plants he discovered was the first Podolepis, which he collected at Cape van Leeuwin. The name he gave to this new genus was derived from two Greek words *podos* meaning a foot and *lepis* which means a scale. This name describes the appearance of the individual bracts, which collectively make up the involucre surrounding each inflorescence.

The genus Podolepis belongs to the daisy family—Compositae. In this family what most people refer to as flowers are, in fact, inflorescences which are called heads. The stalk of the flower ends in a flattened structure referred to as a receptacle; and many narrow tubular flowers (or florets) are crowded together on this receptacle.

The whole structure is surrounded by the involcure which consists of rows of overlapping bracts. In this family, there are some plants in which all the florets are tubular and regular. In this genus, about half the species have their outer row of florets like the petals of a gerbera or sunflower with an irregular flower with the corolla tube split down the inner side and modified into a conspicuous strap-shaped structure called a ligule. Such flowers are referred to as ligulate.



Right. *Podolepis arachnoidea*

Podolepis plants are always herbs and can be either annuals or perennials. Often a loose, deciduous wool can be seen on the stems and the leaves. In most species, a conspicuous clump of radical leaves is present in both young plants and established flowering plants.

A strong taproot is found in perennial plants. The leaves are always entire and the cauline leaves (those on the flowering stems) are alternate, usually sessile and linear to lanceolate. Often the leaf bases clasp the stem.

The heads can be either terminal or axillary, and the structure of the involucral bracts in each species is distinctive.

In most species all of the florets are yellow, but in one species in Western Australia, the ligulate flowers are pink. The genus Podolepis is confined to Australia. Four species can be found in south-eastern Queensland—*Podolepis arachnoidea, P. monticola, P. neglecta* and *P. longipedata.*

Podolepis arachnoidea

The famous explorer, Sir Thomas Mitchell, first found this plant on his journey into tropical Australia. It was growing at the base of the ranges near Mt. Pluto, Mt. Playfair and Mt. Hutton. In his journal he wrote of this 'tall, herbaceous perennial' which he placed in another genus. The specific epithet is a Greek word which means covered with entangled hairs giving the appearance of a spider's web. The name refers to the covering of fine woolly, hairs which are found on all parts of the plant (particularly on the radical leaves) except the inflorescences.

DESCRIPTION: This is a perennial in which most of the leaves are in a clump at ground level. The covering of fine, white, woolly hairs gives a grey-green appearance to the leaves. At their base, the cauline leaves are auriculate and clasp the stem. On the lower part of the stem, the cauline leaves can be up to 15 cm long and 2 cm wide. Those closest to the inflorescences are much reduced in size and the radical leaves are about the same size as the lowest cauline leaves.

The erect, flowering stem is firm and wiry with many inflorescences. These are in clusters of three to ten at the ends of the lateral branches. Each head is about 1·5 cm long, and is shaped like an urn with a wide neck and a slightly wider base. Their overall colour is greenish-gold. The involucre consists of about four imbricate rows of narrow, elliptical bracts with the shortest on the outside. None of the bracts have conspicuous claws. They end in thin, papery laminas which are golden-brown. Magnification shows transverse wrinkles across the tips of the laminas.

The florets are regular and narrow tubular and are golden-yellow. Superficially they all appear to be identical, but magnification shows that the ray florets are actually ligulate. Because the ligules are less than 0·3 cm long they are inconspicuous.

FLOWERING TIME: Flowering specimens of this plant have been collected in autumn, but the main flowering period seems to be from late in winter to the end of spring.

HABITAT: This plant always grows in sandy soil. On the coastal lowlands it can be found on wallum slopes or near the sea on sand dunes. Inland it grows in grassland, on creek banks or in open eucalyptus forest. It appears to be a pioneer species in situations where the landscape has been disturbed by man with such activities as bulldozing.

DISTRIBUTION: This plant grows only in the north-west and western districts of New South Wales and in Queensland where it is widespread from the Endeavour River in the north to Charleville in the west.

Podolepis monticola

This plant was first collected in 1965 on a rocky hillside in the Lamington National Park. When it was described in 1969 it was given the name *monticola* which means growing on mountains.

DESCRIPTION: It is a perennial herb with a strong taproot and a large rosette of leaves at ground level. The leaves are soft grey-green and can be 20 cm long or longer and up to 8 cm wide. Woolly, white hairs are scattered over the upper surfaces of the leaves and form

Right. *Podolepis monticola*


0·5 cm
10 cm
2 cm
M.A SAUL

a dense covering on the lower surfaces and the flowering stems. The basal leaves are persistent and dead leaves from the previous season can be found beneath the fresh, green leaves on a flowering plant. When in flower, this is a very striking plant. The vivid colour and the size of the ray florets, together with the prolific flowering habit make it the most attractive species in South-eastern Queensland.

The flowering stem can be up to 50 cm high and is usually simple and unbranched. Long, lateral, flowering stems arise from the axils of the lowest cauline leaves. These usually have only one or two flowering heads. The lower cauline leaves are similar in shape to the rosette leaves but are smaller and have stem-clasping bases. Further up the stem, the leaves are very much reduced and the lateral flowering stems are much shorter, ending in a solitary inflorescence.

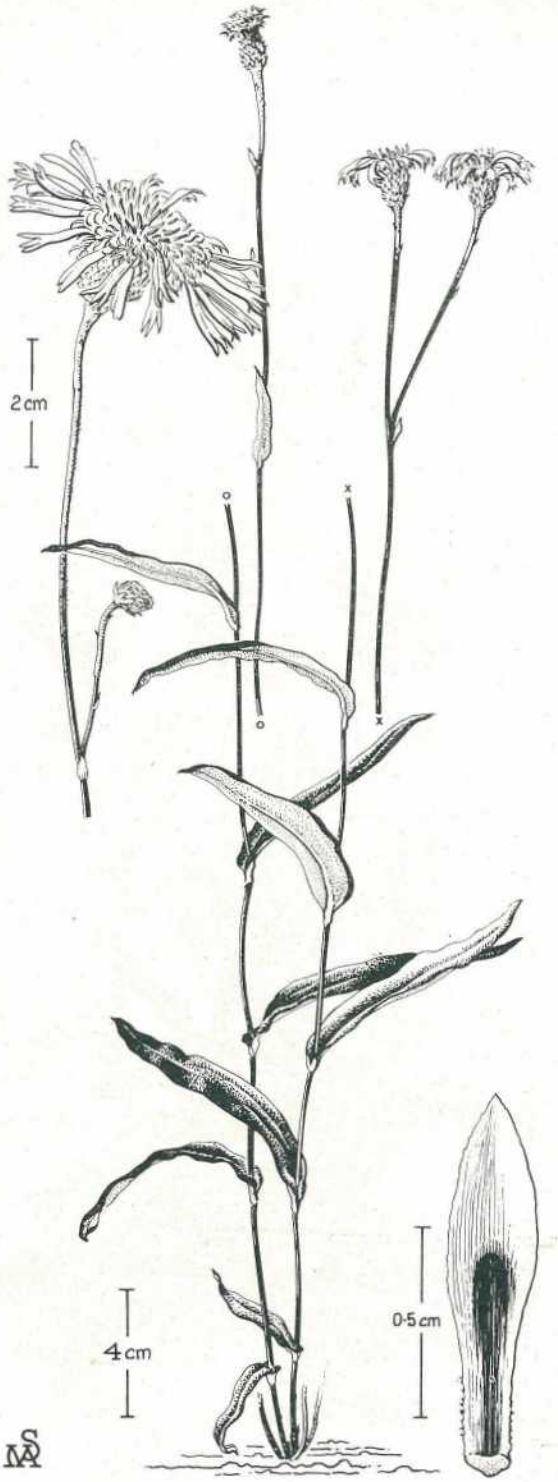
The involucres in this species are cup-shaped, up to 1·5 cm long and as wide as long. Their overlapping bracts are arranged in about six rows and the involucre has a golden-yellow overall appearance. When the bracts are pulled from the inflorescence it can be seen that each bract consists of two parts—a short, narrow, green claw and a shiny, golden-brown, papery terminal lamina. This lamina is roughly ovate in shape. With magnification, it can be seen that white papillae form a dense covering on the outer surface of the claws.

The most striking features of the inflorescences are the ray florets around the perimeter of the inflorescence. The ligules are light golden-yellow and about 1·5 cm long. They are usually deeply divided into four lobes. Since those ligules spread widely around the involucre the heads can be up to 5 cm across. At the peak of its flowering, this plant makes a brilliant splash of colour.

FLOWERING TIME: Flowering commences in spring and continues into summer.

HABITAT: This plant grows on rocky hillsides, in crevices on exposed rocky slopes or on ledges near cliffs.

DISTRIBUTION: It has been found only in Queensland on the McPherson Range.



Right. *Podolepis neglecta*

Podolepis neglecta

In 1863, this plant was collected on the top of a mountain near Rockhampton. Until 1957, when a critical revision of the genus was published, it had been confused with another species and misidentified. It was then realised that this particular plant belonged to a new species. The name chosen for it is very appropriate since it means hither to overlooked.

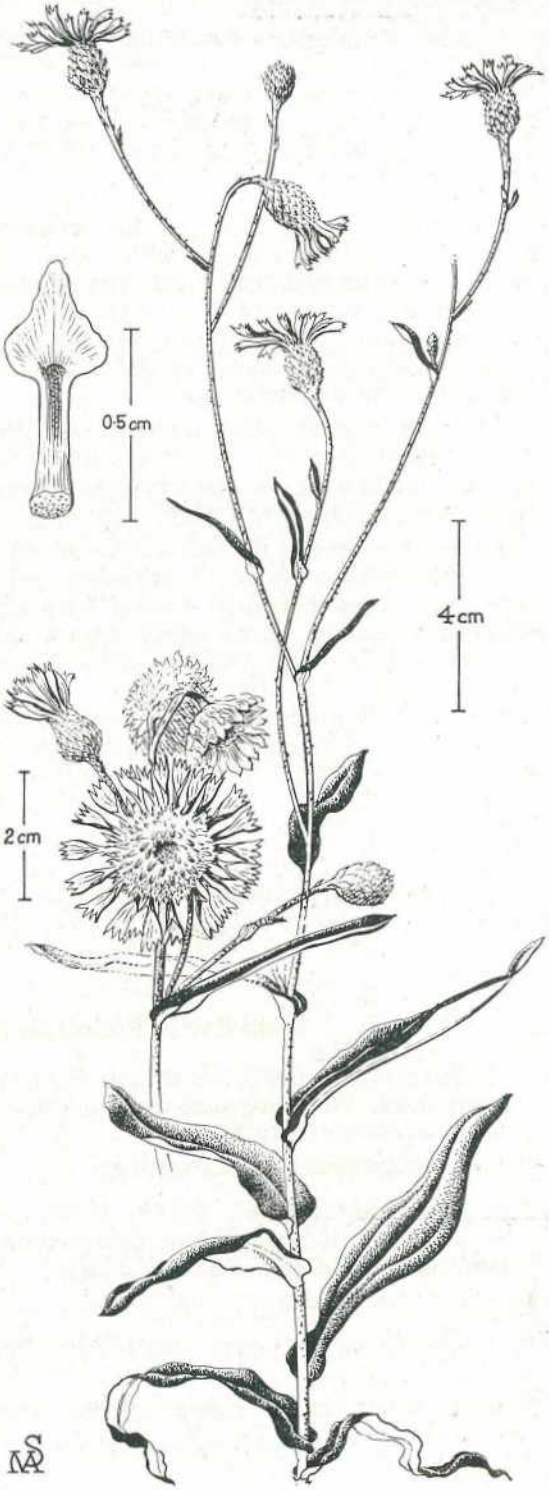
DESCRIPTION: This plant is a perennial which usually grows to about 45 cm high. The flowering stem is simple and erect. It is wiry and brown and either completely glabrous or with a sparse covering of woolly hairs. No radical leaves are present except on young plants and then only a few. The cauline leaves are widely-spaced, stem clasping and discolorous with a dark green upper surface. Minute, white hairs are sparsely scattered on the upper surfaces making them fell rough. The leaves are narrow-oblong, up to 10 cm long and 2 cm wide. The terminal inflorescences are solitary and often have a second, small head lower down on the stem. The involucre is urn-shaped but much wider than in *P. arachnoidea.* Its overall appearance differs from that species in being green for the greater part, with only the terminal papery lamina being golden. The claws are green with a thicker, darker green area at the top of the claw. The papery lamina extends down on both sides of the claw and the tip is pointed.

The head can be up to 5 cm in diameter and the ligulate ray florets are very conspicuous, with ligules 2 cm long. These are deeply divided at the tips into three lobes. In this podolepis, the disc florets are also prominent, and their tubular structure is seen easily with the naked eye.

FLOWERING TIME: This plant flowers from late in winter to the middle of spring.

HABITAT: It grows on sandy loam in open grassy forests, on rocky slopes, on the summits of mountains and in sand on the tops of headlands close to the sea.

DISTRIBUTION: This species is found in New South Wales to as far south as Denman (north-east of Newcastle) and in Queensland to as far north as Rockhampton.



Right. *Podolepis longipodata*

Podolepis longipodata

Allan Cunningham found the first plant of this species on the sandy seashores of Moreton Bay. He suggested that specific epithet. It probably refers to the long, narrow claws on the involucral bracts, particularly those of the innermost row.

DESCRIPTION: Young plants of this perennial could be easily confused with those of *P. neglecta* since both have erect, wiry, flowering stems and widely-spaced, dark green, stem-clasping leaves. In this species, however, the upper surfaces of the leaves are quite glabrous and smooth to the touch.

Although in young plants a cluster of bright green, almost succulent, leaves is present by the time the flowers are developed the radical leaves have withered and died.

Flowering plants of the two species are easily distinguished. In *P. longipedata* long, spreading, lateral branches develop from the axils of the cauline leaves. Each branch can have up to seven or more inflorescences. These stems develop first from the upper cauline leaves and then gradually almost down to the ground level. The lower branches can be up to 25 cm long. Loose, white, cottony hairs form a covering over the stems. The involucre is shorter and broader than that of *P. neglecta* and also appears greener. The green basal claws are narrowed and much longer. Very high magnification is needed to see the short glandular hairs which cover the outer surfaces of the claws.

The most distinctive feature of this species is the triangular lamina at the end of each claw. It is membranous, shiny and golden brown. These laminas are easily seen on old heads in which all that remains is the naked receptacle surrounded by the spreading bracts.

The ligules of the ray florets are shorter than those of *P. neglecta* and are slightly paler in colour. They are usually divided into four lobes.

FLOWERING TIME: This plant blooms in spring.

HABITAT: It is always found in sandy soil, or the frontal dunes, and further inland in mixed open eucalyptus forest. Further west in Queensland, it grows on sandy ridges.

DISTRIBUTION: This podolepis is widely spread in Queensland to as far north as Alpha and as far west as Cunnamulla. It is also found on the northern coast of New South Wales to as far south as Cape Byron.

Field Key to Podolepis in South-eastern Queensland

1. Ligules inconspicuous, less than 0·3 cm long. Rosette leaves grey-green, covered with fine, white hairs. Flowering stem erect and branched. Involucre urn-shaped; lamina golden-brown with transverse wrinkles ..... *Podolepis arachnodea*

Ligules conspicuous, up to 2 cm long 2

2. Involucre cup-shaped. Rosette leaves grey-green and hairy. Flowering stem erect and branched. Involucral bracts with narrow, green claws and ovate, papery golden-brown laminae ..... *Podolepis monticola*

Involucre urn-shaped 3

3. Rosette leaves on young plants only. Flowering stem unbranched. Involucral bracts with broad, green claws and golden-brown laminae, decurrent on to the claws ..... *Podoelpis neglecta*

Rosette leaves in a cluster, bright green and succulent. Flowering stem branched. Involucral bracts with long, narrow, green claws and triangular, golden-brown, papery laminae ..... *Podolepis longipodata*

Apple root distribution under drip irrigation

by P. S. Crew and G. J. Funk, Horticulture Branch

ALTHOUGH drip irrigation has proved satisfactory on deciduous fruit trees in the Granite Belt, there have been doubts about the adequacy of a drip-irrigated root system.

To assess root distribution, a drip-irrigated apple tree was excavated.

The tree

The tree, a 10-year-old Delicious apple on Merton 778 rootstock, was planted in 1969 on a bank at a spacing of 4·6 m between the rows and 3·4 m between trees. The tree was part of a drip irrigation trial and was irrigated four times a week unless interrupted by rainfall. The tree in 1978 had a trunk girth of 35 cm and yielded about 4 cases. One of its unirrigated counterparts yielded about 2½ cases and had a girth of 25 cm in the same year.

The soil

The soil type is generally described as a podzolic soil of granitic origin. The soil profile and the dimensions of the bank can be seen in diagram 1.

The top soil below the tree was significantly increased with the formation of banks. The top soil had a depth of about 55 cm in the bank and about 20 cm in the inter-row. There is a sharp change to a 30 cm layer of sandy clay below the top soil. This layer contains aggregates scattered throughout and was not affected by the formation of the banks. Below the sandy clay layer is a hard clay pan at about 85 cm below the top of the bank. Roots did not penetrate this hard clay pan.

Irrigation

The tree was irrigated with two 9 L per hour drippers. Urea, and muriate of potash were applied in the irrigation water throughout the season.

Each dripper outlet developed a wetted pattern approximately 1 m in diameter in the surface soil, with greater lateral spread above the hard clay layer.

In an average season, the mature tree received about 4 500 L of irrigation. The average monthly rainfall and evaporation figures over the life of the tree are shown in table 1.

The excavation

The root system was exposed by hosing away layers of soil with a jet of water. As the root system was progressively uncovered, it was labelled according to position.

Where roots crossed the extremities of the excavation along the row they were cut (diagram 2). Apart from these roots, no other roots were damaged during the excavation.

After the root system was exposed, the complete tree was removed and assembled on a frame for demonstration. The tree was sprayed with Creosote to preserve the tree for as long as possible.

TABLE 1

AVERAGE MONTHLY RAINFALL AND EVAPORATION OVER THE LIFE OF THE TREE

——	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall	113	91	86	30	36	35	43	49	63	82	91	95
Evaporation	190	144	144	110	81	63	73	97	118	159	182	205

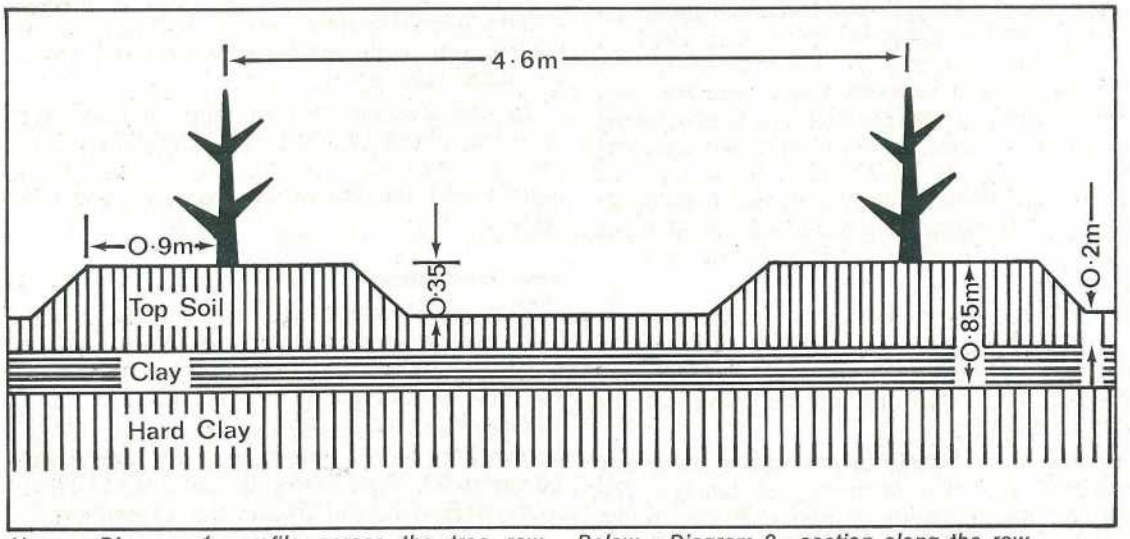
The feature of the root system was the concentrated root development under the drippers. Dense root development occurred in all parts of the wetted zone from the surface down to the hard clay pan. However, there was also extensive root development in the rest of the bank which ensured good anchorage.

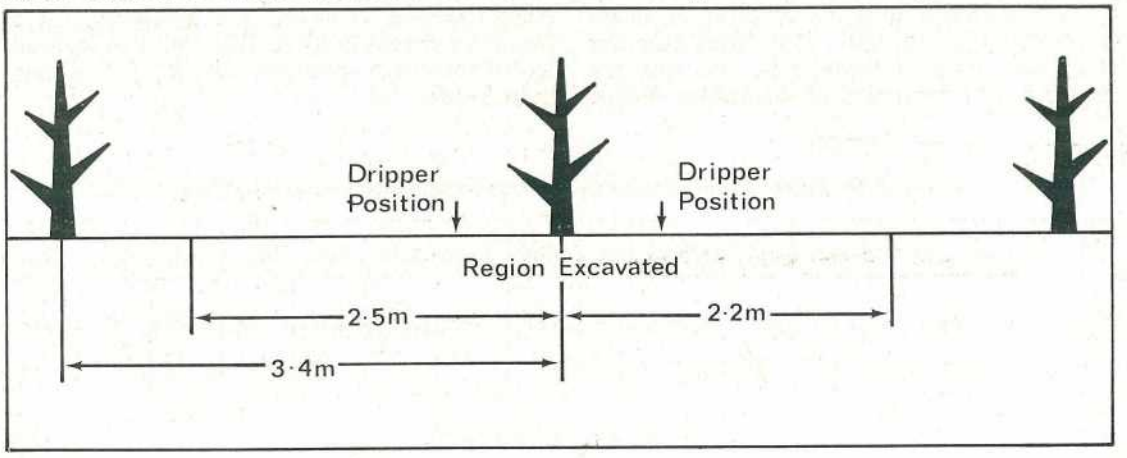
The root system of the neighbouring tree entered the wetted zone of the excavated tree and vice versa. This typically involved the extension of a scaffold root along the bank to branch and proliferate in the neighbouring wetted zone.

Few roots were found in the inter-row. Grass and clover roots almost exclusively occupied the inter-row top soil. Where roots did move into the inter-row, they were mainly in the sandy clay layer. The planting of the tree on a large bank would not favour inter-row root development. So, it cannot be concluded that inter-row root development was restricted by sod competition or wheel compaction.

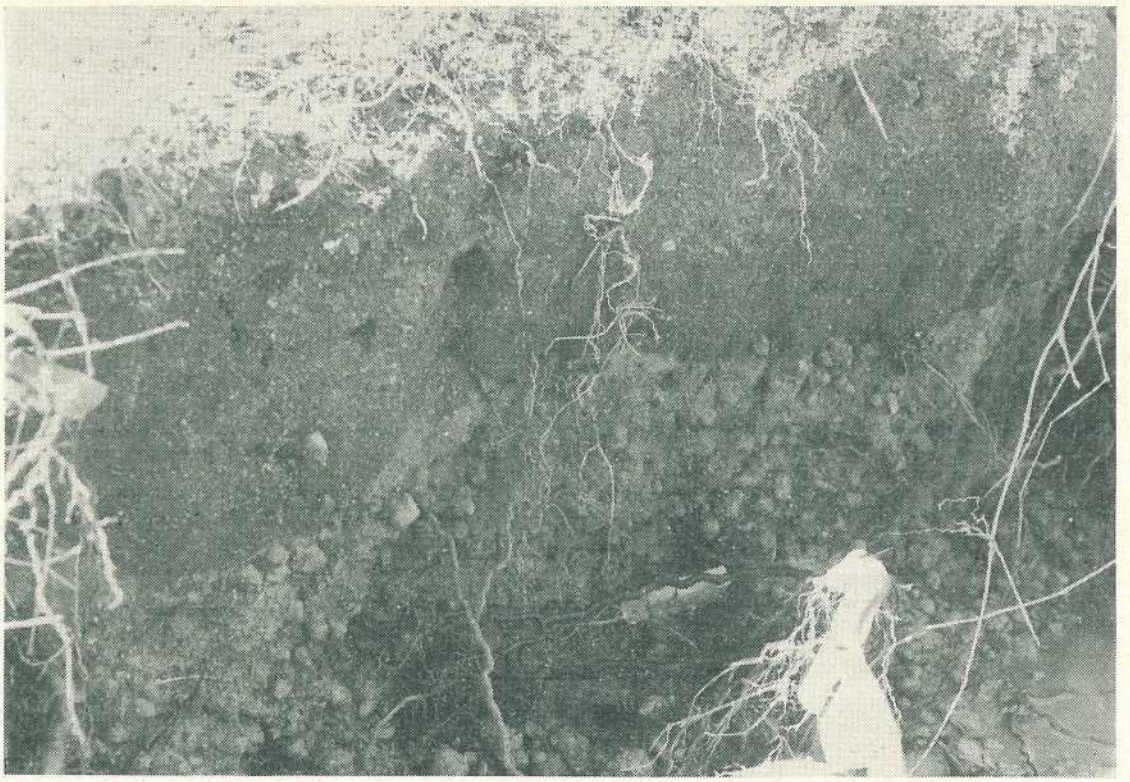
It was encouraging to find such a high density of healthy roots in all parts of the wetted zone. There was no sign of waterlogging in spite of relatively poor soil structure and drainage.

This root distribution should be considered in the context of the soil, the bank, the rootstock and the rainfall. However, the general conclusion from the excavation is the adaptability of the apple root system to drip irrigation and that under Granite Belt conditions an adequate and healthy root system can develop under drip irrigation.



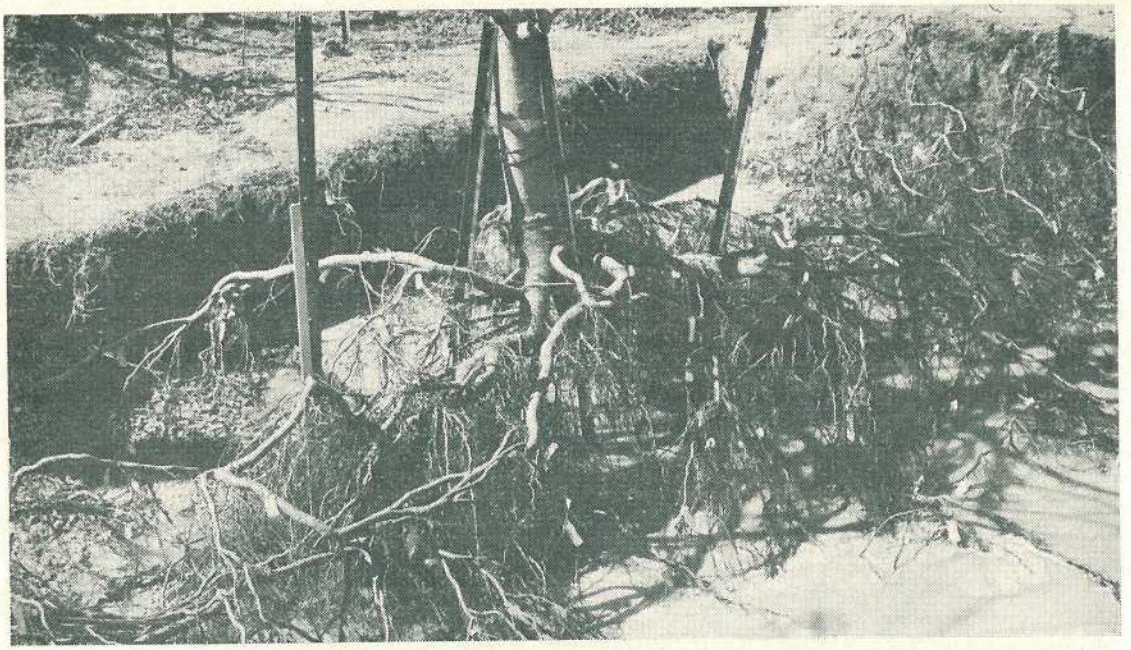


Above. Diagram 1—profile across the tree row. Below. Diagram 2—section along the row.



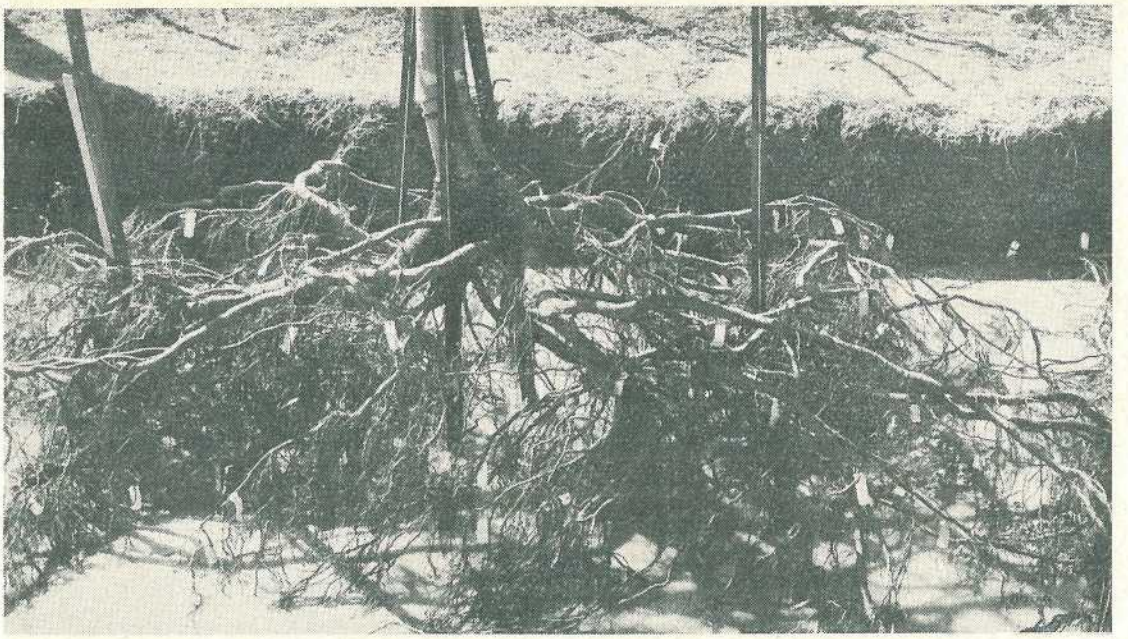
The soil profile in the inter-row.

The bank profile and root development beyond the wetted zone.



The bank profile and root development along the bark.

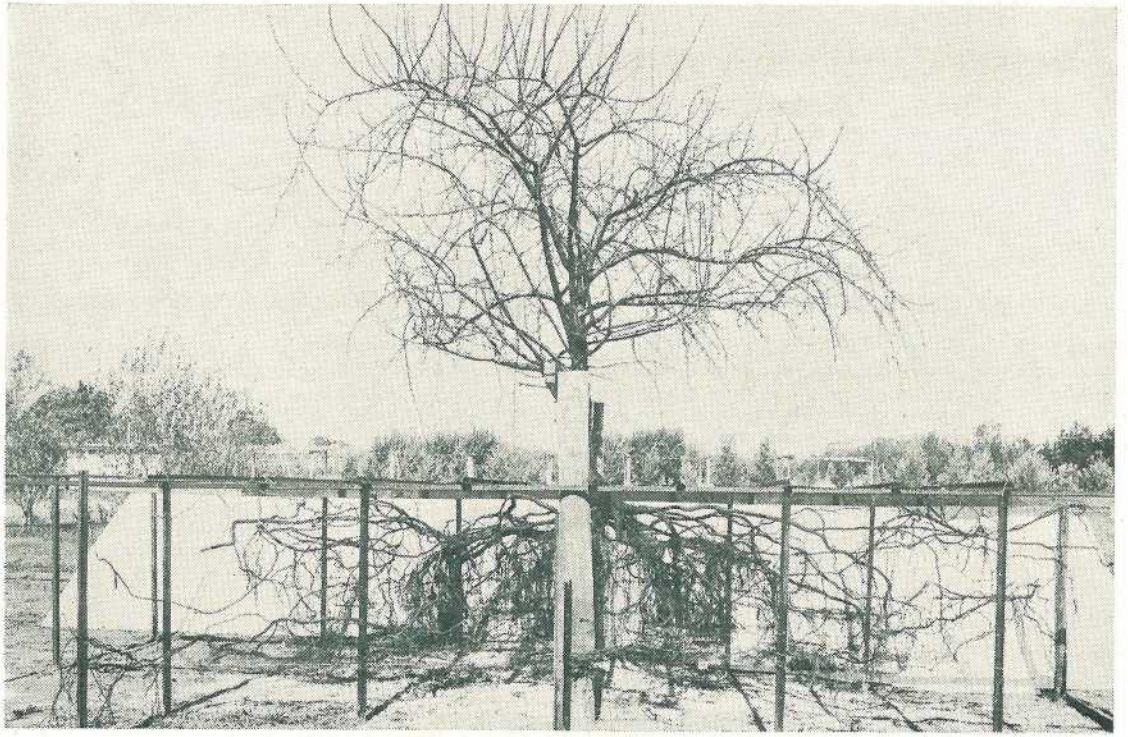
Root development around the dripper position.



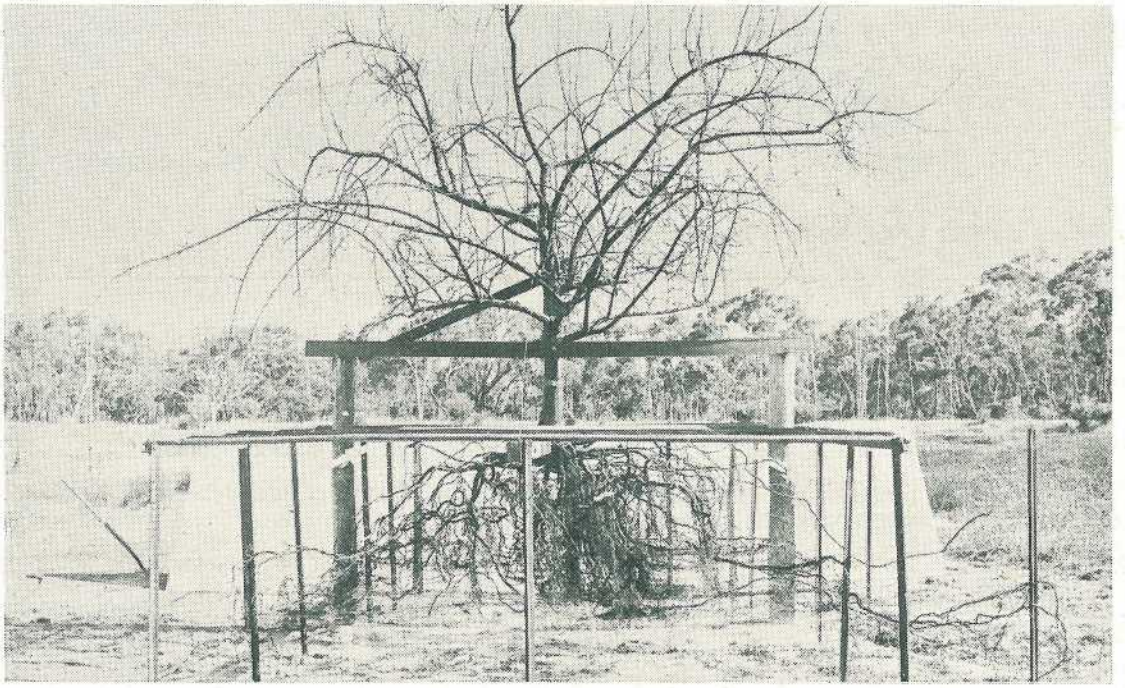
Above and below. View across the bank showing the wetted root zone.

Dense root development in the wetted zone.

The tree butt.



Reconstructed root system-view across the bank.



Reconstructed root system-view along the bank.

Root development across the bank in relation to bank profile.

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Insect pests of sunflower... part I

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.

Seedling pests

Of the many field crops grown in Queensland, sunflowers are one of the most susceptible to seedling damage by soil-dwelling insects. This is because damaged sunflower seedlings lack the capacity possessed by many other field crops to regrow or tiller, and plant death and a patchy crop often result from injury.

Seedlings are particularly vulnerable to damage before they develop three or four 'true' leaves, during periods of moisture stress and when other factors such as low soil temperature or soil compaction limit plant growth. The practice of stubble mulching, while being desirable for soil and water conservation reasons, often leads to higher soil insect numbers and seedling mortality.

Pre-planting inspections to determine populations of soil-dwelling pests enable appropriate control action to be taken before damage occurs. These insects are usually found in and above the well defined level where the dry and moist soil layers meet. The accompanying photographs will help in recognising the insects which are likely to cause injury.

False wireworms

The three species which cause most damage are *Gonocephalum macleayi* Blackburn, *Pterohelaeus darlingensis* Carter and *P. alternatus* Pascoe; Family Tenebrionidae. Both adults and larvae feed on young seedlings.

Larvae are typically creamy or creamy-yellow in colour with a thin, wire-like, tough body. Three pairs of legs are situated just behind the head. Larvae of *Gonocephalum* grow to approximately 20 mm in length, while those of *Pterohelaeus* reach about 50 mm when fully grown. Larger false wireworm larvae generally cause more damage than smaller and younger specimens.

Favoured feeding sites of larvae after seed germination are stems, roots, and cotyledon leaves. In addition to sunflowers, false wireworms have a wide range of crop hosts which include sorghum, maize, wheat, barley and millets. They can also survive on organic material in the soil.

The life cycle of false wireworms usually involves a single generation per year in south Queensland, but is largely dependent on temperature. Adult beetles, which often shelter under weeds or stones or around seedling leaves during daylight hours, can also severely damage young plants by nibbling stems and aerial parts.

Earwigs

Two types of earwigs are commonly found in sunflower paddocks. One, the black field earwig (*Nala lividipes* (Dufour); Family Labiduridae), is an extremely mobile, small, black, plant-feeding insect (15 mm long), with a pair of curving pincers attached to the rear of the body. These are arched over the body in a threatening posture when the earwig is disturbed. Both adult and nymphal black field earwigs feed on sunflower plants and are often found clustered around damaged sunflower seedlings.

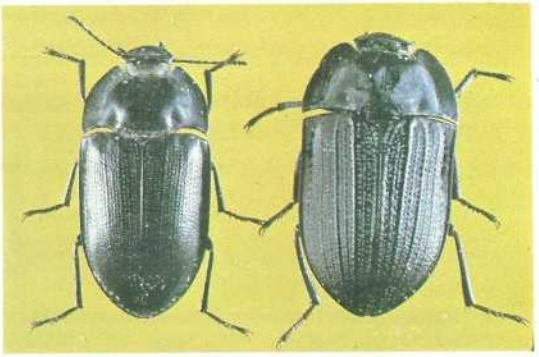
The other, the predatory earwig (*Labidura riparia truncata* (Kirby); Family Labiduridae), is a much larger (25 mm in length) cream and brown-coloured insect. This earwig is a predator and has been recorded feeding on false wireworm larvae in the laboratory.

Field crickets

Both nymph and adult field crickets (*Teleogryllus commodus* (Walker), *Teleogryllus lepidus* (Walker); Family Gryllidae) are capable of causing injury. They feed on the cotyledon leaves as well as on the 'true' leaves. Stems may be excavated and, in extreme

Insect pests of

A false wireworm larva (x 1.9).



Beetles of two common species of false wireworm (x 2).

Sunflower seedlings showing typical damage by false wireworm and wireworm larvae (x 1).

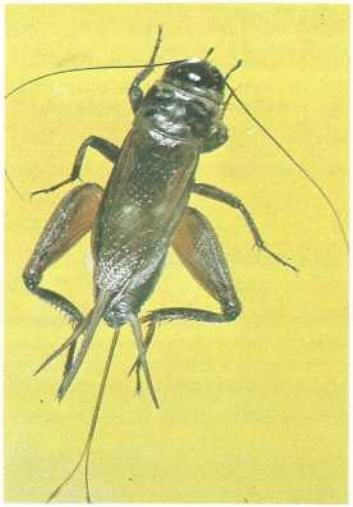
A wireworm larva (x 4).

Black field earwig nymph and adult (x 3.8).

Black field earwig damage to germinating sunflower seed and newly emerged seedling (x 1.4).

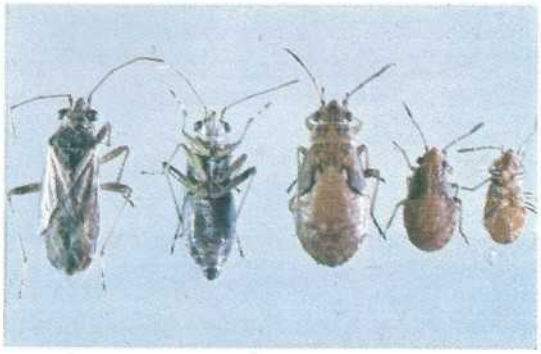
by R. H. Broadley and D. A. Ironside, Entomology Branch

sunflower . . . part I



Adult field cricket (x 1.4).

Cutworm larvae and damaged sunflower seedlings (x 1.4).



Adult and nymphal stages of the Rutherglen bug (x 5.0).

Whitefringed weevil adult (x 3.6).

Above. Sunflower seed dissected to show typical damage by Rutherglen or grey cluster bug. Undamaged seed on left. (x 2).

Left. Sunflower seed with the outer seed coat removed to show Rutherglen or grey cluster bug feeding injury (x 4.6).

instances, the stem is severed above ground level. The availability of alternative sources of food and moisture plays a major role in determining whether crickets feed on young sunflowers.

Cutworms

Several cutworm species (*Agrotis* spp.; Family Noctuidae) may damage young sunflower stands in Queensland. The larvae are stout, soft-bodied insects which hide in the soil at the base of the seedlings during the day and at night emerge to feed on the stems and young leaves. Stem-cutting often results in collapse of the seedlings, which may then be partially covered or dragged into the soil. When disturbed, the larvae curl up and lie motionless. The fully grown larvae, which are up to 40 mm long, form earthern cells in which they pupate. From these, the moths emerge and escape from the soil to commence another life cycle.

Wireworms

These are cream-coloured larvae of click beetles (Family Elateridae). They may be distinguished from false wireworm larvae by the shape of the rear end of the body. Wireworms have a flattened tail, whereas the false wireworm has a blunty-rounded tail.

Wireworms are not as common in sunflower paddocks as false wireworms, but their mode of feeding is quite similar. Wireworms appear to prefer undisturbed situations and are often found where plant regrowth or weeds occur.

Other soil insects

Sunflower seedlings are at times attacked by black scarab beetles (*Pseudoheteronyx* sp.; Family Scarabaeidae), whitefringed weevil (*Graphognathus leucoloma* (Boheman); Family Curculioidae) and cockroaches (*Cosmosteria biccola* Shaw or *Desmosteria cincta* Schelford; Family Blattidae).

Post-establishment pests

There are a number of insects which may assume importance once the sunflowers have developed beyond the seedling stage.

Rutherglen and grey cluster bugs

Rutherglen and grey cluster bugs (*Nysius vinitor* Bergroth and *N. clevelandensis* Evans respectively; Family Lygaeidae) are among the first pests to move into developing sunflower crops and can usually be observed in the crop until the completion of harvesting. The two insects are almost identical in appearance and their life history, habits and effects are similar. Rutherglen bug is usually the dominant species on sunflower after the critical budding stage.

Alternative host plants include various poppies and composite weeds, sow thistle, variegated thistle, cudweed and also grasses and legumes. Adults readily disperse from such hosts to the crop or from one crop to another.

LIFE HISTORY AND HABITS. The adults are small, dull grey insects about 6 mm long and possess two pairs of silvery-grey wings. Nymphs are wingless, pear-shaped and are often reddish in colour. Both nymphs and adults feed by inserting tube-like, sucking mouth parts into the plant.

On sunflowers at the budding stage, the bugs congregate on the upper stem and are often found sheltering under the bracts on the back of the bud. Large breeding populations, which may reach 2 000 or more on a single plant, generally coincide with ripening of the seed. The insects are most frequently found sheltering around the seed heads, among the flowers and developing seed and sometimes in the bases of the petioles.

The female deposits her small, cream, sausage-shaped eggs between the seeds and dead flowers usually within 2 weeks after completion of flowering. The small, wingless nymphs emerge about 7 days later. After about 3 weeks of feeding, the mature winged adult stage is reached. At 30° C the total life cycle from egg to egg can be completed in about 22 days.

DAMAGE. Damage can occur at any stage of sunflower growth but the usual critical periods are at budding and after seed formation. High populations at budding dessicate the head and cause wilting, terminal collapse and even plant death; damage to the leaves and stem may give rise to axillary buds at the leaf axils. This type of damage is more common on rain-grown crops suffering moisture stress and damage is often more severe on outside rows. High populations after seed formation can result in reduced yield and oil quality, and in lower seed germination.

Running cattle on the traprock

by D. Llewelyn, Beef Cattle Husbandry Branch

TRAPROCK country to the south and south-west of Warwick is a unique grazing area in Queensland.

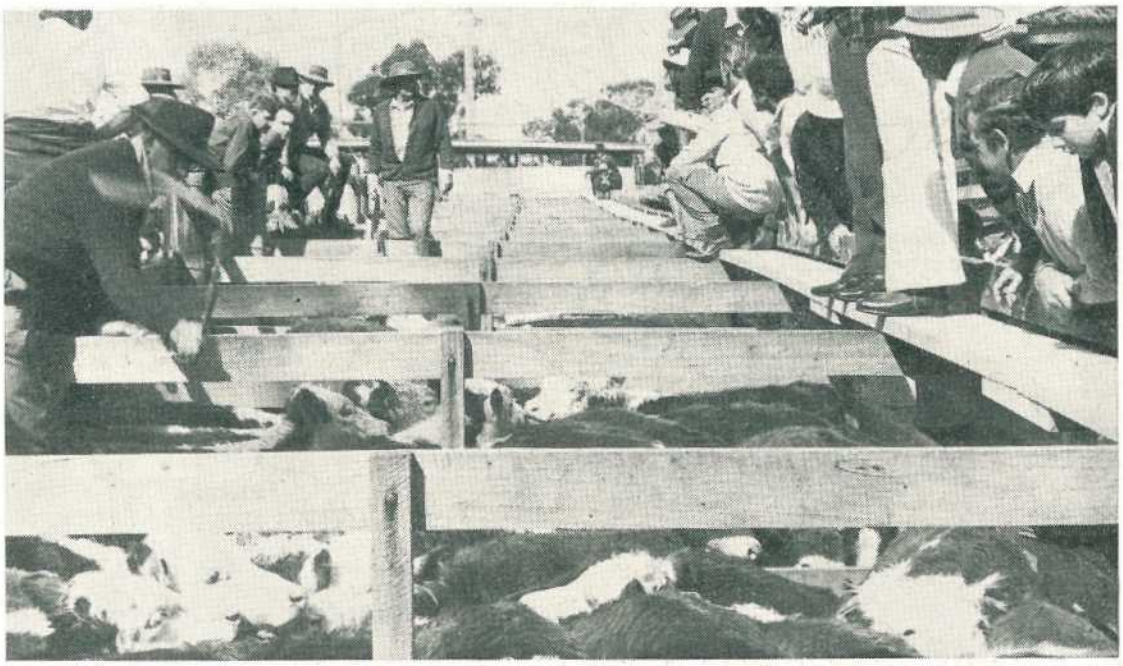
Its special pasture and winter feed attributes limit the type of grazing enterprises for which it is suitable.

Bordered by Stanthorpe, Karara, Inglewood and Texas, the Traprock covers some 6 700 km^2 of shallow, stony and hilly country, with extremely limited cultivation potential. Although the area receives 600 to 700 mm (average 660 mm) of rainfall in normal years, its utilization is poor because of run-off and low soil fertility. About 35% of the total rainfall is received in winter.

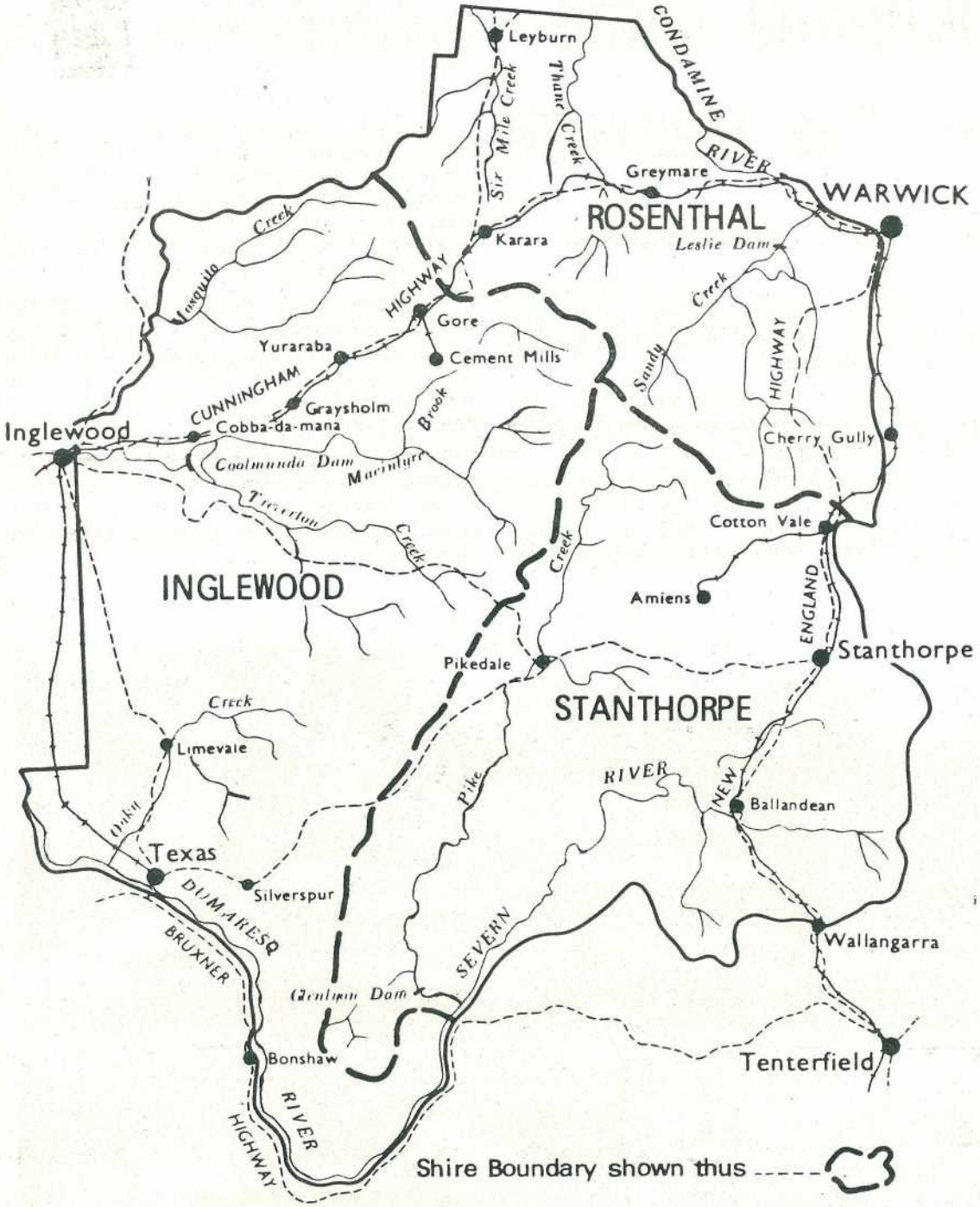
The area is hard wintering country for livestock. Traditionally, sheep are run as woolgrowers on native pastures to produce good quality fine wool, at somewhat lower cuts per head than in western areas. This is the main enterprise. Since the early 1960s, favourable returns for beef have lifted cattle numbers.

Properties vary in size from 600 to 20 000 ha, while an average property of say 2 400 ha would carry 4 000 sheep and 80 head of cattle. Some properties have increased their cattle numbers up to 200 to 300 head. Very few properties only run cattle.

At low cattle numbers the sheep/cattle combination is complementary and very useful due to the different grazing habits of sheep and cattle, and their ability to rotationally graze each species.



Encouraged by a group of local cattle breeders, the first Stanthorpe weaner sale was held in May 1976. It is now a very popular annual event with both store breeders and buyers alike.



Map 1. Traprock country comprises a large proportion of southern Rosenthal, Stanthorpe and the eastern half of Inglewood Shires.

Where the cattle enterprise becomes more than a sideline, cattle must compete with sheep. This competition is usually to the detriment of the cattle, especially where both species are run in common paddocks. Fencing and watering facilities which have developed under the all sheep system can often prove inadequate for running cattle in this area.

Properties with alluvial creek flats have a greater potential for cattle production due to their ability to grow winter fodder crops.

The basic cattle enterprise on the traprock is breeding and turning-off store weaners or yearlings. The alternative is to run less breeders and sell 3-year-old bullocks. Store breeders' sales developed at Inglewood and Stanthorpe attract fatteners from the Darling Downs, N.S.W. and the local Granite Belt areas.

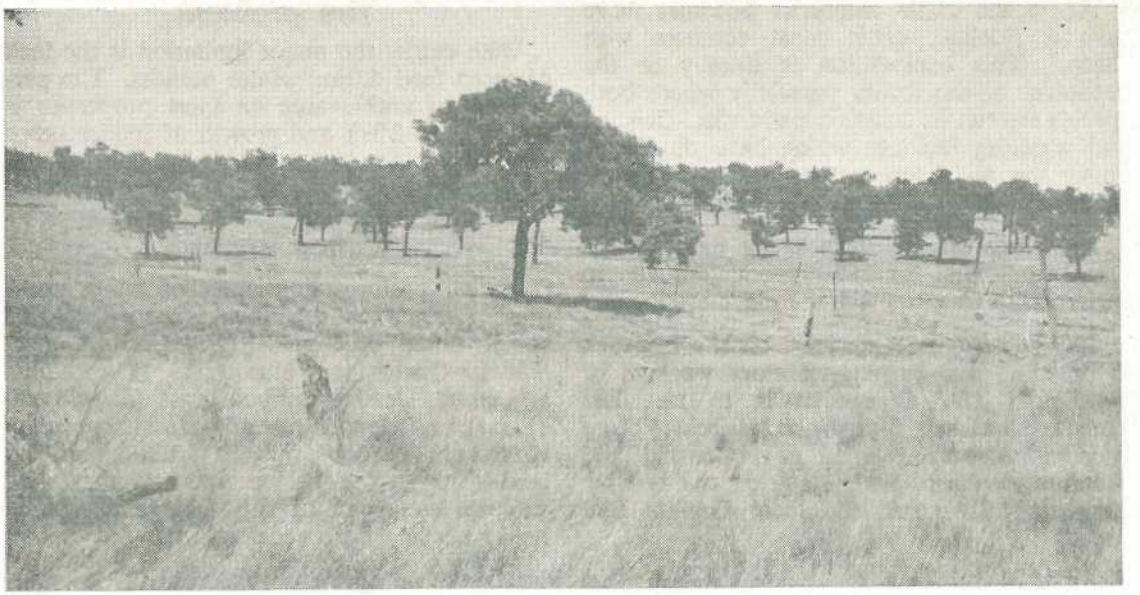
The problem

With cattle, the major limitation is the lack of green feed during winter months. The percentage of arable area on most properties is small (0 to 3%) and growth of fodder crops (mainly oats) is restricted by cold winter weather.

Native pasture

Native pastures consisting of white spear grass (*Aristida* spp.), love grass (*Eragrostis* spp.), pitted blue grass (*Bothriochloa decipiens*), Queensland blue grass (*Dicanthium sericeum*), slender bamboo grass (*Stipa verticillata*) and slender ratstail grass (*Sporobolus elongatus*) produce 600 to 1 000 kg of dry feed (D.M.) per ha on open country, and carry an average of 2 D.S.E. (dry sheep equivalents) per ha or a breeder to 5 ha.

Breeders are normally run at about one beast to 5 ha on open native pasture areas. The rate is less when the country is timbered.



This is typical open (timber thinned) traprock country carrying a reasonable body of feed.

Paddocks that have been subjected to severe grazing pressure for a few seasons can produce as little as 250 kg DM per ha per year as very little soil moisture is absorbed when the ground has been grazed bare.

On heavily-timbered country, the carrying capacity may be 0·5 D.S.E. per ha or less. Most properties have 60 to 100% of country which has been timber thinned.

Common tree species include narrow and silver leaf ironbark (*Eucalyptus crebra* and *E. melanophloia*), tumbledown gum (*E. dealbata*), yellow box (*E. melliodora*), brown box (*E. microcarpa*) and white box (E. *albens*) with rough barked apple (*Angophora floribunda*) along the creeks.

When timber is killed (rung or poisoned), carrying capacity increases for a few years but may revert to the original carrying capacity unless regrowth is effectively controlled.

Native pasture supplies reasonably good quality grazing during the summer months (November to February), but grasses usually become dormant from March through to September.

Heavy frosts during June to August cause marked deterioration in the feed value of native pastures for cattle. Both protein and energy can be limited at this time. The two hardest winter months for cattle are normally July and August.

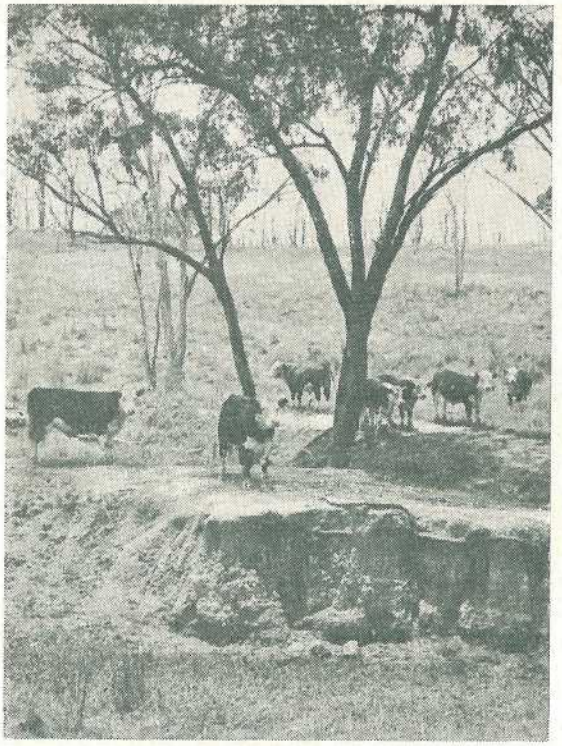
Potential for improved pasture

Since traprock country cannot be cropped continually for grazing oats, development of improved pasture is the more logical proposition. The major pasture development on the traprock has been with lucerne. Lucerne provides strategic feed for cattle from September to December with useful short growth in autumn and in mild winter periods.

Additional species for most pasture programmes are the annual winter legumes such as the medics, cluster clover, woolly pod vetch together with Wimmera rye grass.

In the past, these species have been sown together with lucerne or under oats in a pasture development programme.

The annual cost of this programme based on clearing, cultivation and sowing costs spread over a 10-year period can range from



Well-grown yearling steers like these from 'Alum Rock' are a result of good management and a very favourable winter/spring season in 1978.

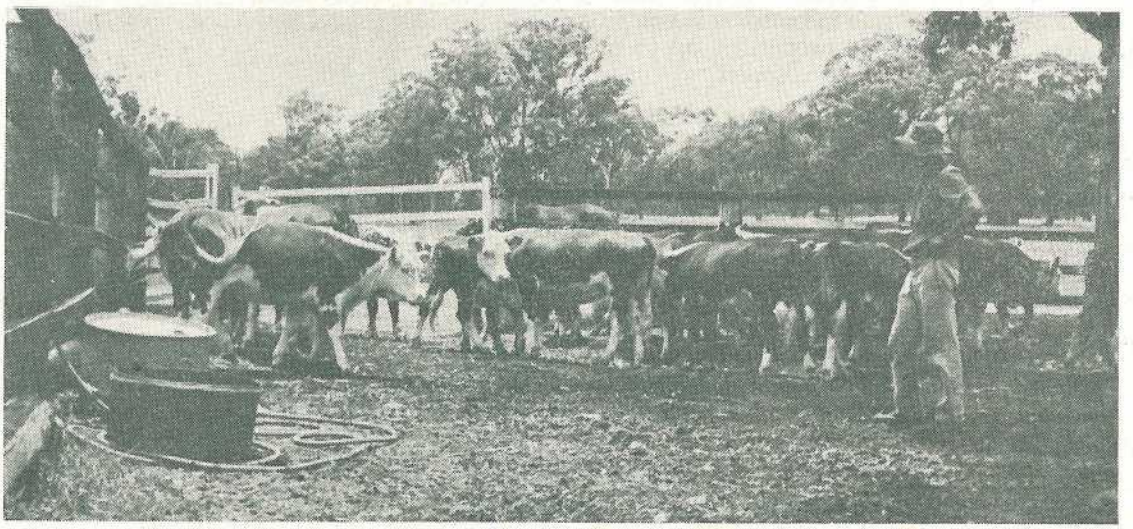
$11 to $20 per ha (1979 prices). At least 1 ha per breeder should be allowed if this pasture is to be used as a winter/spring feed supplement.

Techniques for developing pasture through oversowing at a lower cost are currently being examined.

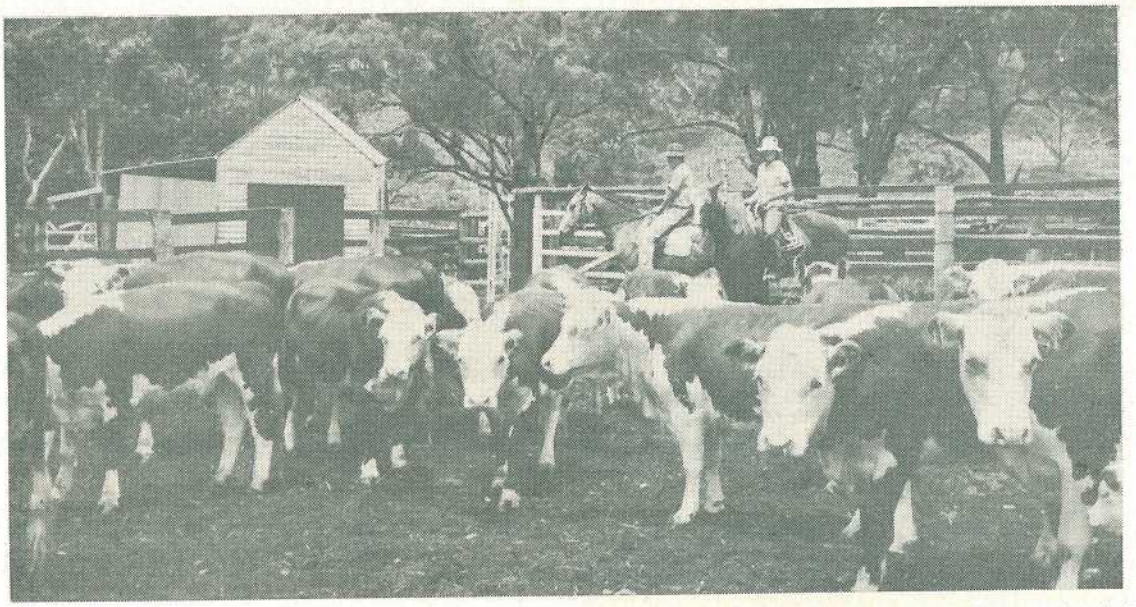
The important benefits of improved pasture are that annual dry matter production can be increased two to threefold with a much higher proportion of winter/spring feed.

Improved pasture legumes have shown much higher energy values than native pasture at the same site (2·4 vs 1·7 Kcal. per kg) along with their markedly better protein, phosphorus and sodium levels. This must account for some of the vast differences in cattle performance on the two different pasture types.

Unfortunately, pasture improvement on the traprock involves high capital outlay and the scope for long term development is limited to the better pasture sites. Consequently, there will always be a need to put more effort into managing and utilizing native pastures, be this by supplementary feeding or by basic pasture management aimed at encouraging the growth of more nutritious and winter active species (such as the Danthonias).



John Smith of 'Alum Rock' sorts out some replacement heifers. Heifers need to be sound and well-grown to handle the subsequent winter and still go in calf again at their second joining.



Gordon and Belinda Smith with cull cows headed for the works. Cows are normally culled out at weaning time in April/May. This allows a lightening off of breeders before winter.

When breeding cattle are run exclusively on native pastures they lose both condition and weight over the winter period. Observations on six different properties during the winter of 1975 showed a range of weight losses in breeders from 10 to 50 kg. Further weight losses put animals at risk and a 3 to 5 % mortality rate in breeders is common in this area. On some properties, up to 8% breeder losses have been recorded.

High calving rates cannot be expected without careful management and some supplementary feeding. Average branding rates in the district are 70% with a variation of 50 to 90% depending on management, feed, and seasonal conditions.

Management

Most herds in the area (at least 70%) seasonally mate breeders to calve in the spring. However, variable seasons and a cattle price slump have caused this to spread a little in recent times. Seasonal calving is necessary to reduce stress over winter and therefore cut losses to a minimum. With a store weaner turn-off, it is important to keep calving as compact and early as possible (within reason)

Bull control is an essential part of winter cattle management on the traprock. To ensure good tight calvings, bulls should normally be out of the herd from March to October.

First calf heifers require special treatment in most winters if they are to join up well in the summer.

so as to produce a good, even line of cattle with reasonable live weights. Calves born in August to October have weaning weights of 160 to 180 kg in normal years.

With an older age of turn-off (for example, 3-year-old bullocks) a later calving is acceptable. It has the advantage of reducing mortality risks during winter. Calves should be weaned in April/May in normal years or earlier in drought years.

Close attention to heifer nutrition in the first two winters is particularly important to ensure good breeding potential for later life. Heifers often do not attain their mature weights until after their second calf (4-years-old).

Joining is recommended at 2 years of age and as close as possible to 300 kg liveweight. It is an advantage to over-mate heifers and cull any shy breeders and poor milkers judged on their first calf. Well-grown, heifers can be mated 1 month to 6 weeks earlier than the main cow mob giving the heifers additional time to recover following their first calving. This increases their chances of subsequent conception. It also avoids the heifers' calves being automatically overlooked for selection as replacement breeders.

Careful culling of cows, before old age increases the risk of losses is necessary in this country. This means checking teeth when cows get close to 8 years of age.

When limited good feed is available give preference to breeders and particularly first calf heifers. With native pastures, it is a good practice to summer save a winter paddock for exclusive use by cattle in the winter.

At weaning, the weaners should be drenched and all cattle are treated for lice control.

When bulls are not in the breeding herd (March to October) they should receive special attention. Feed hay if necessary and do not miss out on their lice treatment and drench. With the advent of high voltage electric fences, there are no excuses for less than adequate bull control.

Bulls are normally run at 3 to 4% of breeders. Check bulls thoroughly for soundness each year prior to joining.

Despite sound management, some form of winter supplementation will still be necessary to maintain a highly productive breeder herd for most properties in most years. With a high standard of herd management, feed, pasture and crop supplements can be used far more effectively and at lower cost.

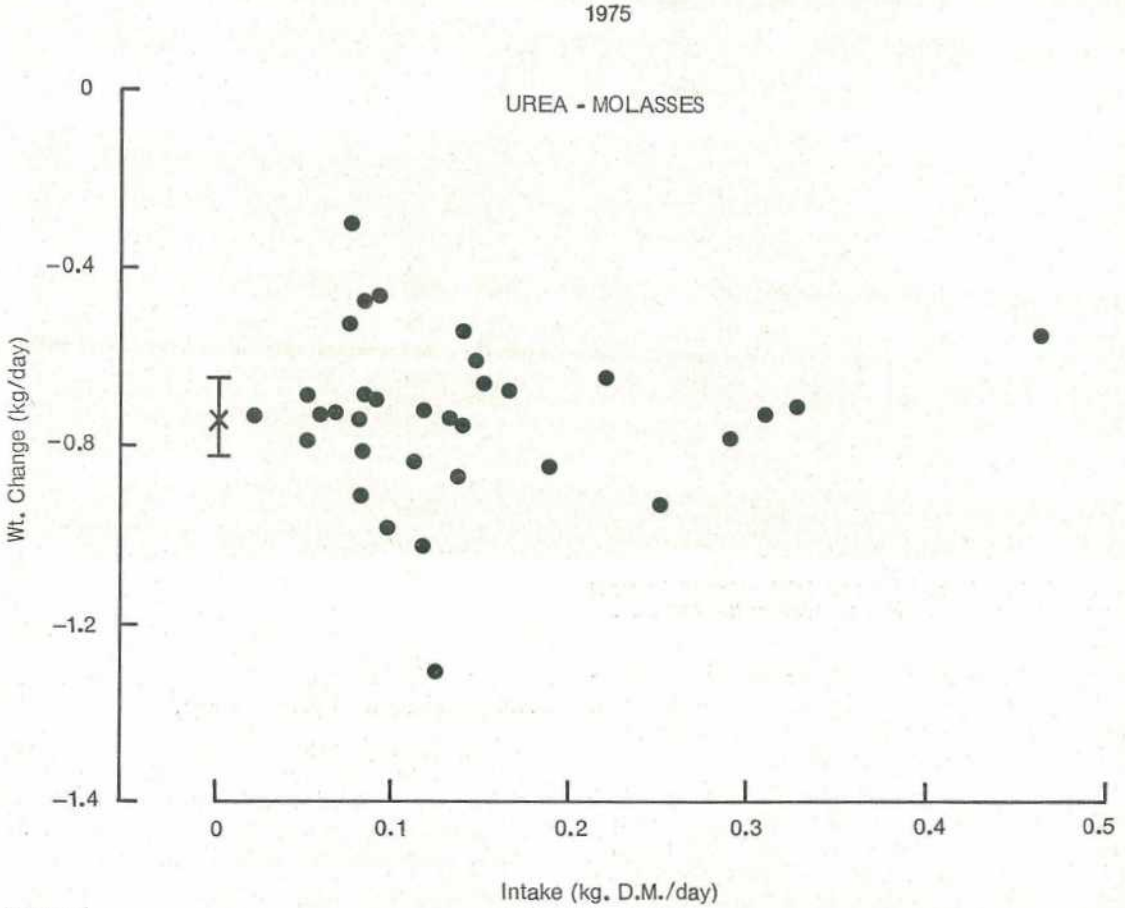


Figure 1.

Local feed supplement trials

In an attempt to refine our understanding of what to feed, when, and how to go about it we conducted field trials between 1975 and 1977 on 'Mt. Malakoff' and 'Wobur' the properties of the Blundell family of 'Jibbenbah Pastoral Company' 28 km south-west of Stanthorpe.

This has provided some objective information on the response to feed supplements in terms of actual weight changes and subsequent fertility of first calf heifers.

In 1975

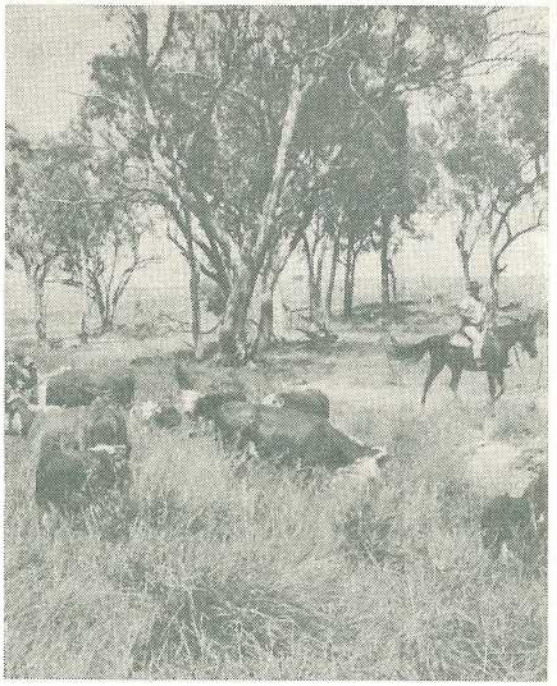
A commercial supplement consisting of urea-molasses and a home-made supplement of meat meal-molasses were assessed as winter supplements for two groups of 30 pregnant 2-year-old heifers grazing similar native pasture paddocks during the early winter period. They averaged 320 kg at the start of the trial in June.

The urea-molasses was fed in roller drums while the meat meal-molasses was fed out in open troughs three times per week. With the assistance of the University of New England, a supplement labelling technique was used to estimate the individual intakes for each animal during the first 65 days of feeding. Although 87% of the animals offered the urea-molasses supplement consumed it, there was no liveweight response. This is shown in figure 1.

Of the heifers offered meat meal-molasses (1 : 1·3 ratio) only 18% consumed it thus giving somewhat higher intakes than were originally planned. These heifers lost significantly less weight (0·52 kg per day vs 0·85 kg per day) and were still 11 kg heavier than unsupplemented animals when their calves were branded in February of the following year (see figure 2).

These results occurred during this early winter period while adequate dry standing pasture was available.

Meat meal-molasses eaters also held the advantages of going back into calf 21 days earlier than non-eaters, and having no mortalities. Their non-eating sisters, however, suffered three deaths during the feeding period and five subsequent calf losses.



Right. Peter Blundell mustering for branding on 'Mt. Malakoff'. The best feed is found along the gullies.

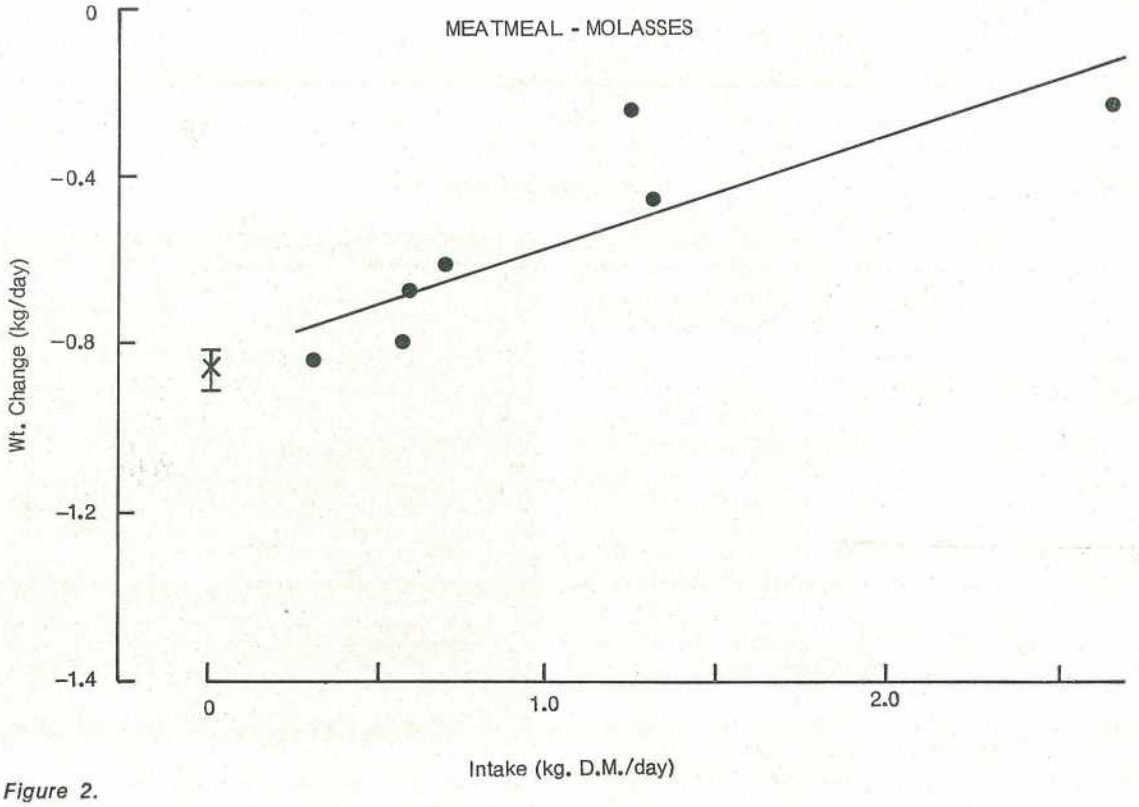


Figure 2.

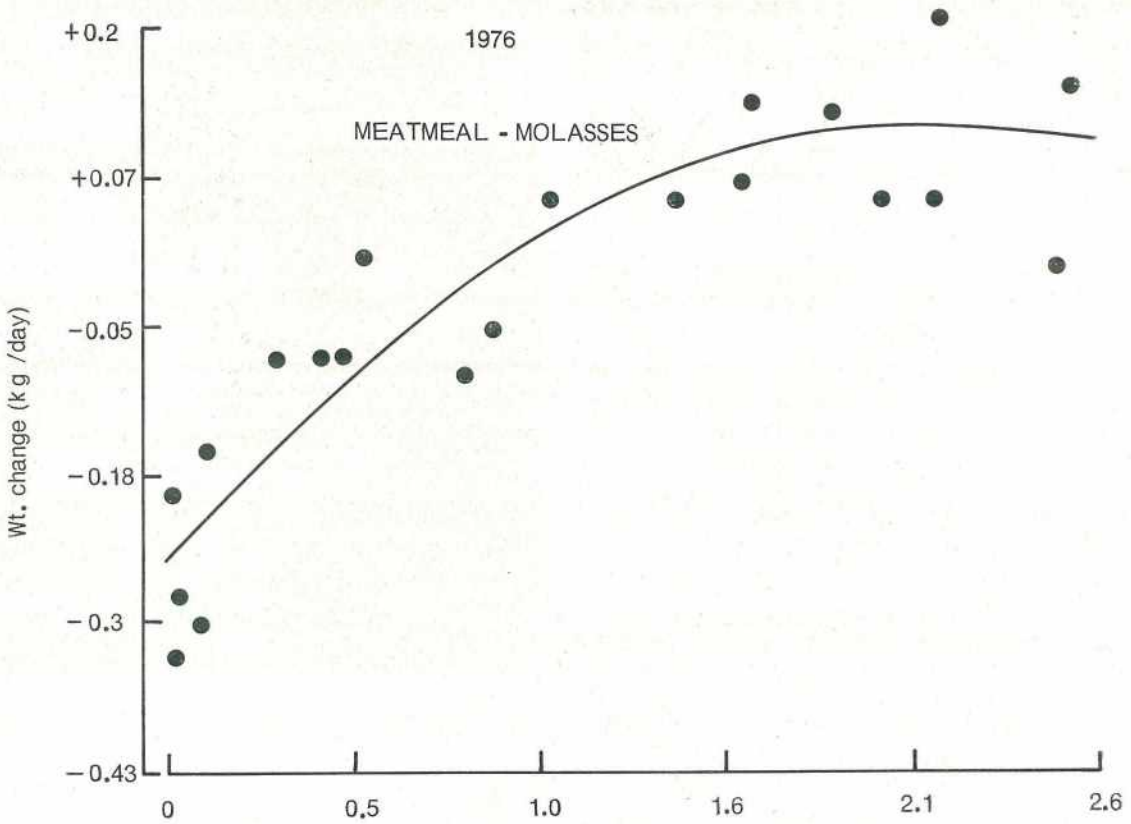


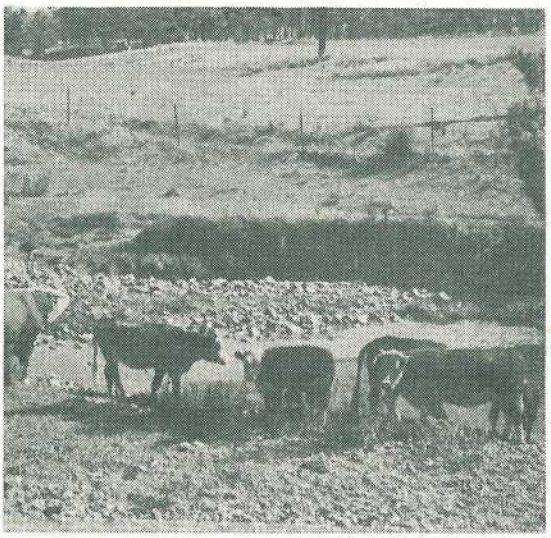
Figure 3.

In the urea-molasses group, two deaths occurred during the feeding period, one from malnutrition and the other from urea toxicity very early in the period. Three subsequent calf losses occurred.

In 1976

Using the same class of heifers in a somewhat milder winter and using a wider meat meal-molasses (1:12 ratio) so as to supply a higher energy level, we again showed a significant response to supplementation over a 133 day period. The 37 heifers involved averaged 363 kg at the start of the trial in May.

The type of response occurring in the first 96 days of feeding is shown in figure 3. Here, we were able to change a weight loss into a small weight gain through increasing the amounts of supplement. This effect tapered off at the higher levels of intake and the overall conversion of supplement eaten to live weight response was only 6·4 : 1.



The odd, dry summer during mating can upset winter feeding programmes that are aimed at increasing calving percentages in the herd.

A very dry summer followed on from this winter and non-eaters compensated to a large degree. By branding time, in 1977 there was very little difference in heifer weights. Furthermore, calves weaned from each group (eaters and non-eaters) had similar live weights—both averaging 161 kg.

None of the 62% of heifers that ate supplement died and although two heifers had trouble calving, both calves survived. Three non-eating heifers died while calving and another died of dystocia.

In 1977

Of the same class of heifers (320 kg), 48 head were again fed during the winter period prior to calving. In this year, the intake measurements were disrupted by rain and the eaters in the mob had to be subjectively determined by observation. This was made possible due to the extremely runny nature of the molasses used in the lickermix-meat meal-molasses mixture (0·2 : 1·4 : 14) fed at an average intake of 1·5 kg per day. Given that our assessment of eaters was reasonably accurate, eaters gained weight at the rate of 0·25 kg per day while non-eaters lost weight at a similar rate (0·29 kg per day). The conversion efficiency of this supplement was approximately 4 : 1.

Two dystocia calves were the only losses in 1977. A considerable advantage in rebreeding fertility occurred in supplement eaters. This was in keeping with the trend of previous years. When results from all 3 years are considered, the overall rebreeding rate in supplement eating heifers comes to 75·5% compared with a rate of 55% in non-eaters. These figures are derived from a total of 163 heifers.

Overall, the results show:

- The ability of supplementation to reduce mortalities.
- The variability of winter seasons and the differing levels of supplements required to maintain weight in each season.
- The potential for increasing calving rates.
- A lack of response to urea-molasses in the year in which it was used.
- The importance of a protein energy ratio to suit the season. As the energy proportion in the supplement becomes too high, there seems to be a greater chance that substitution feeding will occur.
- The poor acceptability of meat meal based supplements and the necessity to train cattle to accept supplement from an early age (preferably at weaning).

Additional Information

Irrespective of treatment, an analysis of weight and conception during the summer following the first year's feeding period showed:

- Individual spring and summer weight gains were directly related to fertility.

Summer Weight Gains	Pregnancy Percentage
<0·4 kg/d.	48%
>0·4 kg/d.	74%

- Rejoining weights (as indicated by weight at branding) had a direct influence on the number of conceptions.

Rejoining Weights	Pregnancy Percentage
<320 kg	33%
320–360 kg	61%
>360 kg	89%

These results emphasise the need for having well-grown heifers at first joining.

They also suggest that the variability in summer seasons could at times have an overriding influence on planned winter feeding projects.

Winter feeding approaches

From these results, it is extremely difficult to come up with standard programmes for winter feeding cattle in this area.

It depends on the size of the cattle operation, the type of country, where they are run, present branding rates, the particular winter season, and the availability of paddock feed.

This improved pasture incorporating lucerne and medics was used on 'Melva' by Scott Finlay to profitably look after breeders during the winter/spring period.

The decision of whether or not to feed supplements or plant winter pasture for cattle hinges directly on the future market outlook for beef when the extra production is to be marketed. With store weaners, this means looking 18 months ahead.

In theory, for weaner prices of $150, a 20% improvement in fertility would mean that up to $30 per breeder could be spent on a winter feeding or pasture improvement project, ignoring the small summer stocking rate increase for more calves.

In practice, this large increase in calving rate may be difficult to achieve across the whole herd. However a 10% improvement amounts to $15 and therefore a $10 per breeder outlay would certainly be realistic in these circumstances.

The economics for improved calving rates decline with increasing age of turn-off of cattle. This is because the herd will naturally adjust its overall carrying capacity commensurate with its calving percentage.

On the other hand, a smaller total feed bill will accrue with a lower number of breeders. More calves on the ground gives better opportunity to select good heifer replacements.

With weaners at $30 to $60 a head as in 1977, it is difficult to justify any outlay on feed costs.

There are however, other benefits of winter feeding which give immediate returns. These include:

- A reduction in average mortalities. Mortalities can be virtually eliminated with a good feeding programme.
- Supplemented cows should milk better following calving and therefore produce weaners having more weight and bloom with a significant reduction in the proportion of tails in the mob. (Note: This was not achieved in the second year's trial work where a poor summer was experienced).
- Shorter mating seasons and earlier calvings are made possible.
- Feeding necessitates seeing cattle at least once a week and this in itself is an aid to management.

The timing and length of winter feeding is largely a matter of experience. Once breeders reach backward store condition, weight can be lost very quickly in some years without visual indicators. A typical feeding period would be 80 to 100 days.

From a flexibility point of view, improved pasture has an advantage over supplementation as it can be used by either ewes and lambs or breeders. This is significant in years when low prices are attached to only one of these industries.

A sod-seeded improved pasture of lucerne and medics has been used by Mr Scott Finlay of 'Melva' for wintering Hereford breeders. Melva (6 500 ha) runs 10 500 wethers and 150 breeders turning-off store weaners to be fattened on the river country at Texas.

In 1975, not only did breeders maintain their body-weights (when stocked at 1 : 1·5 ha), they actually gained 11 kg per head on average prior to calving. Also, a rebreeding fertility rate of better than 90% was obtained.

The ability to drift cows as they calve on to a lick of lucerne (old lucerne paddocks) has further strategic potential. It may allow a lower level of winter feeding to be used. This system was used by Mr Peter Blundell in the years prior to commencing the trials reported in this article. He would normally allow an area of 0·6 ha per breeder and claims very good results from it.

What to feed in winter

Three principles are of importance:

- With a good amount of paddock feed, a high protein to energy ratio supplement should be chosen. The protein is designed to stimulate intake of roughage and reduce replacement feeding.
- As the body of dry feed lessens and you approach a winter drought, supplements should be purchased mainly on the basis of their energy value. The protein content need not exceed 15%.
- Mineral requirements are not important until both protein and energy requirements are met.

An average winter normally runs on somewhere between the first and second situations. It seems that the form of protein could be critical to the results obtained in the first situation. While non-protein nitrogen supplements have been used to good effect in many parts of Queensland, their value for traprock country may be of less significance.

Our decision to feed meat meal as a protein supplement was based on work by the University of New England. This work showed its specially good ability to stimulate intake of dry roughage because of the insoluble nature of its protein. A large amount of meat meal protein is not digested in the rumen but passes through to the abomasum (true stomach) and intestine where it can be utilized more efficiently.

Meat meal is not the only protein which is 'protected' from rumen degradation. Many true proteins (animal and vegetable) have this property to varying degrees. They have therefore been called protected or bypass proteins. Although bypass proteins have been fed for many years, it is only recently that the true nature of their mode of action in ruminants has become known.

Bypass proteins have special value for animals with high nutritional demands such as growing weaner heifers and breeders in late pregnancy and early lactation.

The energy, protein and bypass (protection) value of a number of commonly used supplements is shown in table 1.

The costs of feeding various supplements can be computed from table 1 and with respect to the feeding requirements of a particular property.

In practice, the use of bypass proteins will be tempered by the requirements for availability at reasonable prices in comparison with beef values.

Intake problems can sometimes occur with animal proteins, particularly meatmeal. Problems seem to be largely overcome by the use of pellets and training animals to eat them. The pelleting process itself may also add some protection value to the supplement. Pelleted bypass proteins are now available commercially.

District experience has shown that small amounts (1 to 2·5 kg per day) of good quality lucerne hay fed to breeders during the winter have given good results. This hay is either home-grown or brought in. One advantage of lucerne hay is that it can be fed at very low levels of less than 1 kg per day as a protein supplement increasing up to 2·5 kg per day as the winter deteriorates.

TABLE 1

Feedstuff	Crude Protein %	% Protection Value*	Energy Value (KCal/kg)
Urea	(equivalent to) 287%	..	..
Meat meal (first grade)	55%	High	2·5
Soya meal	45%	Med./High	2·7
Peanut meal	45%	Medium	2·7
Sunflower meal	30%	High	2·45
Sunflower meal	35%	High	2·45
Cottonseed meal	40%	High	2·5
Heated peanut meal	45%	High	2·7
Barley grain	13%	Low	2·65
Sorghum grain	10%	Med./High	2·65
Lucerne hay (good)	18%	Medium	2·1
(fair)	12%	Low	1·9
Dehydrated lucerne meal	19%	High	2·24
Molasses	0–3%	..	2·00
Fresh clover	20%	Low	2·5
Dry clover	16%	Medium	2·1

*High (60%). Medium (40–60%). Low (40%).

Grain feeding of breeders for production has also been practised on some properties when the price of grain on an energy basis is competitive. This requires the addition of a protein component to the ratio (often in the form of a commercial premix) to reduce the amount of substitute feeding which can occur. For safety reasons, cattle should be trained to eat grain.

Mr John Smith of 'Alum Rock' has used grain (2 kg per day) to feed breeders during hard winters. This has resulted in fewer losses, sappier weaners and high calving rates.

John says, 'I wouldn't be without a winter supplement of some sort given that beef prices are reasonable!'

Molasses is often one of the cheapest sources of energy available but is sometimes difficult to handle during the coldest winter months. When feeding molasses, the full protein requirement must be added.

Again, we should not overlook the importance of management in the total approach to feeding. For example, on 'Terrica Station', which is one of the largest properties in the area (some 20 000 ha—it has carried up to 24 000 wethers and 1 000 head of cattle) Mr Neville Wuth, a manager for 17 years, was able to maintain very high calving rates in their breeding cattle with limited assistance from supplements. Admittedly, the large size of this property allowed young cattle to be run in their own area and not boxed with sheep.

'This was of tremendous benefit,' he said. Supplements were only provided in drought years. The branding rates achieved on 'Terrica' over a 5-year period speak for themselves.

Year	Females Joined	Calves Branded	%
1975	368	320	86
1976	459	427	93
1977	454	412	90
1978	394	361	91
1979	405	352	87

Neville attributes this result to sensible stocking and being able to split breeder groups by age, thus giving special attention to replacement heifers and heifers on their first calf.

Culling cows on fertility was also part of the programme. Cows were sold when they missed more than one calf.

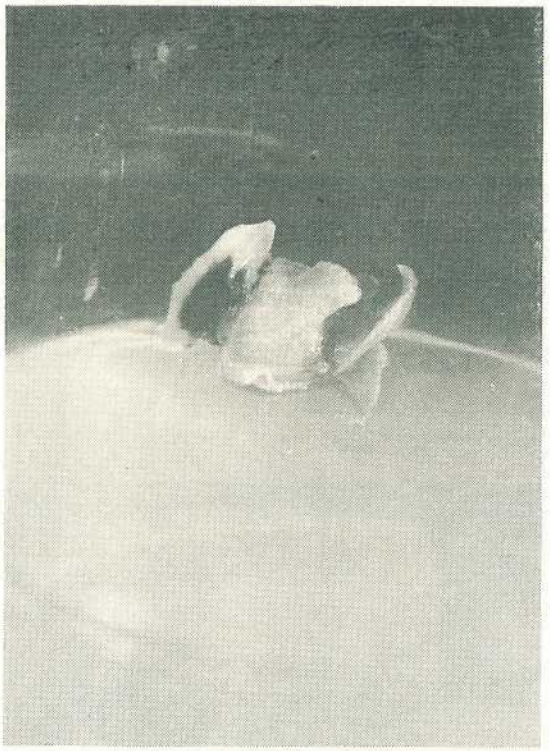
The mortality rate in breeders for the same period was always less than 3%, the large bulk of these losses being due to eye cancer rather than nutrition.

One problem that did result was a lack of regrowth control in paddocks grazed only by cattle.

Acknowledgements

The author wishes to thank Mr Phillip Kemp, the Blundell family and the University of New England's Department of Biochemistry and Nutrition for the initial stimulation and continued encouragement with this work.

Pineapple tissue culture



unequalled for rapid multiplication

by R. A. Drew, Horticulture Branch

TISSUE culture in pineapples has been developed at Redlands Horticultural Research Station to the stage where rapid clonal multiplication is a practical proposition, requiring only moderate laboratory facilities and training.

These facilities are now available at a number of private laboratories in South-east Queensland.

Plant tissue culture is a method of plant propagation by growing small sections of dissected tissue on artificial media in sterile conditions. If the plant has been cultured elsewhere in the world, it may be simply a matter of finding the relevant journal and copying the technique and medium (or nutrient solution) used.

If clear information on the culture of a particular species is not available then it is often difficult to work out the required combination, and relative strengths of chemicals to be added

Photograph above left. Stage 1—a single pineapple shoot initiating from a dissected lateral bud.

Photograph above right. Stage 2—a developing single shoot.

to the medium. For the past 3 years, the Department of Primary Industries has been researching pineapple tissue culture and has developed an improved procedure for the rapid multiplication of pineapples. Using this technique, it is possible to produce 100 000 plants from one shoot in less than 12 months.

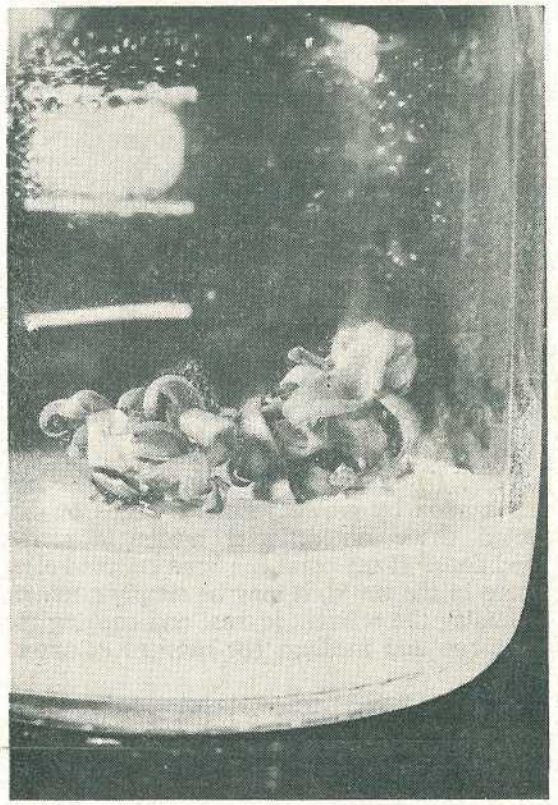
Stages of pineapple tissue culture

The first stage is to take a surface-sterilized lateral bud and place it on a simple medium for about 3 weeks. This initial period should confirm whether the culture is free from microbial contamination and initiate growth of the bud.

The second stage of culture is to place the tissue on to a medium which will support shoot growth. The aim at this stage is to produce a strong single shoot.

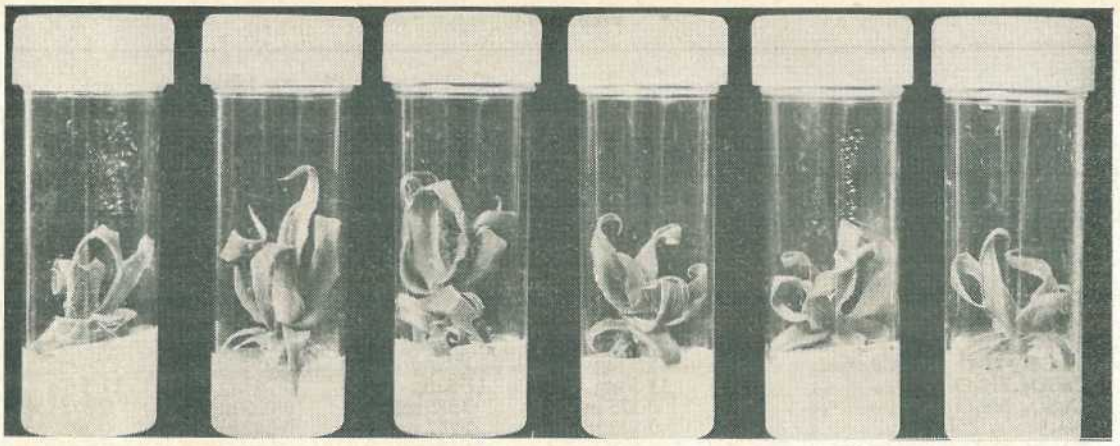
The third stage of culture is to produce multiple buds. This is achieved in two ways.

Firstly, the media is changed to one which is conducive to multiple bud growth. Secondly, apical dominance of the single shoot can be overcome thus stimulating lateral bud growth. This can be achieved by dissecting the single shoot vertically, cutting through the apical bud and producing two halves. These pieces are placed with the cut section on the medium.



Stage 3—lateral buds initiating on both halves of a bisected single shoot.

Stage 3—final stages of multiplication. The plantlets are ready for sub-culturing or transfer to single shoot medium.



Stage 4—Growth of plants on single shoot medium.

Stage 4—This plant is ready for planting in soil.

The final stage of culture is to transfer single shoots on to a medium which will initiate roots on the plant. The plants may then be transferred to a pot, preferably in a glasshouse or shadehouse. Work at present is aimed at experimenting with transplanting these plantlets into reusable seedling containers such as 'Speedling trays' or 'Gro-pots'.

Technique

Selection of tissue for culture

The best material for dissecting is the axillary buds at the base of the leaves. Only a percentage of these buds grow; so it is best to obtain buds from actively-growing material such as slips and suckers. Tops can be used but the percentage of buds surviving can be as low as 10%. A 50% success rate with this process of initial dissection is considered good.

Disinfestation of plant tissue

Firstly, all leaves should be peeled off the slip or sucker leaving only the stem. Small triangular-shaped lateral buds should be visible at this stage. A useful pre-treatment is to put the stem section into running water for 30 minutes to remove microbial spores. The stem should then be subjected to a chlorine treatment of 5% w/v calcium hypochlorite or 1% sodium hypochlorite for 15 minutes. Improved contact of the chlorine with the tissue can be achieved by performing this operation in a vacuous chamber or adding a

TABLE 1

Constituent	Concentration (Wt. per Litre)			
	Solution A	Solution B	Solution C	Solution D
A. Elements—				
NH_4NO_3	1·6 g	1·6 g	0·8 g	1·602 g
KNO_3	2·0 g	2·0 g	1·0 g	2·0 g
NaH_2PO_4	0·24 g	0·24 g	0·12 g	0·24 g
$CaCl_2$	0·33 g	0·33 g	0·22 g	0·33 g
$MgSO_4.7H_2O$	0·74 g	0·74 g	0·37 g	0·74 g
H_3BO_3	9·27 mg	9·27 mg	3·09 mg	9·27 mg
$MnSO_4.H_2O$	15·9 mg	15·9 mg	8·45 mg	15·9 mg
$ZnSO_4.7H_2O$	11·5 mg	11·5 mg	5·75 mg	11·5 mg
$CuSO_4.5H_2O$	0·375 mg	0·375 mg	0·025 mg	0·375 mg
$Na_2MoO_4.2H_2O$	0·242 mg	0·242 mg	0·242 mg	0·242 mg
$CoCl_2.6H_2O$	0·238 mg	0·238 mg	0·119 mg	0·238 mg
KI	0·83 mg	0·83 mg	0·415 mg	0·83 mg
NaFeEDTA	36·7 mg	36·7 mg	18·35 mg	36·7 mg
B. Auxins—				
Indole acetic acid		0·175 mg	0·175 mg	
Indole butyric acid		0·203 mg	0·203 mg	
Naphthalene acetic acid		0·186 mg	0·186 mg	
2–Naphthoxy acetic acid		0·202 mg	0·202 mg	
2.4–dichlorophenoxy acetic acid		0·221 mg	0·221 mg	
Para-chlorophenoxy acetic acid		0·186 mg	0·186 mg	
C. Cytokinins—				
Kinetin		2·152 mg	2·152 mg	
Benzyl amino purine		2·252 mg	2·252 mg	
D. Carbon source—				
Sucrose	20 g	20 g	20 g	20 g
E. Growth factor—				
Inositol		108·09 mg	108·09 mg	
Nicotinic acid		4·92 mg	4·92 mg	
Pyridoxine HCl		1·23 mg	1·23 mg	
Thiamin HCl		13·49 mg	13·49 mg	
Biotin		0·24 mg	0·24 mg	
Folic acid		0·88 mg	0·88 mg	
D-Ca-Pantothenate		2·38 mg	2·38 mg	
Riboflavin		3·76 mg	3·76 mg	
Ascorbic acid		1·76 mg	1·76 mg	
Choline chloride		1·40 mg	1·40 mg	
L. Cysteine HCl		18·91 mg	18·91 mg	
Glycine		3·75 mg	3·75 mg	
Adenine sulphate	80 mg			
(f) Agar	8 g	8 g	8 g	8 g

few drops of detergent non-toxic to tissue culture such as 7X or Medox. The chlorine treatment should be followed by three rinses in sterile water.

Dissection and transfer

While taking the normal precautions against aerial contamination, the triangular-shaped buds can be dissected and transferred to the culture tube. When dissecting the buds, it is best to cut a deep V in the tissue underneath to give them a better chance of surviving. It is not necessary to peel the scale leaves off the buds.

The best culture tubes available are the autoclavable polycarbonates. The tube plus media should be autoclaved for 15 minutes at 121°C preferably the day before dissection.

Culture media

As explained earlier, best results have been obtained by using different media at each stage of the culture. The media and stages are listed below and then defined in table 1.

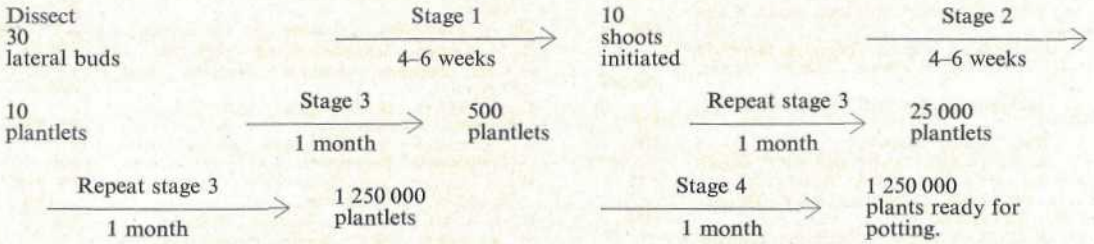
- Stage 1—Growth Initiation: cull contaminated tubes.
- Stage 2—Promote single shoot
- Stage 3—Multiplication.
- Stage 4—Root initiation on single plantlets.

The approach we have used to determine the best culture media is to begin with a broad spectrum media (with more vitamins and hormones than are necessary) and then refine it. At present, it appears that any one of the auxins in group B is satisfactory for pineapple tissue culture if used singly. Also, it is doubtful if in group E we need to add any more than the first four growth factors (Inositol, Nicotinic acid, Pyridoxine HC1 and Thiamin HC1). However, the above solution is satisfactory and further refinements should be known next year.

Rate of multiplication

Growth initiation and single shoot production may take 2 to 3 months. After dissection, and transfer to multiplication media, growth is rapid with 30 to 50 plants being produced in 1 month. The number produced is regulated to some extent by the size of the culture vessel. The last stage of development (root initiation and growth of single plants) takes about 1 month. Even if roots are not produced, the plants will initiate roots when placed on moist soil. The importance of the last stage is to increase the size of the single plants to enable planting in soil.

If ten lateral buds are initiated, the following multiplication is possible.



One problem faced by other workers in tissue culture is the production of genetic off-types. These are normally produced if the multiplication stage involves undifferentiated callus growth. The technique described here, which involves bisecting a shoot and placing the halves on the multiplication media, produces minimal callus. Field testing is at present underway to study plants which have undergone three sub-cultures. No off-types are apparent at this stage. At present, multiplication is not recommended beyond three sub-cultures.

If facilities are available, multiplication is unlimited. It is not suggested that this procedure would replace normal propagation—tops, slips and suckers—of a satisfactory clone on an established farm. However, it represents an unequalled potential for rapid multiplication of a small nucleus of clonal material, with minimal land requirement.

This has two main advantages: an aid to plant breeding, and, the release of new and superior clones. Firstly, multiplication of single plant selections will facilitate rapid evaluation of new clones. Secondly, it stands alone as a technique to multiply proven and superior clones for release to industry of large numbers of plants in a short time.

Bovine brucellosis accredited-free herd scheme

THE following list contains all herds which have been given accredited-free status under the bovine brucellosis accredited-price herd scheme as at 30 July, 1980.

Brisbane Division

F. J. & M. I. Anderson, Currumbin Creek Road, Currumbin.	JS, FS, JSX
E. R. Andrew, Woodford Road, Peachester.	FS
Animal Husbandry Research Farm, Dept. Primary Industries, Rocklea.	MIXED
Arababy Angus Stud, 'Arababy', Moore.	AG
H. R. Arthy, 'Beauvale', Laravale, via Beaudesert.	JS
Artificial Breeding Centre, c/- Dept. Primary Industries, Grindle Road, Wacol.	MIXED
R. J. & L. A. Bachmann, 'Mulgowie', M.S. 182, Laidley.	PH
W. S. & E. M. Badcock, 'Wandall Estates', Serpentine Creek Road, Redland Bay.	MG
Bando Pastoral Co., c/- P. B. & C. M. Schmidt, 'The Homestead', Yandina, and 'Avonel Park', Kenilworth.	BM
R. & M. Barnes, 'Echo-Dell', Diamond Valley, Mooloolah.	HF
A. Bassingthwaite, Yabba Pastoral Co., Yabba, Junica, via Kilcoy.	SG
A. V. Bauer, 'Warralea' Droughtmaster Stud, M.S. 825, Ipswich.	DM
W. R. & G. W. Bauer, 'Grampians' and 'Amaroo', Cannon Creek, M.S. 484, Boonah.	BM
G. W. Beck, 'Banbeck', Blenham Road, Laidley.	DM
C. H. Beckingham, Cosme Jersey & Hereford Stud, Bridgeman Downs, Darien Street, Aspley.	JS, HF
E. C. Behrendorff, 'Inavale' Stud, M.S. 488, Boonah.	FS
A. G. Bell, 'Aroo', Boonah.	HF
R. G. & E. J. Bell, 'Nallaview A.I.S. Stud', Commissioner's Flat Road, Woodford.	AIS
Bellreen Pty. Ltd., 'Coolalinga Stud', Hunchy Road, Palmwoods.	DM
H. G. & C. M. Benstead, 'Analwon', Wonglepong, via Tamborine.	AIS
J. H. W. & T. Betts and R. K. & B. E. Perry, 'Nindethana', 12 Camp Mt. Road, Samford.	DM
R. Biggs and Sons, Dulong, P.S. 1096, Nambour.	FS
N. J. & J. F. Birch, 'Bonny J' Stud, River Road, Peachester.	BF
L. A. & C. R. Bischoff, 'Taminnis' Stud, P.S. 1978, Beaudesert.	FS
R. A. Bischoff, 'Buaravale', Buaraba Creek, Coominya.	DM
P. G. & C. A. Blanche, 'Blandson' Stud, Stock Route Road, Fernvale.	BF
L. Blank, Running Creek via Rathdowney.	SG
D. R. Bleakley, Tumbeelluw Stud, Maleny.	MG
N. J. & E. B. Blumel, 'Willow Glen Farm' Stud, Farm Road, Bunya.	DM
G. C. & L. D. Bond, 'Willow Valley', Kings Scrub, Dayboro.	AIS
J. J. & S. L. Brider, 'Kenmar' Stud, Cryna, M.S. 1916, Beaudesert.	FS
A. & A. J. Brown, Kidman Creek, Obi Obi, Maleny.	AIS, HF, JS
H. D. & P. R. Brown, 'Westerngales' Stud, Wight's Mountain Road, Samford.	SG
M. J. & M. P. Brown, 111 Lemke Road, Taigum.	HF
G. A. & J. L. Buchanan, 'Airdrie' Brahman Stud, 242 Holmes Street, Brighton.	BM
R. W. & T. R. Buchanan, Clarinnis Droughtmaster Stud, Steihardts Road, Marburg.	DM
K. & C. Buchbach, 'Dingelee Dell', Wootha Road, Maleny.	FS
Estate of Dr S. A. Buckingham, 'Banyak-Suka', D'Aguilar via Woodford.	BM, CL
A. H. & M. Burridge, Hatari Lodge, Mutdapilly.	CH
J. A. & A. W. Butler, 'Coochin', Old Gympie Road, Beerwah.	BF
D. E. Byrne, 'Agostine Brahman Stud', 11 Glindeman Drive, Holland Park.	BM
J. Byrne & Co., G.P.O. Box 1677, Brisbane.	BM
R. B. & L. M. Cahill, 'Carinya', Lamington via Beaudesert.	HF, HFX
R. J. & G. E. Callaghan, 'Canowindra', Upper Camp Mt. Road, Samford.	DM
J. D. & H. Campbell, 'Hilden', Burpengary Road, Narangba.	MG, LM
R. H. Challen, 'Chalhaven Droughtmaster Stud', 52 Haven Road, Pullenvale.	DM
L. A. & C. M. Chesworth, 'Willette', Cryna Road, Beaudesert.	FS, AFS
B. L. & M. O. Christensen, 'Elavesor' Poll Hereford Stud, Rosevale via Rosewood.	PH
G. E. Christensen, 'Double E', Moorang via Rosewood.	SG
M. R. Christensen, Santra Gertrudis Stud, Santa Rio, Rosevale via Rosewood.	SG
T. & W. Christensen, 'Omaha', Tarome via Kalbar.	PH
M. A. Christoffel, Veresdale via Gleneagle.	AY
B. H. Clancy, Callaghan Road, Narangba.	SW
G. R. Clapham, Amazon Brahman Stud, D'Aguilar.	BM
C., C. H. O., S. H. Clarke, M.S. 825, Peak Crossing, via Ipswich.	JS, FS
A. H. Clinch, 'Beauden' Poll Hereford Stud, Nindoonidah, Beaudesert.	PH
W. A. Collard and Sons, 'Cedar Park', M.S. 16, Witta Road, Maleny.	FS, GS, AFS
K. J. & G. J. Colley, 'Mirondi', Kiamba.	PH
N. A. Collins, (R.J.), Kuloe, Ocean View via Dayboro.	BM
I. S. Conochie, 'Brookland', M.S. 461, Kalbar.	JS
B. M. Conroy, 'Logan View', via Coominya.	CL
T. J. Cottee, 'Tallegalla Stud', 1 Bygott Road, Samford.	CL
R. T. & P. A. Craig, 'Dulong' Stud, M.S. 1096, Nambour.	MG
D. B. & E. Crane, 'Keglsugl', P.O Box 7, Dayboro.	PH
J. Crombie, Woodlyn Properties, 'Woodlyn', Glen Esk Road, Esk.	DM
Mrs M. Crombie, Old Hidden Vale Santa Gertrudis Stud No. 49, Old Hidden Vale, Grandchester.	SG
M. H. & R. M. Crouch, Mt. Mee, Dayboro.	FS
G. & M. A. Cummins, Waubra Park, Thagoona.	SM
R. J. & J. M. & L. C. Daniels, Jandella Friesian Stud, Woodford Road, Mt. Mee.	FS
B. H. Davis, Petrie Creek Road, Nambour.	MG
T. W. & M. D. Deans, Dino Glen, Watson's Lane, Reeseville, Maleny.	FS
F. G. & L. M. Delroy, 'Wandarri', Boonah.	BM
M. D. & D. J. Delroy, Old Mt. Alford Road, Boonah.	BM
D. V. Dent, 'Rosemount' Stud, M.S. 16, Conondale Road, via Maleny.	SM
Mr Dieckmann and Son, 'Keystone' Stud, Running Creek, Rathdowney.	SG
M. J. Dignan, Herron Road, Closeburn via Samford.	MG, JS, FS
H. J. & L. G. Dippel, Thornton Mountain Crest, M.S. 182, Laidley.	GS

W. A. Dodd, Glengannon Stud, M.S. 435, Rosewood. **PH**

L. J. & L. E. Donnelly, 'Cedar Grove' Poll Hereford Stud, Cedar Creek Road, Wolfdene via Beenleigh. **PH**

D. C. Doyle, 'Aspel', Lacey's Creek, Dayboro. **FS**

H. F. & W. H. Duhs, Green Valley, Kiamba via Yandina. **GW**

V. L. Duhs, Murray Grey Stud, Image Flat Road, Nambour. **MG**

W. H. Dunn, 'Ranorwen', New Country Creek, Kilcoy. **MG**

D. P. H. & C. G. Earl, 'Boolaroo', Boyland, via Tamborine Village. **MG**

G. G. Endres, Willowmundi A.I.S. Stud, Wilson Lane, Eumundi. **AIS**

E. G. Evans, Lauraven, Mountain View Road, Maleny. **AIS**

W. R. & L. M. Falkenhagen, 'Lynnwill Stud', M.S. 794, Warwick Highway, Kalbar. **GS**

G. Falls, Karinga Valley, M.S. 1096, Nambour. **JS**

G. T. C. Farrawell, Landershute Road, Palmwoods. **DM**

J. A. & D. P. Ferguson, 'Dorallah' Jersey Stud, Veresdale via Beaudesert. **JS**

E. Ferrar, Anthony Murray Grey Stud, Roadvale. **MG**

R. R. & S. G. Findlay, M.S. 23, Rosevale. **JS**

J. W. Fisher and C. E. Bond, 'View Fair', River Road, Peachester. **JS**

P. Fleming, 'Wundaburra', Mt. Archer via Woodford. **HF**

M. Flynn, Normanby, Wilsons Plains, Harrisville. **DM**

D. J. Fogg, 'Den-Dia' A.I.S. Stud, M.S. 336, Toogoolawah. **AIS**

W. A. Freeman, Trevlac Stud, Walloon Road, Rosewood. **CL**

G. J. & M. Freer, Coottha Coottha Charolais, 445 Simpsons Road, Bardon. **CL**

French Bros. and Co., 'Rivervale', Mt. Pleasant via Dayboro. **FS**

J. Friedland and Son, 'Glen-Opal', Obi Obi, via Nambour. **JS**

P. & J. Gibbons, 'White Mists', Mt. Glorious, via Kilcoy. **DM**

P. Gillingham, 'Jerra Marumba', Witta. **RP**

K. J. & M. S. Gilmour, 'Ridgegrove', Oakey Creek, Kenilworth. **HF**

T. H. & D. D. Gooding, 'Booboogan' Stud, 'Merrimac' via Nerang. **PH**

R. T. Goodrich, 'Glen Home' Stud, Perwillowen Road, Nambour. **DM**

B. B. Gotke, Reynold Valley Jersey Stud, M.S. 461, Kalbar. **JS**

R. A. & T. M. Gould, 'Shannonvale', Lot 6, Coominya. **DM**

L. R. Granzien, 'Caboonbah' Jersey Stud, Kalbar. **JS**

A. J. & A. G. Grech, Shady Oakes Friesian Stud, Post Office, Oxenford. **FS**

J. C. Grigg, 'Bethonga' Braford Stud, P.O. Box 4, Wamuran. **BF**

S. K. & S. M. Guppy, 'Lynstarr', M.S. 956, Nambour. **FS**

D. A. Hardie, Bromelton House, Beaudesert. **HF**

H. R. Harris, 'Temora Park' Stud, M.S. 33, Cedar Creek via Samford. **PH**

N. & F. M. Harrison, 'Oakridge Stud', Bartholomew Road, Elimbah. **BS**

R. & R. I. Harsant, 'Oaklea', Warrill View via Harrisville. **PH**

J. H. Heard, Toddbrooke, Townson Road, Thornton via Laidley. **SM**

W. H. Heck and Son P/L, 'Undulla', Woodhill via Beaudesert. **BM**

H.M. State Farm, Numinbah Valley, Numinbah via Nerang. **FS**

Superintendent, Her Majesty's Prison, Neurum Road, Woodford. **JS**

H.M. State Farm, Palen Creek, Rathdowney. **JS**

H.M. Prisons, 'Wolston' Stud, Station Road, Wacol. **FS**

A. T., R. E. & J. A. Herron, M.S. 16, Conondale via Maleny. **FS, AFS**

W. F. Herron, 'Bundaleer Stud', Herron Road, Closeburn via Samford. **FS**

R. S. & E. M. Heslip, Shamrock Friesian Stud, Sommerville Road, Beechmont. **FS**

C. J. Hewitt, 'Judel' Friesian Stud, Delaney's Creek via Caboolture. **FS**

K. A. Hickey, 'Limerick' Stud, Bunya Road, Bunya. **FS**

F. J. Hirn and Sons, 'Glen Avon', Peachester Road, Beerwah. **JS**

R. H. Hodby, 'Hurstview Stud', 100 Ewing Road, Woodridge. **JS**

G. & J. F. Hodgens, Bunyeris, Peachester via Beerwah. **JS**

A. T. Holt and Son, 'Karowara Santa Gertrudis Stud', Hartley Road, Tamborine Mt. **SG**

M. K. & M. R. Hooper, Kareela, Plainland via Laidley. **DM**

H. W. Hopper, 'Ellendean' Guernsey Stud, P.O. Box 4, Maleny. **GS**

Sir Alan Hulme, Alcheringa Droughtmaster Stud, Highlands Road, Eudlo. **DM**

S. P. & L. I. Hung, Mandarin Brahman Stud, corner of Middle and School Road, Purga. **BM**

S. E. Hunt and D. J. and M. Doyle, 'Kudo' Stud, 'Komirra Pastures', Glasshouse Mountains. **PH**

T. M. Hunt, Bald Knob Road, Peachester. **AIS, FS**

R. B. & S. R. Huth, M.S. 23, Moorang via Rosewood. **JS**

Innisplain Cattle Co., c/- I. W. Wightman, Running Creek Road, Innisplain. **SG**

Inverstanley Pastoral Co., 'Inverstanley', Esk. **BM, DMX**

R. F. & G. P. & G. C. Isbell, 'Figtree', Coulson via Boonah. **DM**

R. Jameson, 'Narich', Buaraba Creek Road, Coominya. **HF**

G. R. Jess, 'Adnamira Stud', Old North Road, Strathpine. **DM**

Jimora Grazing Co., c/- G. N. & K. Brandon, 'Morden', Toogoolawah. **BM**

H. N. Johns, 'Alouette' Stud, M.S. 435, Rosewood. **LM, FS**

J. E. & M. T. Johnson, Logan River Stud, Woodhill. **FS**

F. S. Johnston, 'Jon-Dene', Obi Obi, via Mapleton. **AIS**

R. W. Johnston, 'Wallum Hills' Santa Gertrudis Stud, Franks Lane, Wamuran. **SG**

R. L. & S. S. Jones, 'Valley View' Stud, Samford Road, Samford. **AY**

C. L. Keaveny, Kerry via Beaudesert. **HF**

Kengoon Pastoral Co., 'Kengoon' Studs, Kengoon, Kalbar. **BM, CL, DM, AF, PH**

A. B. Kerle, 'Sunnyvale' Braford Stud, Marburg. **BF**

J. L. King, Ridley Park, 79 Bridgeman Road, Bridgeman Downs, Aspley. **PH**

Miss T. J. Kingston, 'Auchen Gowan' Ayrshire Stud, M.S. 435, Tallegalla via Rosewood. **AY, GS**

L. B. & M. Kirby, 'Kalanga' Stud, Wesley Road, Kallangur. **CL**

D. V. Knight, Bonnie View, Old Fernvale Road, Vernor via Lowood. **JS**

K. R. & M. S. Knight, Mt. Mee via Dayboro. **FS, AFS**

E. W. & L. M. Langley, 'Charolong Charolais Stud', Langlands via Kallangur. **CL**

K. R. & E. A. B. Lawler, 'Coolibah' Stud, M.S. 292, Marburg. **AIS**

A. E. Lawley, 'Arley A.I.S. Stud', Reesville Road, Nambour. **AIS**

R. C. & J. E. Lawrence, Lorandale Droughtmaster Stud, Lot 31v, Boyles Road, Belli. **DM**

N. F. & A. A. Ledger, 'Dulong', 7 Image Flat Road, Nambour. **JS**

O. G. & P. J. Leis, Mountain View Stud, Kings Scrub, Dayboro. **FS**

Lenorco Pastoral Co., Pierce Avenue, P.O. Box 143, Caloundra. **CL**

K. D. & J. K. Little, 'Woodleigh' Stud, Beaudesert. **JS**

G. L. & A. E. Lobegeiger, 'Sunny Grove' Jersey Stud, Moorang via Rosewood. **JS**

N. E. Lobley, 'Neloby', Mt. Pleasant via Dayboro. **FS**

D. D. Logan, 'Glenmaurie', Kilcoy. **BF, HFX**

D. D. Logan, 'Pine View', Kilcoy. **BS, BM**

G. M. Logan, 'Neara Stud', Pineview, Kilcoy. **CL**

Mrs J. Logan, 'Jay-El' Stud, 'Callemondah', Tarome, M.S. 21, Kalbar. **BM**

W. J. & R. J. Logan, Emma Josey Stud, Murrays Crossing Road, Mt. Walker West, via Rosewood. **SM**

R. H. & B. M. Lostroh, 'Springlands' Stud, M.S. 366, Rosewood. **FS**

R. D. Lowe, 'Willola', P.S. 1406, Upper Caboolture. **BM**

C. R. Loweke, 'Willowside', Kenilworth. **JS**

K. D. & D. R. Ludwig, 'Sun Valley', Tarragalba, M.S. 411, Beaudesert. **FS**

L. H. Ludwig, 'Riverview', Boyland via Tamborine. **FS**

S. H. & R. L. Ludwig, 'Glenvale', Boyland via Tamborine. **GS**

J. MacIntyre, Dulong Road, Dulong via Nambour. **JS**

P. D. MacIntyre, Ti Tree Springs, P.S. 1096, Dulong via Nambour. **JS**

D. C. McConnel, 'Cressbrook', Toogoolawah. **HF, FS, AIS**

M. M. & G. E. McGuire, 13 Burton Street, North Booval. **CL**

McInnes Bros., Inverclyde, M.S. 126, Harrisville. **AFS**

A. & R. D. McLaughlan, 'Brightview' and 'Akubra' Studs, Old Rosevale Road, Warrill View, Harrisville. **BF**

B. F. McNamara, Woodford Road, Peachester, via Woodford. **PZ**

V. P. McShane, 'Mareevale' A.I.S. Stud, Lacey's Creek Road, Dayboro. **AIS**

F. A. Mallinson, 'Ganbeer' A.I.S. Stud, M.S. 438, Boonah. **AIS**

A. G., E. B. & L. G. J. Marshall, 'Yurunga', Beechmont via Nerang. **JS**

J. W. & I. J. Martin, 'Kirkton' Friesian Stud, M.S. 411, Beaudesert. **FS**

R. J. P. Martin, 'Jacaranda' Friesian Stud, M.S. 546, Forest Hill. **FS**

F. D. & P. A. Mayo, 'Logan Park' Simmental Stud, Pacific Highway, Loganholme. **SM**

S. J. Mecklem, 'Calgai', Toorbul Road, Caboolture. **HF**

R. C. Mogg, 'Raymount' Friesian Stud, Dulong via Nambour. **FS**

P. Mort, 'Franklyn Vale' Braford Stud, Franklyn Vale, Grandchester. **BF**

H. A. Muir, Church Road, Bethania. **PH**

L. J. Muller Pty. Ltd., 'Illoura', M.S. 21, Kalbar. **SG**

A. J. Mumford and Son, North Pine Stud, Todds Road, Lawnton. **PH**

K. J. Murphy, 'Ka-Amm' Stud, 'Homeleigh', Mt. Walker via Rosewood. **BF**

M.V. Pastoral Development, 'Noorra Munga', Mutdapilly. **MG**

J. C. & A. Newton, 'Merryvale Stud', M.S. 2132, Upper Caboolture. **JS**

G. & V. Niebling, Thornton, M.S. 182, Laidley. **HF**

A. &. K. Niethe, Lockrose, M.S. 546, Forest Hill. **DM**

J. D. & K. F. Noonan, M.S. 182, Laidley **GS**

N. F. Nutt, Ferny Vale, Canungra. **FS**

T. A. & M. W. O'Brien, Coolum Park Stud, Toolborough Road, Yandina Creek. **BF**

M. J. O'Dwyer, Renmark Poll Hereford Stud, Grey Street, Roadvale. **PH**

Pagel and Hayes, 'Trafalga' Stud, Tarampa via Lowood. **AIS**

K. S. R. & E. M. Patrick, Boyland, via Tamborine. **GS**

S. & S. M. Paulger, 'Adadale', Kenilworth. **JS**

A. J. Peden, 'Warroolaba Stud', Warrill View via Harrisville. **AIS**

D. M. Perrett, 'The Cedars', Harrisville. **MIXED**

Perrin Enterprises Pty. Ltd., 'Mascott Park' Stud, Gilston via Nerang. **BM**

Pickering Bros., 'Granite Vale' Stud, Sellins Road, Mt. Mee via Dayboro. **FS**

Pipi Holdings P/L, c/- R. G. Bell, 'Gindibah', P.O. Box 37, Caloundra. **AIS**

R. H. & R. R. J. Pocock, 'Maroon', M.S. 488, Boonah. **BF**

C. E. & M. L. Pointon, Melford Park, Lanefield, Rosewood. **BF**

J. F. Porter, Westwood Jersey Stud, M.S. 16, Maleny. **JS**

B. & D. Pugsley, 'Aikira', Landsborough Road, Maleny. **SM, HFX**

H. D. N. & C. K. Quast, 'Lincolnfield', P.O. Box 150, Beaudesert. **SM**

Rahane Pastoral Co., c/- A. O. Clark, Innisplain via Beaudesert. **SG**

O. A. Raine, 'Raine Drops Poll Hereford Stud', 43 Dunbeath Drive, Burpengary. **PH**

J. L. & L. R. Ramsay, 'Binowee', Currawong Place, Caboolture. **CL**

R. F. & B. Reberger, 'Rose Meadows Stud', c/- Post Office, Rosewood. **BS**

I. H. & J. P. Reck, 'Robynlea', Laidley. **GS**

H. M. & N. F. Redgen, 'Bonnie Brae', Palm Street, Maleny. **MIXED**

Redlands Licensed Semen Export Centre, c/- Dept. of Primary Industries, Horticultural Research Station, Ormiston. **SW, AMZ, RS, AIS**

K. G. Reinhardt, 'Kenway' Red Poll Stud, M.S. 906, Mapleton. **RP**

E. G. & B. Roach, 'Omaru', Bellmere Road, Caboolture. **CL**

K. O. Roberts, Purga Pastoral Co., 9 Woodgate Street, Churchill **CL**

Rockton Nominees Pty. Ltd., 'Guijar' Stud, c/- Austral Industries P/L, P.O. Box 109, Ipswich. **CL**

A. J. T. & I. M. Ross, 'Rosdale' Stud, Dayboro Road, Samford. **FS**

G. R. & R. J. & D. B. Ross, "Starview", M.S. 523, Rosewood. **AIS**

Mrs M. A. Rostedt, M.S. 1916, Cryna Road via Beaudesert. **HF**

P. D. & B. M. Rowley, 'Lac-Mel', Mt. Pleasant via Dayboro. **FS**

F. & G. Ruckman, 'Sarabah', M.S. 413, Beaudesert. **BF**

L. D. Russell, 'Courtleigh' Brahman Stud, Woodford Road, Peachester via Woodford. **BM**

K. W. W. & V. J. Schlodfeldt, 'Wyandah', Kargorum Road, Beaudesert. **SM**

J. C. Schmidt, 'Cordell County', Winn Road, Mt. Samson, via Dayboro. **FS**

W., L. W. & D. J. Schossow, 'Teviot Brooke', M.S. 488, Boonah. **FS**

D. I. Scott, Shepherd Hill Stud, Beechmont Road, Nerang. **JS**

E. I. Scott, J. S. Edwards and L. M. Randall, 'Auchenflower', Glenore Grove via Forest Hill. **AY, FS**

J. N. Scott & Son, 'Auchen Eden', Camp Mountain Road via Samford. **AY**

H. D. Searl, 'Karralbel', 807 Upper Brookfield Road, Upper Brookfield.

L. & E. F. Sellin, 'Pasture Glen', Kings Scrub, Dayboro. **FS**

L. Shaw, 'Padue' Stud, Kareelpa via Nambour. **SM**

J. Simon, 'Broshami' Stud, Maleny. **BM**

R. E. Simpson, 'Tangarine Springs', 25 Waraba Crescent, Caboolture.	MG
R. L. Sinnamon, 'Robenlea' Stud, Robenlea, Harlin.	SG
E. J. Smith, 'Hillcrest' Ayrshire Stud, Borallon via Ipswich.	AY
F. J. & H. R. Smith and Sons, 'Rubyvale' Angus Stud, 'Bralea' Burnside Road, M.S. 1096, Nambour.	AG
J. W. & B. A. Smith, 'Wyanba', Lamington, Beaudesert.	AIS, HF
L. D. & G. L. Smith, "Sweetacres A.I.S. Stud', Lot 6, Rossmore Road, Kingston.	AIS
N. D. Solomon, 'Springwood', Kureelpa, Mapleton.	GS
E. W. & M. W. Sorensen, 'Farmlands Jersey Stud', Montville Road, Palmwoods.	JS
W. Spresser and Sons, 'Carnation', Mt. Walker Road, Rosewood.	JS
A. E. Stanton and Sons, Stanton's Dairy, South Pine Road, Strathpine.	FS
Dr J. A. Stephenson, 'Sahwalid Sahiwal Stud', 'Belli Downs', Kenilworth Road, Belli via Eumundi.	SW
S. R. & I. B. Stevens, "Lasswade" Stud, Peak Crossing.	RS
M. Stitz, Ocean View, Dayboro.	BF
M. D. Stokes, P.O. Box 56, Laidley.	JS
J. G. Stubbings, 'Stratton Vale', Lacey's Creek, Dayboro.	FS
K. F. & A. R. Stumer, Glen Rock Stud, Frenches Creek via Boonah.	MG
R. L. & V. M. Stumer, 'Lavron Nook' Friesian Stud, M.S. 484, Boonah.	FS
L. R. & P. M. Summerville, 'Fairy Bower', Cryna via Beaudesert.	FS
K. Sutton, 'Startwell', Basin Road, Wamuran.	BM
Tantallon Grazing Co., 'Tantallon', Darlington via Beaudesert.	HF, JS, X FS
A. J. Taylor, 'Glen Alpine', Veresdale via Gleneagle.	JS, FS
J. T. Taylor, 'Bianca Jersey Stud', Eagle Street, Harrisville.	MIXED
G. A. Teese and Son, Toolamba Cattle Co., Innisplain, Beaudesert.	AIS, FS
J. & B. J. Teese, 'Lyndith Stud', Veresdale via Beaudesert.	AIS
J. R. H. & R. V. Thomson, 'Dewrang', Natural Bridge, via Nerang.	JS, AIS, GS
M. A. S. Thomson and G. J. Michael, Meltowia Stud, M.S. 336, Toogoolawah.	FS
H. G. M. & B. V. Thorne, 'Dewhurst Stud', Hattonvale via Laidley.	JS
H. A. Thornton and Sons, 'Bellmore', Woolmar Road, Kilcoy.	JS
I. G. and D. E. Tidswell, Lake View via Tewantin.	CL
J. R. Todd, 'Aberfoyle', Laravale via Beaudesert.	JS
A. C. Toney, Flagstone, M.S. 411, Beaudesert.	GS
Toururrong Past. Co., P. N. Thurbon & A. D. Lee, Christmas Creek Road, Beaudesert.	DM
R. N. & C. M. Towner, Par Deux Droughtmaster Stud, Thornton, M.S. 182, Laidley.	DM
K. J. Townsend, Terrah's Park, Ocean-View, Dayboro.	AIS
J. P. V. Trier, 'Tamrookum Valley', Braford Stud, Rathdowney.	BF
T. J. & A. C. Tutton, Hopkins Street, Beaudesert.	COM
University of Queensland, Vet. Science Farm, Moggill Road, Pinjarra Hills.	MIXED
M. G. & D. R. Unthank, 'Jabiru', Norwell via Beenleigh.	CL
P. & B. H. Van Popering, 'Brunetta' Jersey Stud, Coominya Road, Lowood.	JS
M. S. Venz, The Mar-Venz Ranch Pty Ltd, 'Benwerrin', Kerry Road, Beaudesert.	MIXED
E. M. Voight, 'Chelmadale' Stud, M.S. 825, Ipswich.	BF, AIS
W. T. & L. Voss, Mt. Vista Stud, M.S. 292, Glamorganvale, Ipswich.	AIS
P. F. Wadley, Nindethana and Bendemeer Studs, M.S. 21B, Kalbar.	JS, FS
R. A. & M. L. Walker, Blackrose, M.S. 366, Rosewood.	SM
R. & M. Walther, 'Roseborough', P.S. 1790, Lowood.	BM
R. C. & S. A. Warren, "Garrendenny', 77 Hope Street, Kilcoy.	FS, AFS
M. G. & G. E. Weier, 10 Wickham Street, Laidley.	PH
B. G. & B. Wells, Bundilla Murray Grey Stud, Thornton, M.S. 182, Laidley.	MG
N. R. & G. Wenzel, 'Gwen Ray Stud', M.S. 342, Roadvale.	AIS
E. E. W. West, 'Belmadochie' Friesian Stud, 19 Oatlands Court, Samford.	FS
C. Westaway, 'Sarner Alp', Colinton.	BF
C. Westerway, 'Meridan', Meridan Plains, P.S. 1170, Mooloolah.	HF
A. C. & V. J. Westphal, 'Alun Jersey Stud', M.S. 342, Roadvale.	JS
K. Wheildon, 'Good Luck', Lower Cressbrook, Toogoolawah.	FS
E. D. & H. White, 'Wombbalano' Stud, 29 School Road, Logan Reserve.	DM
C. I. & G. J. Wieland, 'Alhaven', Allandale via Boonah.	MG
L. R. & M. M. Wild, 'Parraweena', Bald Knob, via Landsborough.	BF
F. A. Willey, 'Mar-sel Stud', M.S. 292, Lowood Road, Glamorganvale.	AIS
I. G. R. Williams, 'Spion Kop', M.S. 1136, Toogoolawah.	FS, AFS
G. Wilson, Koora-Namoona Guernsey Stud, 'Adina' Boyland.	GS
J. C. Wilson, 10 William Street, Buderim.	SM
B. J. & I. M. Winkel, 'Gibba' Stud, Sellins Road, Mt. Mee.	FS
J. & L. M. Winks, Allanbrae, Laidley.	HF
P. W. Wiseman, 'Clover Grove', P.S. 1973, D'Aguilar via Woodford.	JS
D. B. & V. M. Wolter, 'Cobba Poll Hereford' Stud, Beenleigh.	PH
J. R. & A. Wood, 'Jarmal', M.S. 16, Maleny.	DM
A. & A. Woodgate, 'Woodgate Park', Bidda-dabba via Tamborine.	FS
G. T. & H. E. Woods, 'Hazelwood' Jersey Stud, M.S. 906, Mapleton.	JS
K. V. Wright, 'Wattle Vale', M.S. 288, Boonah.	FS
M. G Wright, 'Bethany' Stud, Mapleton Road, M.S.F. 956, Montville.	FS
G. W. Yarrow, Alvington A.I.S. Stud, M.S. 366, Rosewood.	AIS
Dr B. R. Yeates, 'Ugarapul', Boonah.	DM
G. S. Young and M. J. Cooper, 'Coograli', North Maleny Road, Maleny.	BF
W. J. Young, Willverra Friesian Stud, Browns Road, Narangba.	FS, AIS
V. L. Zanow, No. 4 Oxford Street, North Booval.	HF
A. R. Ziebarth, 'Lynton Brahman Stud', 35 Campbell Street, Laidley.	BM
E. F. & I. M. Zischke, 'Lynview' Jersey Stud, M.S. 231, Laidley.	JS

Toowoomba Division

J. L. & S. E. Abraham, 'Kaho' Stud Farms, M.S. 892, Meringandan.	AIS, JS, SM
R. N. Alexander, 'Trefoil Park', Warra.	HF
R. M. & E. M. Allan, Quarrion Park, P.O. Box 45, Jondaryan.	MG
C. P. Alvisio, 'Valis' Braford Stud, 21 Janelle Street, Aspley.	BF
J. H. & B. J. Amor, 'Carinya', Dulacca.	BF
J. W. Anderson, 'Austral and Acme Studs', 'Talawah', Chinchilla.	SG

Anderson Pastoral Co., 'Inverary', Yandilla.	PH
R. M. & B. Anderson, 'Balinga', Millmerran.	SG
K. R. & J. M. Anderton, 'Hill Park', Bell.	HF
W. J. Atkin, 'Sandon', Durah Road, Chinchilla.	AG
Australian Estates, 'Wainui', Bowenville.	SG
D. Baker and R. & S. Wool, 'Nympton' and 'The Diamond' Studs, Hollymount, Miles.	DV, PD, SH
M. F. & H. A. Balfour, 'Maxheath Friesian Stud', M.S. 212, Oakey.	FS
H. A. Balke, 'Balhaven', Westbrook.	JS
I. K. & D. A. Barlow, 'Lyndoch', M.S. 150, Pittsworth.	MG
R. Barr, Eukey Murray Grey Stud, P.O. Box 194, Stanthorpe.	MG
D. J. Bartkowski, 'Sunnyglyn Stud', M.S. 892, Meringandan.	AIS
E. Bassingthwaighte, 'Woodlands Stud', Greenmount.	PH
G. W. & R. Bauer, 'Milford Rocks', M.S. 1069, Crows Nest.	BM
D. J. & E. M. Beal, 'Tara Park', Gowrie Junction.	MG
N. R. & E. A. Beckman, 'Glendra Stud', Aubigny, M.S. 212, Oakey.	AIS
R. J. Begg, M.S. 162, Warwick.	MG
A. J. & M. A. Bell, 'Belheath' Stud, 'Karingal', M.S. 1231, Millmerran.	PH
G. P. & D. I. Bell, 'Ment More', Dulacca.	BF
L. G. Bell, 'Delgowrie', Jimbour.	BF
M. G. Bell, 'Heatherlea' Stud, Dulacca.	BF
J. W. & J. K. Best, 'Idlewild' Stud, 'Idlewild', Warwick.	CL
Bidson Pastoral Co., c/- K. C. Johnson, 'Bidson', Dulacca.	SM, HF
Big White Cattle Co., 'Big White', Nobby.	CH
Binda Brae Pastoral Co., 'Binda Brae', P.O. Box 2, Jimbour.	BF, HF
R. G. & M. C. Bligh, 'Mirrabooka', Millmerran.	AIS
A. R. & V. H. Bondfield, 'Palgrove', Dalveen.	CL
J. S. & S. & W. N. & P. M. Bonthrone, Ingaby Station, St. George.	SG
R. Boshammer, 'Glenock' Angus Stud, 'Sandon', Durah Road, Chinchilla.	AG
Estate of W. Bourke, 'College Green', M.S. 422, Clifton.	AIS
J. C. Brandon, Boomerang Park, Hill Road, Yangan.	MG
M. J. & G. E. Branson and Sons, 'Alma Park', Jandowae.	MG
L. J. Breen, 'Tarrawatta', Eukey via Stanthorpe.	AG
J. T. Breydon, 'Brooklyn', Haden.	HF
I. & D. J. Brimble Combe, 'Wyalong', Jimbour.	BF
Brookview Pastoral Co., P/L., 'Emohruo', Brookstead.	SG
W. L. & J. M. Brown, 'Acedale' Stud, P.O. Box 18, Southbrook.	AIS
T. J. Brownlie, 'Thornton', Columboola.	SG
Bruggeman Bros., Dandaloo Braford Stud, 'Currandale', Jandowae.	BF
Burnett Downs Pastoral Co., 'Burnett Downs', P.O. Box 11, Brigalow.	MG
R. B. & J. P. Cameron, 'Belconnen', McDougall Street, Warwick.	MG
N. A. & J. W. Campbell, 'Jowonga Stud', Wongalea, 'Barramornie', 'Bendalla and Topwater', Condamine.	SG, CL
G. F. & J. M. Chandler, 'Benandu', M.S. 143, Texas.	BF
H. Cherry, 12 Davidson Street, Oakey.	HF
A. W. Christensen, 'El-Paso', M.S. 394, Gladfield, Warwick.	FS
E. M., C. & G. W. Ciesiolka, 'Valley View', M.S. 212, Oakey.	AIS, SG
N. & L. C. Clark, Mt. Alice Stud, M.S. 863, Maclagan.	FS, JS, AIS
I. E. & J. E. Clarke, 'The Shanti', Chinchilla.	DV
P. J. Clarkson, 'Baroona', Bowenville.	BF
Colanya Cattle Co., 'Narlagoon' M.S. 902, Dalby.	SG
R. A. Cook, c/- Stirling Park Past. Co., Stirling Park, Condamine.	CL
T. W. & M. J. Crank, 'Gracelyn', Mt. Tyson.	AIS
C. N. & P. J. Crisp, 'Destiny Stud Farms', P.O. Box 40, Stanthorpe.	HF
L. C. & S. G. Cronk, 'Beltana', M.S. 1073, Crows Nest.	LM
Culloden Pastoral Co., 'Lingi', Chinchilla.	PH
D. J. & M. F. Curtain, 'Villeneuve', M.S. 848 B, Warwick.	SG
Daleoak Stud, c/- P. R. Reid, M.S. 360, Bell.	HF
C. T. Dalzell, 'Canimbla', M.S. 355, Chinchilla.	AG
E. T. & E. H. Dalzell, 'Canimbla', M.S. 355, Chinchilla.	AG
N. V. & N. J. Dalzell, 'Daldee', Pelican via Chinchilla.	PH
D. Dance, 'Double D' Murray Grey Stud, M.S. 720, Millmerran.	MG
J. J. E. Davies, 'Glenwyn Park Stud', Charker Street, Toowoomba.	HF
K. W. Davis, 'Walkah', Carpendale via Helidon.	JS
C. & V. N. Devine, Wolsely Stud, Euston Road, Toowoomba.	FS, AIS
F. M. & G. Donovan, 'Ashby' Braford Stud, Jimbour.	BF
Doondi Pastoral Co., 'Doondi Poll Hereford Stud', St. George.	PH
Doro Park Friesians, 'Doro Park', M.S. 918, Toowoomba.	FS
E. O. & L. A. Dorries and Son, 'Panorama', M.S. 212, Oakey.	AIS
Douglas Park Pty. Ltd., 'Shane', P.O. Box 24, Oakey.	PH, AIS
F. R. & G. A. Dowe, 'Wahroonga', Tara.	PH
N. J. Drabsch, 'Erinbrook', Pelican via Chinchilla.	BM
L. J. Drew, 'Bluevale' Stud, M.S. 1116, Haden.	AY
S. J. Edmond, 'Lillyvilla Stud', 'Capowie', M.S. 423, Hopeland.	MG
D. C. Elder, 'Royston', Columboola.	PH
R. W., A. J. & D. G. Elder, 'Katupna Park', Goombi via Chinchilla.	PH
P. J. Evans, Dragon Street, Warwick.	FS
R. C. Fahl, 'Sandalwood', Meandarra.	PH
G. N. Fairbrother, 'Orion' Stud, Pierce's Creek, M.S. 26, Crows Nest.	BM
R. J. A. & C. M. Farmer, 'Morel Stud', Oaklea, Killarney.	SH
J. & W. Fawcett, Coreen Stud, 'Sedgwick', Tara.	BS
Dr. E. S. P. Ferguson, 'Coonoona', Jondaryan.	PH
G. L. & M. I. Ferguson, 'Glenview', Nobby.	CH
M. J. & J. Ferguson, 'Antrim', The Gums.	HF
Finlay Pastoral Co., Emu Plains, Texas.	HF
G. C. Fischer, 'Karalee' Murray Grey Stud, 68 Hume Street, Pittsworth.	MG
G. D. & S. S. Fogarty, M.S. 29, Clifton.	PS
B. H. Ford, 'Aldersyde' and 'Old Cameby' Studs, 'Aldersyde', Old Cameby Road, Miles.	PD, HF
M. R. & J. E. Fowler, 'Donna-Lynn', M.S. 195, Pittsworth.	CH
Franz Josef Pty. Ltd., 'Bellevue Park', Tara.	HF
A. J. & Y. L. French, 'Wilston Park', M.S. 181, Pittsworth.	FS
R. Freshney, Karena Hereford Co., 'Karena', Bowenville.	HF
A. W., E. M. & D. W. Frohloff, 'Trinity', M.S. 191, Cambooya.	FS
Garryowen Pastoral Co., 'Corolla' Stud, M.S. 29, Clifton.	HF
Gayway Pastoral Co., 'Gayway', Anduramba.	BM
M. & G. M. Geddes, 'Rhodavale', Hodgson Vale, via Toowoomba.	FS

J. S. & E. J. Genge, 'Carinya', P.O. Box 78, Miles. **SG**

A. J. & E. M. J. Gill, 'Bramston', Tara. **PH**

D. H. & G. M. Glasser, 'Yagaburne', Goondiwindi. **PH**

B. Goddard, 'Inverell', Mt. Tyson, via Pittsworth. **AY**

Golden Grove Pastoral Co., 'Golden Grove', Glenmorgan. **SM, HF**

J. & N. Golding, 'Manuka' Stud, Smithfield Road, Gatton. **JS**

T. H. & D. D. Gooding, 'Uralla', Booboogan Poll Hereford Stud, Dalby. **PH**

K. J. & J. L. Gordon, 'Merriwa', M.S. 499, Toowoomba. **BF**

N. J. & G. E. Gossow, 'Oaken Pine', Crows Nest. **CH**

R. N. & L. M. Graham, 'The Homestead' Stud, Couper's Road, Westbrook. **FS**

K. G. & G. F. Graving, 'Bellevue', M.S. 26, Crows Nest. **CL**

W. J. Grayson, 'Lindavale', Killarney. **DV**

G. T. Green, 'Woodridge', M.S. 371, Greenmount. **GS**

E. R. Greenhalgh, 'Willawong', M.S. 150, Pittsworth. **BM**

G. A. Greenup and Co., 'Rosevale', Jandowae. **SG**

E. G. & E. O. Grice, 'Carawatha' Stud, 'Mirrabooka' via Millmerran. **CH, MA**

J. R. & R. Grieve, 'Invernaion', Yandilla. **PH**

D. H. & P. O. Guilford, 'Mooloolah' Stud, 'Richmond', Allora. **HF**

N. J. & H. M., B. J. & G. R. Guppy, 'Riverdell', Southbrook. **FS**

Gurimba Pty. Ltd., 'Gurimba', M.S. 212, Oakey. **AIS, BF**

I. & B. J. Hart, Trahni, M.S. 1867, Greenmount. **HF**

N. P. Hartwig, 'Ky-Lew', Goombungee. **GS**

A. E. Harvey, 'Ronel', Kingsthorpe. **FS**

E. & R. F. Harvey, 'Dumboy', M.S. 918, Toowoomba. **FS**

B. E. & J. M. Hayward, M.S. 765, Allora. **HF**

B. E. Hayward, 'Denville' Stud, M.S. 465, Cambooya. **HF**

G. H. & L. F. Hayward, 'Nashville', M.S. 1840, Greenmount. **PH**

C. R. & M. Hemming, 'Birra Birra', Thallon. **SG**

N. T. Hemmings and Sons, Murrays Bridge Stud, Murrays Bridge, M.S. 128, via Warwick. **AIS**

M. F. Hemmings, 'Bileena', Canningvale Road, Warwick. **AIS**

V. A. Henderson, Barkala Stud, Greenmount Road, Cambooya. **HF**

A. W. Henry and Son, 'Green Valley', The Gums. **HF**

J. & J. L. Henry, 'Rocky Ponds', Massie via Warwick. **HF**

K., L. J., A. M. & M. J. Henry, Tara and Camtara Stud, M.S. 465, Cambooya. **AIS, HF**

W. G. Henschell, 'Yarranvale', M.S. 1444, Brookstead. **PH**

C. F. & V. M. Hodgson, 'Wingfield', P.O. Box 35, Dalby. **DM**

G. F. & N. E. Hoey, 'Coolalinga Jersey Stud', M.S. 74, Clifton. **JS**

N. T. & M. A. Hoey, 'Merrawah' Stud, M.S. 371, Greenmount. **JS**

J. R. & M. R. Holmes, 'Benbecula', Charlton, M.S. 1497, Toowoomba. **AY**

L. R. & E. E. Hoopert, 'Happy Valley', M.S. 212, Oakey. **SG**

J. W. Hudson, 'Wesslings', Gatton. **DM**

M. E. & V. E. Hughes, 'Mi-Von', Hopelands via Chinchilla. **HF**

W. J. & J. T. Hynes, 'Billagal', Riverton via Texas. **HF**

Ivan Doljanin Pastoral Co., 'Bonni Foi', P.O. Box 125, Inglewood. **PH**

E. P. J. & M. Jackson, 'Rotherham Stud', Ennismore', Nobby. **PH**

M. D. & B. E. R. Jannusch, 'Albion Park', C/- P.O. Box 25, Pittsworth. **FS**

G. D. & B. M. Jensen, 'Kuyura', Jimbour. **BF**

S. K. Johnston, Bondoon Charolais Stud, Toowoomba. **CL**

C. H. & D. N. Jones, 'Glen Wilga', M.S. 423, Hopeland via Chinchilla. **HF**

M. E. Just, Double Dee, Bergen P/A P.O. Box 606, Toowoomba. **SM**

S. E. Kanowski, M.S. 357, Crows Nest. **AIS**

Karminya Pastoral Co., 3 Herronbee Street, Toowoomba. **HF**

L. K. Kath, 'Kathleigh', M.S. 1049, Gowrie Junction. **JS**

J. E. Kemph, 'Bunya Vale', M.S. 222, Oakey. **CL**

G. H. Kerr, 'Glenora', Chinchilla. **HF**

Kerwee Pastoral Co., 'Argyle', Kingsthorpe. **SG**

R. J. & J. J. Kiepe, 'Charlton View Ayrshire Stud', Charlton via Toowoomba. **AY**

C. G. P. King, 'Bonnington', Goombungee. **SM**

King Ranch (Australia) Ltd., 'Macquarrie Downs', Leyburn. **SG**

Klein Bros., Kapleton, Ma Ma Creek via Grantham. **AIS**

J. W. & M. J. Koehler, 'Wattleview', Yamsion. **HF**

A. F. Krinke, 'Plain View', C/- Box 92, Pittsworth. **HF**

P. A. & J. L. Lange, 'Cerana', M.S. 222, Oakey. **AIS**

K. J. & M. Lau, 'Rosallen', Goombungee. **JS**

D. C. Lawrie, 'Croxley', M.S. 918, Toowoomba. **DM**

F. Lax and Sons, 'Wyroona', M.S. 212, Oakey. **FS**

K. J. Lee, 'Brigalow Park', Kurrumbul. **HF**

S. R. & J. M. Lee, 'Reservoir' Braford Stud, P.O. Box 60, Allora. **BF**

N. F. & J. A. Leeson, 'Janel Park', Gowrie. **FS**

W. M. Leonard and Sons, 'Welltown', Goondiwindi. **SH**

Lester Brothers, 'St. Andrews' Stud, M.S. 623, Warwick. **AIS**

C. J. & W. T. Lewis, 'Medland', Toowoomba Road, Crows Nest. **HF**

P. M. & K. H. Lewis, 'Greenstock', P.O. Box 37, Goombungee. **FS**

C. P. & E. G. Liebke, 227B West Street, Toowoomba. **MG**

L. J. & L. V. Litster, Hillside, M.S. 192, Malakoff Road, Dalby. **FS**

B. J. & J. N. Little, Linvale Park, M.S. 150, Pittsworth. **FS**

C. L. & H. L. Little, 'Barcolette' Friesian Stud, M.S. 499, Toowoomba. **FS**

G. W. Little, 'Glengarry', Jimbour. **MG**

H. V. & N. A. Littleton, 'Lanacoora', Bowenville. **LM**

W. J. & A. Lloyd, 'Wriembilla', Chinchilla. **SG**

W. M. & A. Logan, Logan Hereford Stud, 'Rose Farm', Gatton. **HF**

L. K. Lostroch, 'Shamrock Vale', M.S. 212, Oakey. **AIS**

Lynn-Eden Braford Stud, 'Warrigal', Columboola. **BF**

D. J. & W. E. MacDonald, 'Rosneth' Jersey Stud, Goombungee. **JS**

R. MacLean, C/- Kerwee Pastoral Co., 'Berwick', Jondaryan. **SG**

L. & M. MacNeill, 'Miamba', Condamine. **HF**

J. S. & E. M. MacQueen, 'Anembo', Highfields. **RP**

W. J. McClelland Pty. Ltd., 'Oakland', Jandowae. **HF**

E. F. McCormack trading as Dilga Pastoral Co., 'Clonlara' and 'Dilga', Glenmorgan. **DM, HF**

A. McDowall, Logancrail, Cement Mills. **HF**

A. & M. McDowall, 'Teebone' Stud, 'Iona', Meandarra. **PH**

W. D. & M. M. McErlean, 29 Rowbotham Street, Toowoomba. **PH**

I. R. & L. M. McKee, 'Belmont Park', M.S. 501, Dalby. **LM**

B. W. & L. J. McNamara, 'The Glen', Bell. **BF**

D. J. McNamara, 'Holmwood', M.S. 360, Bell. **BF**

G. N. & V. M. McNamara, 'Strath-Vale', M.S. 360, Bell. **BF**

N. J. McNamara and Sons, 'Strathgyle', Bell. **BF**

M. & G. J. Major, 'Rosewood Downs', Limevale. **PH**

B. J. & S. L. Mann, 'Mylo', P.O. Box 27, Chinchilla. **AIS, AG, HF**

R. C. & L. E. Manteufel, Unity Friesians, M.S. 223, Nobby. **FS**

V. & D. Mason, 'Deejay', M.S. 150, Pittsworth. **AIS**

J. B. & J. M. Matthews, 'Mt. Moriah', P.O. Box 15, Jondaryan. **SM**

W. H. C. Mayne and Sons, 'Gibraltar', Texas. **AG**

B. J. & B. F. Melrose, 'Glen Eildon' Braford Stud, 'Glen Eildon', Highfields. **BF**

R. G. & M. D. Miller, 'Mt. White Stone', M.S. 428, Grantham. **BF**

S. J. & H. L. Miller, 'Nardoo', Miller Street, Warwick. **SM**

J. P. & G. E. Moran, 'The Belahs', Kumbarilla, M.S. 902, Dalby. **HF**

M. W. & J. D. Moran, 'Ferndale', P.S. 1014, Bell. **HF**

G. E. Morgan, 'The Grove', Myall Grove, Condamine. **PS**

A. E. Morris, 'Hillsdale', Gowrie Junction. **JS**

R. Morris, Piccadilly Pastoral Co., 'Cotswold Hills Stud', Gowrie Road, Toowoomba. **CL**

J. T. Mundell, 'Redmarley Stud', 'Redmarley', Condamine. **SH**

H. J. Mungall, 'Llagnum Acres', Ballandean. **FS**

J. D. & R. P. Murray, 'Bonnie Hills', Yamsion. **PH**

K. E. & D. M. Nauschutz, 'Gold Park', M.S. 118, Warra. **SM**

F. H. Neal, Oaklee Hall, Oakleigh, Tara. **HF**

M. Newton, 'Malland', Kaimkillenbun. **PH**

M. R. & D. E. Newton, 'Royelle', Kaimkillenbun. **PH**

D. J. & E. M. Nielson, 'Kintyre', Mt. Tyson. **MG**

A. B. Nixon, 'Devoncourt Stud', Dulacca. **HF, PH**

D. M. & M. T. Nolan, 'Maydan', M.S. 848, Warwick. **BF**

D. G. Noller P/L, 'Cunnadoo', Oakey. **CL**

R. J. & B. M. Nothdurft, 'Glen Heath', Yalangur, M.S. 918, Toowoomba. **AY**

A. O'Dwyer, 'Mt. Manning Pastoral Co.', M.S. 422, Clifton. **SG**

J. M. Officer, Warrawee, Miles. **DV, PD**

Old Talgai Pastoral Co., 'Old Talgai', M.S. 422, Clifton. **SM**

M. J. O'Leary and Sons, 'Remolea', M.S. 422, Clifton. **PH**

J. D. O'Sullivan, Navilloween, M.S. 371, Greenmount. **PH**

P. W. O'Sullivan, 'Navleigh' A.I.S. Stud, M.S. 371, Greenmount. **AIS**

L. M. Oxlade, Arona Brahman Stud, M.S. 852, Ruthven Street, South Toowoomba. **BM**

E. I. & S. Pacholke, 'Sunnylawn', M.S. 74, Clifton. **BF**

L. R. Pain, 'Cabandah', Jandowae. **BF**

(N. Rose), Palahra Farming Pty. Ltd., P.O. Box 19, Grantham. **BF**

R. L., L. F. & F. Palmer, 'Cloverdale', M.S. 371, Greenmount. **FS**

L. S. Park and Co., 'Parklands', Maclagan. **MG**

P. J. R. P'ship, Remlap Poll Hereford Stud, M.S. 371, Greenmount. **PH**

G. R. & B. J. Patch, 'Kiara', P.O. Box 52, Bell. **AIS**

P. A. & J. T. Paterson, 'Wheel Park', M.S. 852, Hodgsonvale via Toowoomba. **FS**

E. A. Paton, 'Sherdale', M.S. 30, Millmerran. **SG**

K. H. Paton, Wallanba Pastoral Co., 'Sherglen Stud', 'Wallanba', Meandarra. **SG**

M. C., R. C. W. & I. M. Pearce, M.S. 582, Toowoomba. **JS**

G. N. & S. L. Pedler and Sons, Athol Park Braford Stud, Box 10, Jimbour. **BF**

J. N. Penglis, 'Pendale' Poll Hereford Stud, Westbrook Road, Wellcamp. **PH**

K. J. & D. M. C. Perrett, 'Kerralea', Goomburra. **MG**

A. V. Peters, Gladwyn Angus Cattle Co., M.S. 892, Meringandan. **AG**

L. W., M. J. & G. F. Peters, 'Wilmington' A.I.S. Stud, M.S. 212, Oakey. **AIS**

P. J. & V. R. Peters, Ripple Vale Angus Stud, M.S. 582, Toowoomba. **AG**

R. G. Pharoah, 'Merroo' Encourage Stud, P.O. Box 34, Chinchilla. **HF, SM**

C. W. Phillips, 'Sunnyview Park', M.S. 623, Warwick. **AIS**

C. J. & J. Potter, 'Uandi', Inglewood. **MG**

N. R. Potter and Sons, 'Acton Vale' Stud, Wellcamp. **PH, AIS**

G. J. Potts, Aratree Jersey Stud, Kingsthorpe. **JS, FS**

D. A. Price and Co., 'Deloraine', P.O. Box 7, Jimbour. **CL**

C. & E. L. Prosser, 'Thuruna' Stud, Tara. **HF**

B. P. & M. Quinlan, 'Home Valley', Meringandan. **SW, X, CH**

D. G. Raff, 'Forres', Karara. **AG**

P. D. & T. R. Rauchle, 'Oakmount', M.S. 150, Pittsworth. **SM**

F. S. & J. V. Regan, 'Iluiga' Stud, 10 Gilbert Cres., Warwick. **MG**

K. R. & G. A. Reid, Goomeran, Thane, via Warwick. **HF**

Reid and Sons, 'Bundarra Hereford Stud', 'Gregmore', Malakoff Road, Dalby. **HF**

A. Reilly, 'Lennie Brae Stud', Coongarrie, Condamine. **HF**

R. L. & L. R. Reimers, Hill's Road, Oakey. **PH**

A. I. Reis, Marlan Pastoral Co., Marlan, Condamine. **HF, SM**

B. W. & R. A. Reisenleiter, Viscount, M.S. 149, Gatton. **HF**

D. J. & G. W. Reisenleiter, Qugee Grazing Partnership, M.S. 149, Gatton. **PH**

S. B. & L. W. Reynolds, 'Moorlands', M.S. 918, Toowoomba. **HF**

R. L. & I. Richardson, 'Old Cameby' Stud, 'Hillcrest', Drillham. **HF**

L. E. & R. E. Rider, 'Opal Stud', Jimbour. **BS**

M. & D. Roddau, Wonga Vale (Lime Vale Stud), M.S. 902, Dalby. **BF**

E. C. & M. L. Rogers, Midlands Park, 24 Herries Street, Toowoomba. **PH**

E. G. & M. Ryland, 'Blanc Gros Stud', Wyona, Condamine. **CL**

St. Peters Lutheran College, 'Ironbark', Crows Nest. **DM**

Samari Farming and Grazing Co., 'Samari', M.S. 918, Toowoomba. **PH**

G. G. Savage, 'Venvale', Ramsay via Cambooya. **AIS**

Estate of W. T. Savage, 'White Park', M.S. 852, Toowoomba. **AIS**

N. N. Schelbach, 'Allanview', M.S. 848, Warwick. **AIS**

W. J. T. & D. V. Scrymgeour, 'Aberfoyle', 'Arran', Warwick. **AG**

A. E. & M. V. Scurr, 'Domvale', M.S. 720, Millmerran. **MG**

G. C. Seibel, 'Mountvale', M.S. 848, Warwick. **HF**

A. G. Seppanen, 'Roena-Amarylis' Stud, M.S. 371, Greenmount. **CL, SM**

H. L. Shaw, Padua Pastoral Pty. Ltd., M.S. 892, Meringandan. **SM**

L. J. Sheahan, 'Kyilla Park Stud', 'Kyilla', Condamine. **HF**

W. J. Shepherd, 'Morwidgee', M.S. 1231, Millmerran. **MG**

V. C. & G. C. Shoesmith, 'Rocking Bullett', Westbrook.	PH, AIS
R. L. & T. K. Shooter, 'Willow Bend', M.S. 765, Allora.	HF
J. & S. C. Siebenhausen, 'Merriton', M.S. 195, Pittsworth.	AIS
Dr. C. N. Sinnamon, 'Brora Stud', Oakey.	DM
F. Sippel, 'Callemondah', Ballandean.	JS
W. R. Slatter and Sons, Berryglen Murray Grey Stud, M.S. 1605, Killarney.	MG
L. W. & K. J. Smith, 'Judi-Jindi' Braford Stud, M.S. 1014, Bell.	BF
M. T. & B. R. Smith, 'Pamalyn' Friesians, Wellcamp.	FS
A. N. & S. L. Sorley, 'Alma', Bell.	BM
A. W. P. & R. A. Sorley, 'Alma', Bell.	BM, BF
N. A. Sorley, Mt. Callen, M.S. 501, Dalby.	BM, BF, DM
J. D. & P. W. Spann, 'Minlacowie Droughtmaster Stud', M.S. 422, Clifton.	DM
R. M. & L. A. Sperling, M.S. 360, Bell.	BM, BF, FS
Dr. M. E. Stevens, 'Wyalla', North Branch, Maryvale.	SG, HF
P. & N. Stirton, 'West Haran', St. George.	HF
M. C. & C. P. Sullivan, 'Valera', Springvale, Pittsworth.	AIS
A. M. & D. M. Sullivan, 'Crystal Springs', M.S. 195, Pittsworth.	AIS
R. O. Sutton, 'Bundabar', Glenmorgan.	SG
Tarata Pty. Ltd., 'Tarata', M.S. 212, Oakey.	CL
H. R. & D. M. Thomas and Son, 'Euranga-tuck', Jandowae.	HF
W. D. J. & K. Thomas, 'Bryn', M.S. 720, Millmerran.	HF
C. Thompson, 'Kingston', Dulacca.	BF
Mrs. B. Tout, 'Berrima', Elbow Valley, Warwick.	AG
R. R. & E. D. Treasure, 'Iona Park', Brigalow.	MG
D. A. Treweeke, 'Umbercollie', Goondiwindi.	SH
L. M. & R. G. Vandersee, 'Rovan', M.S. 26, Crows Nest.	SG
M. Vandoren, 'Glen-Aero' Stud, P.O. Box 46, Applethorpe.	MG
R. Van Ee, 'Sheaveen Downs', Ranger Road, Gatton.	BM
S. I. Vellnagel, 'Rosedale', Brigalow.	HF
A. R. Vohland, M.S. 150, Pittsworth.	JS
E. Volker, 'Mt. Rascal' Stud, P.S. 1497, Toowoomba.	RP
S. A. & J. A. Volker, 'Mt. Rascal Stud', M.S. 371, Greenmount.	RP
W. F. & K. P. Vonk, 'Misty Meadows' Stud, P.O. Box 269, Warwick.	FS
D. H. Wagner, 'Strathgarve' and 'Wahroongah', Dalveen.	SM
Wal-Anne Pastoral Co., 'Wal-Anne' Stud, P.O. Box 2, Haden.	PH
G. I. Warfield, 'Dernan Court', M.S. 223, Nobby.	PH
P. R. & H. D. Watters, 'Lynford' Stud, Callemondah, Ballandean.	JS, HF
R. West, 'Boxmoor' Stud, 'Boxmoor', Grantham.	BF
E. J. & G. J. Weymouth, Murrabea Hereford Stud, 'The Grange', Tara.	HF
Wilga Park Partnership, 'Wilga Park', M.S. 658, Texas.	BF
J. R. Williams, 'Forest Glen', Columboola.	BF
T. J. & D. R. Williams, Jastwil Park Braford Stud, Greenmount.	BF
T. J. Williams, Jastwill Park, C/- 47 Rowbotham St., Toowoomba.	FS
C. T. Williamson and Son, 'Colelgre Angus Stud', 'Eagle Farm', Nobby.	AG
J. R. & M. E. Willis, 'Avalon', Bell.	BF
L. W. & N. E. Wilmot, Koetong Hereford Stud, P.O. Box 7, Applethorpe.	HF
D. P. & E. A. Wilson, 'Winbirra', M.S. 852, Hodgson Vale.	AIS, HF
G. B. Wilson, Tullaringa Stud, 227 Cavendish Road, Coorparoo.	CL
W. G. Wilson, 'Tarko', M.S. 444, Jondaryan.	HF
A. R. & G. G. Wockner, 'Durn' Stud, Maclagan.	AG
S. Wolfenden, Willdoo Farming Co., 'Willdoo', Southbrook.	CL
N. W. Wolff and Sons, 'Brigalow Plains', Brigalow.	SG
O. J. & S. D. Woodcock, 'Kanara', Yelarbon.	BF
Wyalla T.D.T., 'Wyalla', M.S. 886, Texas.	CL, LM, SM
V. & R. York, 'Victory Downs', P.O. Box 127, Dalby.	HF
R. & J. Ziesemer, Belbar Stud, Bell.	HF
L. W. & H. M. Zirbel, 'Lacewood', Derrymore via Helidon.	PH

Roma Division

B. B. & G. A. Allen, Eladnalla Hereford Stud, 'Allandale', Morven.	HF
N. D. Bahnisch, 'Brafield' Stud, 'Orchard Vale', Guluguba.	BF
A. D. Bassingwaite, 'Waco', Wallumbilla.	SG
A. D. & J. L. Bassingwaite, 'Waco Stud', 'Kiah', Yuleba.	SG
D. Bassingthwaighte and Co., 'Yarrawonga', Wallumbilla.	SG
C. J. H. & M. E. Blackley, 'Alcheringa', M.S. 851, Wandoan.	BF
Boreview Pastoral Co., 'Boreview', Wallumbilla.	PH
R. R. & I. A. Bowen, 'Pine Tree Farm', Roma.	HF
E. R. & M. E. Brown, 'Benalla', Roma.	PH
W. D. Cormack, 'Fourex Braford Stud', 'Oakwood', Wallumbilla.	BF
W. D. & A. V. J. & I. G. Cormack, 'Fourex' Stud, 'Burnside', Wallumbilla.	BF
E. & H. C. Denton, 'Narra Burra', M.S. 619, Roma.	MG
Estate W. J. Elder, 'Alamby Stud', 'Trevilla', Jackson.	PH
I. M. & A. L. Galloway, 'Duarran', Roma.	HF
G. B. Gould, 'Guluguba' Stud, 'Waitangi', Guluguba.	PS
N. J. & M. Harper, 'Bungarra', Wandoan.	HF
G. W. Johnston, 'Westquarter-Stud', 'Westquarter', Tambo.	SH
F. A. & M. Kehl, 'Hillview', Wallumbilla.	BF
Lambert Pastoral Co., 'Lambert', Charleville.	HF, PH
D. K. & J. A. Leeds, 'Murweh', Murweh Siding.	SH
Lenroy Pastoral Co., 'Lenroy', Roma.	PH
R. K. Lethbridge, 'Warren Point Stud', Warren Point, Mitchell.	PH
C. D. & M. P. Mills, 'Glen Roby' Stud, 'Tamarang', Wallumbilla.	PS
Noorindoo Pastoral Co., 'Bylong' Stud, 'Noorindoo', Surat.	SH, SG
Norolle Pastoral Co., 'Norolle', P.O. Box 138, Roma.	PH
North Bindango Pastoral Co., 'Naganimp' Stud, 'North Bindango', Roma.	PH
Paringa Grazing Co., 'Acacia' and 'Narringa' Studs, 'Paringa', Charleville.	AG, MG
J. & E. Robinson, 'Pinora Hereford Stud', Railway Street, Jackson.	HF
N. F. Schmidt, 'Pampoola Stud', 'Avondale', Cunnamulla.	SG
S. A. & V. M. Skerman, 'Rarcamba', Wandoan.	BF
L. R. & B. Sommerfield, Hayfield, Cunnamulla.	SG
H. J. Stewart, 'Wycombe', St. George.	BF
N. L. Stiller, 'Vine Veil', Guluguba.	MA, RN, X, CH
Talana Pastoral Co., 'Talana', M.S. 960, Roma.	PH
Tomkins Pastoral Co., 'Stuart's Creek', P.O. Box 479, Roma.	HF

Whitney Pastoral Co., Claverton Stud, Wyandra. **SH**

S. J. & N. E. Wippell, 'Morocco', Roma. **HF**

I. S. & E. J. Woodside, 'Wallace Brae', 'Go-A-Long' Stud, Guluguba. **MG**

W. Woodside, 'Wallace Bank', Guluguba. **BF**

W. Woodside, 'Kiewa', Guluguba. **BF**

A. J. York, 'Grain Farm', Stud, 'Grain Farm', Wallumbilla. **PH, HF**

A. J., C.J., I.G. and J. E. York, Yorkaringa Stud, 'Taunton', Wallumbilla. **PH**

N. W. York, 'Mt. Leigh', 'Wonga Park', Wallumbilla. **HF**

N. W. & B. E. York, 'Yorkaringa Stud', 'Kindabung', Wallumbilla. **PH**

York Bros., 'Mount Leigh Stud', 'Mount Leigh', Wallumbilla. **PH**

Maryborough Division

Agar Pastoral Co., P.M.B. 3, Murgon. **SG**

D. A. N. Agnew, Mikobe Poll Hereford Stud, Imbil. **PH**

M. Ahern, 'Bandon', Gayndah. **BS**

Alcheringa Pastoral Co., 10 Coomber Street, Bundaberg. **CH**

J. & L. Avis, M.S. 979, Monto. **JS**

D. E. Bayliss and Co., 'Del Spring', M.S. 537, Kingaroy. **MG**

E. J. & P. A. Bentley, 'Jedda Park', No. 1, Pope Road, Mother Mtn., Gympie. **AG**

Berajondo Pastoral Co., 'Glenmore', Berajondo. **BM**

P. R. Bishop, Garglen, Southside, Gympie. **BM**

A. E. & C. S. Black, 'Ventnor', M.S. 90, Kingaroy. **AIS**

T. G. & M. K. Black, 'Hazeldean' Stud, M.S. 692, Nanango. **SG**

F. H. & F. Boyd, Robin Vale Stud, Neusa Vale, via Gympie. **JS**

M. R. K. Brown and I. W. Smith, 'Silverdeen', M.S. 979, Monto. **JS**

J. M. Browne, 'Achil' Stud, 'Achil', M.S. 660, Proston. **HF**

C. E. Buchholz, 'Baron Downs', P.O. Box 175, Maryborough. **SG**

B. A. & B. J. Burnham, Bimbadeen Brangus Stud, 'Upson Downs', Abercorn. **BS**

H. E. Burnham, 'Boolgalgopal', Abercorn. **BM**

F. & E. L. Cameron, Evelor A.I.S. Stud, M.S. 767, Yarraman. **AIS**

M. P Campbell, Tiaro Park, Tiaro. **BM**

D. I. & J. C. Carlyle, 'Wonga Hills' Stud, M.S. 355, Chinchilla. **PH**

Charbray Farms, Bells Bridge, Gympie. **CL**

B. J. & D. M. Cooke, Boubyjan, Upper Widgee, Gympie. **BF**

C. & G. Cotter, 'Adina', Upper Widgee via Gympie. **BF**

C. V. & J. R. Cotter, 'Narrabri', P.S. 1030, Gympie. **BF**

G. L. Crawford and Sons, 'Glenvillan', Mannuem Road, M.S. 90, Kingaroy. **JS**

J. Crombie, 'Woodlyn Stud', 'Mellera', Blackbutt. **DM**

R. A. Cudlipp, Beaver Rock, Granville, M.S. 781, Maryborough. **CB**

Dandilla Pastoral Co., 'Dandilla', M.S. 514, Kingaroy. **BF**

G. F. & A. M. Dean, 'Gadfield' Stud, Home Creek, Wooroolin. **CH, SM**

N. J. & E. J. Dingle, 'Dingleville Braford Stud', 'Dingleville', M.S. 221, Maryborough. **BF**

C. M. & B. E. Dolding, 'Dilston', Gayndah. **DM**

R. W. & J. A. Downes, 'Roweena Charolais Stud', M.S. 285, Bauple. **CL**

Eidsvold Station Holdings Pty. Ltd., 'Belvedere', Eidsvold, c/- Douglas, Heck and Burrell, G.P.O. Box 35, Brisbane. **SG**

S. R. Ford and Sons, 'Wattlebrae', M.S. 514, Kingaroy. **CL**

V. & S. Forman, Laguna Jersey Stud, Gympie. **JS**

I. E. Frohloff, 'Charland Stud', M.S. 648, Yarraman. **CL**

R. J. & C. A. Galloway, 'Cootharaba', Monto. **HF**

C. Gauld, 'Moongana', Brooweena. **SG**

H. H. & P. E. Gear, Takura via Maryborough. **MG**

W. W. Gibson, 'Glencrest', Mooloo via Gympie. **GS**

M. Gleeson, Mudjimba Murray Grey Stud, P.O. Box 184, Noosa Heads. **MG**

Glenrae Pastoral Co., Pty. Ltd., 'Bowenfels', P.O. Box 54, Kingaroy. **PH**

Goonoona Pty. Ltd., 'Kemsdale', M.S. 612, Kingaroy. **HF**

L. M. Graham, 'Glenmore' and 'Glenlea' Studs, P.S. 1494, Nanango. **BF, HF**

K. W. & K. M. Groves, 'Groveleigh', 17 Sorensen Road, Southside, Gympie. **BF**

A. C. & R. Haigh, 'Lagoonside', M.S. 979, Monto. **GS**

B. & M. Hannant, 'Croalah' Stud, M.S. 243, Kingaroy. **PS**

D. & P. F. Hardgrave, 'Arrawatta', M.S. 650, Biggenden. **FS**

B. M. & J. R. Hare, 'Wahpunga', Kin Kin. **BF**

N. J. Harrington, 'Winnington Stud', 93 Sorensen Road, Southside, Gympie. **CH**

Hazelton Pastoral Co., Hazelton, Gayndah. **BF**

H. L. Higgs, 'Bangalla', River Road, Tinana. **BR**

D. W. & J. A. Hinchcliffe, Cane Lands, M.S. 483, Gympie. **DM**

A. E. Horton, 'Springfair', M.S. 1382, Wondai. **JS**

P. J. & R. Ibbott, 'Buffel Vale', M.S. 1132, Mundubbera. **JS**

G. C. & A. J. Iker, 'Illangi', M.S. 448, Monto. **BM**

L. G. Jensen, 'Towerton' Stud, Glenwood, Gunalda. **FS**

N. & D. Johnson, Binda Charolais and Charbray Stud, Caulley Road, Sexton via Gympie. **CL, CB**

F. M. & K. W. Jobling, 'Karalee' and 'Karanga' Studs, M.S. 979, Monto. **AIS, PS**

D. D., P. E. & M. H. Kennedy, 'Bellwood', M.S. 1550, Cootharaba via Pomona. **MG**

B. W. & M. A. Kenny, 'Abernethy Braford Stud', M.S. 1256, Gayndah. **BF**

W. T. & G. M. Kenny, Shirley, Meson Street, P.O. Box 15, Gayndah. **BF**

R. & M. Kerr, 'Maryview', Miva. **BF**

R. R. Kerr, 'Sunnyside', M.S. 117, Monto. **GS**

A. J. Kinbacher, 'Garthowen', P.S. 1216, Biggenden. **DM**

D. P. & J. K. King, 'Brukarn', Maiden Well. **SG**

E. Kirk & Co., 'Mt. Lawless', 'Hazelton', Gayndah. **BM**

S. G. Knight and Co., 'Baalgammon', Manumbar Road, Nanango. **AIS**

L. H. Kunst, 'Sunnyside', Miva. **BS**

B. G. & R. M. Lamb, North Kolan, M.S. 311, Avondale. **BM**

Lanorca Past. Co., c/- L. P. Cotter, Upper Widgee, M.S.F. 115, Gympie. **CL**

C. F. Leacy, Coominga Droughtmaster Stud, 93 Summit Road, Pomona. **DM**

R. S. & R. I. Learmont, 'Scotlea', P.O. Box 102, Monto. **SG**

R. M. & G. E. Leu, Taabinga Pastoral Co., P.O. Box 323, Kingaroy. **MG**

O. H. & W. L. Lind, 'El-Jaycee', Gordon Brook South, M.S. 780, Kingaroy **BF**

Lobegeiger Farmlands Pty. Ltd., 'Lagoon Park', Wallaville. **BF**

J. R. & M. D. Louttit, 'Laggona', M.S. 979, Monto. **BM**

J. P. & A. M. Lowther, Silverleaf Hereford Stud, M.S. 355, Chinchilla. **HF**

R. L. & J. H. Lucas, 'Aeroview', M.S. 243, Kingaroy. **JS**

D. D. & J. L. McGuckin and I. D. and B. J. Francis, M.S. 790, Monto. **HF**

L. M., M. B. & I. D. McIntosh, 'Widgee Homestead', Widgee via Gympie. **AG**

W. R. McIntosh, 'Roadvale' A.I.S. Stud, 1 Tipman Road, Gympie. **AIS**

M. L. & R. G. McKewen, Tansey, Goomeri. **GS**

R. M. & E. C. McNaught, 'Kenjame Park', Abels Road, Wooloogа. **FS**

C. G. Margrie, 'Redvale', M.S. 767, Yarraman. **CL**

C. R. & J. L. Marquardt, 'Cedar Valley' Stud, Box 69, Wondai. **AIS**

R. G. & M. Matheson, 'Inabui', Eatonvale Road, Tinana. **DM**

R. G. & M. Matheson, 'Mioko', Owanyilla, M.S. 221, Maryborough. **DM**

Mimosa Stud and Cattle Co., 'Mimosa', Gayndah. **DM**

P. A. Moore, 'Bell Tower', South Isis, Childers. **BF**

N. S. Morris, Goomong Valley Friesian Stud, 'Tarcoola', Kandanga. **FS**

Moulton Pastoral Co., Noosa Charolais Stud, Old Tewantin Road, Cooroy. **CL**

G. W. Mowat, 'Town View', Jame Street, Yarraman. **AIS**

J. Mulholland, 'Widgee Crossing Santa Gertrudis Stud', 'Widgee Crossing', Gympie. **SG**

M. J. & B. F. Norgaard, 'Yarrabine', Box 61, Post Office, Yarraman. **FS**

G. & K. G. Orphant, 'Westbank', Paterson. **HF**

B. W. Overton, Galaxy Stud, 5 Gap Road, Cedar Pocket via Gympie. **CL**

S. J. & L. J. Pain, Taitlands Braford Stud, M.S. 708, Jandowae. **BF**

B. M. Paine, 'Tolga', Yengarie. **DM**

Pearson Bros., M.S. 1184, Murgon. **COM**

M. J. & E. M. Perkins, Byce Jersey Stud, M.S. 692, Nanango. **JS**

J. Phillips and Sons, 'Sunny View' Stud, M.S. 90, Kingaroy. **DM**

J. R. & R. E. Pickles, 'Saldanha', Coolabunia, via Kingaroy. **PH**

G. D. & P. L. Price, 'Golden Pines Stud', Yabba Road, Imbil. **PH**

Queensland Sub-Normal Childrens Welfare Assoc., P.O. Box 10, Gympie. **BM**

E. R. & H. G. Quilty, 'The Grange', P.O. Box 7, Nanango. **SG**

G. R. Radel, 'Happy Valley Stud', Coalstoun Lakes, Biggenden. **AIS**

R. D. & G. R. Radunz, 'Cool Hill', Wooroolin. **SG**

W. E. & R. M Rose, 'Rosevale' Friesian Stud, M.S.I. 1184, Murgon. **FS**

M. L. & D. M. Sawtell, M.S. 346, Nanango. **AG**

K. G. & M. A. Schloss, 'Tarlatin Hereford Stud', M.S. 648, Yarraman. **HF**

E. A. & R. E. Schroeder, 'Elverum Jersey Stud', Farm 21, Dagun via Gympie. **JS**

C. N. Scott, M.S. 1471, Manumbar Road, via Nanango. **FS**

T. J. Seawright, Stoneridge Guernsey Stud, M.S. 301, Monto. **GS**

D. R. & R. J. Sharp, 'Khancoban', Newspaper Hill Road, Belli. **SG**

N. K. & S. B. Shelton, 'Vuegon', Hivesville. **BF**

Mrs M. G. Smith, Sunday Creek Hereford Stud, Hivesville. **HF**

R. M. Sommerfeld, Brahrock, Beaver Rock, Granville, Maryborough. **CB**

A. H. & B. J. Springall, 'Beralan' Braford Stud, Imbil. **BF**

C. J. & Y. M. Stone, 'Stoneleigh', M.S. 514, Ironpot via Kingaroy. **MG**

A. E. Sutherland, 28 MacIntosh Creek Road, Gympie. **BM**

M. R. Taylor, Glen Alpine, M.S. 346, Nanango. **FS**

W. H. & D. M. Thompson, P.O. Box 20, Nanango. **AIS**

T. L. & V. J. Tidcombe, 'Wallum Lands' A.I.S. Stud, M.S. 483, Bells Bridge, Gympie. **AIS**

A. J. & E. A. Tigell, 'Avondale', Googa Creek, Blackbutt. **MG**

N. C. Tranberg, Loloma Brahman Stud, Upper Pin Barren Road, M.S. 626, Pomona. **BM**

N. C. & M. R. Tranberg, 'Loloma Brahman Stud', M.S.F. 115, Gympie. **BM**

D. C. Tunstall, 'Hi Valley', M.S. 692, Nanango. **SH**

J. G. M. Tyquin, 'Tuncul Park', Tuchenoi Road, Imbil. **PH**

S. A. Wadley, Shanerick Friesian Stud, P.O. Box 21, Kandanga. **FS**

D. V. Wagner & Co., 'Aranbanga Braford Stud', 'Barncleuth', Gayndah. **BF**

D. L. Ward, 'Willow Valley' Stud, Barambah Road, Nanango. **JS**

N. T. & L. J. Watts, 'Perseverance', Kin Kin, M.S. 626, Pomona. **AY, FS**

G. C. & C. A. Webster, Gympie. **BF**

J. N. Wilson and Son, 'The Valley', Blackbutt. **DM, BM**

R. A. & M. R. Wilson, 'Oheden Stud', Oheden Road, Proston. **GS**

Rockhampton Division

Allawah Stud Partnership, 'Allawah', Theodore. **BM**

H. J. Ambrose, Lime Quarries Brahman Stud, Marmor. **BM**

Atkinson and Co., Glenavon, Yamba. **SG**

P. Atkinson, 'Coorumburra', P.O. Box 1, Marlborough. **SG**

S. J. Atkinson, 'Wairuna Brahman Stud', 'Bundarra', Nebo. **BM**

C. R. & V. M. Beak, Mt. Miller, Yarwun. **BM**

J. W. H. Bell, 'Bilandra', Jambin. **BM**

Bell Partnership, 'Camboon Stud Holding', 'Camboon', Theodore. **HF**

B. & E. Bergstrom, 'Chris Aelgy' Brahman Stud, 'East End', Mt. Larcom. **BM**

Bolingbroke Pastoral Co., 'Bolingbroke', via Sarina. **SG**

C. A. Bowkett, Bowville Stud, P.O. Box 221, Biloela. **DM**

F. Brieffies, Blue Mountain via Sarina. **AFS**

Brigalow Research Station, Dept. Primary Industries, M.S. 1586, Theodore. **HF**

Broadlea Partnership, 'Broadlea', Box 35, Theodore. **BM**

Bundaberg Sugar Co., 'Avondale' Brahman Stud, Marlborough Station, Marlborough. **BM**

Calliope Cattle Co., Calliope Station, Gladstone. **HF**

F. & J. M. Carrington, 'Raelee Downs', Corfield. **SG**

D. A. Carter, 'Mirra', Banana. **BF**

E. & A. B. Childs, 'Glenlands' and 'Valuce' Studs, Bouldercombe Road, Rockhampton. **DM**

R. P. Cavanagh, 'Elsewhere' Braford Stud, Jambin. **BF**

Claytons P/L., Pinelands, P.O. Box 120, Yeppoon. **BS**

W. C. & C. B. Cole, Alligator Creek. **FS**

C.S.I.R.O., 'Belmont Research Station', P.O. Box 542, Rockhampton. **BR**

Coombe Bros., 'Roxborough', Greenlake Road, Rockhampton. **BM**

E. J. & R. C. Deguara, Maraju Droughtmaster Stud, Nebo Road, Mackay. **DM**

V. Deguara, Savannah Brahman Stud, Post Office, North Eton. **BM**

L. De Landelles, 'Cherokee', Tanby via Yeppoon. **BM**

D. A. & E. I. Dickson, Eton Park, Dululu. **FS**

H. L. Douce, 'Cleveland', Alpha. **BM**

F. & D. Fordyce, 'Waterhole', Bloomsbury. **BM**

G. & N. & A. Freegard, 'Hillalong', Crediton, Dalrymple Heights. **AFS**

Green Global Trading Co., 'Global' Belmont Red Stud, 'Daisy-Dell' via Bororen. **BR**

L. B. & R. B. Green, 'Isla Downs', Theodore. **HF**

E. R. Greenhalgh, 'Chianti' Stud, 'Tallundilly', Emmet via Isisford. **CH, HF**

K. F. & K. P. Greiss, 'Glendon Friesian Stud', The Caves. **FS**

C. R. Hardwick, 'Charlyn', Marlborough. **BM**

T. R. Hay and Co., Pindi Pindi. **BM**

H.M. Prison, Etna Creek via Rockhampton.	MIXED
Estate H. & F. H. Hinz, 'Glenmoya', Rossmoya Road, The Caves via Rockhampton.	BF
A. Hobbs, Birkdale, Dartmouth.	CL, CH, SG
A. L. & P. Hughes, 'Woodlea', Bluff.	BM
C. J. & M. E. Jackson, 'Jaffra', Gogango, Fairy Bower Road, Gracemere.	BM
K. E. & E. J. Jeppeson, 'Taranga', Bloomsbury.	BM
K. E. & K. J. Johnson, 'Elsinore', M.S. 1396, Biloela.	DM
P. G. & A. Kajewski, 'Newlands', Duaringa.	SG
J. F. Keating, 'Sequen', Baralaba.	BF
E. W. King, c/- Kengoon Pastoral Co., Dingley Dell, M.S. 1017, Biloela.	DM, AF, BM
King Ranch Development Co. P/L., 'Elgin Downs', Clermont.	SG
A. & M. & C. Kirk, 'Rockley', Bajool.	BM
B. F. Kirwan, Colston Park Stud, via Sarina.	DM
B. R. & J. H. Kummerfield, 'Lonley', c/- P.O. Box 7, Goovigen.	GS
C. N. & D. V. Lewis, 'Bramleigh', Baralaba.	BM
C. H. Lund, 'Namlin', Milman.	BM
J. R. & A. McCamley, 'Lancefield' Brahman Stud, Dululu.	BM
A. M. & E. H. McCartney, 'Maroomba' and 'Lomalinda' Studs, 'Maroomba', Marlborough.	BF
J. D. & D. B. McDonald, 'Kolonga', M.S. 656, Habana via Mackay.	BS
F. W. McFadzen, Glenvale Friesian Stud, M.S. 1598, Sarina.	FS
C. A. McMillan, 'Pine Avenue Stud', Rockhampton.	BM
J. L. & A. M May, Gracemere.	BM
R. F. & R. M. Maynard, 'Greenfields', Jambin.	BM, CL
A. R. Meldrum, 'Brackyn Hill', Parkhurst.	BM
M.V. Pastoral Development P/L., 'Woolton', Theodore.	HF
Naree Pastoral Co., c/- H. A. & N. E. Bloodworth, 'Merriwin', Longreach.	BF
S. E. Nielsen, 'Rosendale', Biloela.	DM
P. E. C. & V. K. Nobbs, 'Lyndhurst', Biloela.	BM
A. F. & J. E. North, 'Northbrook', Milman.	BM
G. C. & D. L. Nott, Burwood Brahman Stud, 'Belconnen', Milman, M.S.I. 1244, Rockhampton.	BM
L. & N. M. Ogden, 'Red Hill Brangus Stud', M.S. 1017, Biloela.	BS
A. Olive, 'Nullegai', Marlborough.	BM
D. A. & M. Osbourne, 'Granville', M.S. 588, Alton Downs.	BF
T. P. D. & P. M. Parker, 'Grazzi', M.S. 656, Barcoo via Mackay.	BS
C. W. W. Pask, 'Beacon Pastures Brahman Stud', 33 Perry Street, Mackay.	BM
M. D. & W. L. & A. M. Pullen, 'Tannock', P.O. Box 67, Mirani.	BF
Princhester Grazing Co., 'Princhester Siding', N.C. Line.	SG
A. W. Rasmussen Pty. Ltd., 'Praguelands', Alligator Creek via Mackay.	DM
W. J. & M. Rea and Co., 'Clifton', Marlborough.	BF
Royston Park Graz. Co., c/- Mr W. Fordyce, Kuttabul.	BS
F. T. Rowe, 'Greenacres', Banana.	BM
H. G. & B. Rowe, 'The Hollow', Mirani.	BS
J. A. Scantlebury, 'Badminton', M.S. 1855, Theodore.	HF
G. Schultz, 'Hillview', c/- Post Office, Mt. Larcom.	BM
C. L. & A. R. Schottelius, 'Willawa', P.O. Box 149, Theodore.	HF
V. G. Scott, 'Wiluna Friesian Stud', Wiluna, Wowan.	FS
J. H. Semple, 'Braeview', Biloela.	SG
Shannon Partnership, Cardowan Grazing Co., 'Cardowan' via Sarina.	BF
J. G. & L. G. Sherriff, Wheeler View Yeppoon, 12 Maple Street, Yeppoon.	CL, CB
J. S. & E. A. Sichter, 'The Loch Brahman Stud', Alligator Creek, via Mackay.	BM
F. H. & E. Smith, Sommerville Brahman Stud, 'Brahmeadows', M.S. 1883, Rockhampton.	BM
Stanbroke Pastoral Co., 'Waverley', St. Lawrence.	BM
Swan Hill Pastoral Co., 'Swan Hill', Blackall.	SG
B. Sykes, Glen-App, Milman.	BM
Tennant and Geddes, 'Doonside', Rossmoya via Rockhampton.	BF, BS
G. Thurgood, c/- Post Office, Dalrymple Heights.	AFS
J. F. Titmarsh, 'Wattlevale', Ridgelands via Rockhampton.	AIS
I. E., M. A. & P. L. Walker, 'Strathmore Santa Gertrudis Stud No. 65', 'Strathmore', Longreach.	SG
Sir James Walker, 'Camden Park', Longreach.	SG
Sir James Walker, 'Cumberland', Longreach.	SG
M. Walker, 'Avoca', Barcaldine.	SG
Walloon Pastoral Co., 'Walloon', Banana.	AF, X, BR
K. & M. E. & D. Watts, 'Keimar', Hamilton Creek, Mt. Morgan.	BF
H. L. F. Westcott, 'Olympus', Munbura via Sarina.	BM
Wharton Creek Pastoral Co., Wharton Creek, Springsure.	BF
R. T. & B. A. White, 'Wilangi' Brahman Stud, Wumalgi.	BM
Yarra Yarra Braford Stud, c/- F. M. Hendy, 2 State Farm Road, Biloela.	BF
Townsville Division	
Ayr Research Station, P.O. Box 15, Ayr.	MIXED
F. & I. C. Fraser, 'Dundee' Brahman Stud, Richmond.	BM
Cairns Division	
J. Cardillo, 'Oena', Springs Road, Mareeba.	DM
M. T. A. & R. J. Davidson, 'Waterloo Brahman Stud', P.O. Box 207, Mossman.	BM
Kairi Research Station P.O. Box 27, Kairi.	MIXED
King Ranch Development Co. P/L., Tully River Station, Euramo.	SG
E. J. Rassmussen, 'Euluma Stud', c/- P.O. Box 80, Mossman.	DM

INDEX

AF—Afrikaander
AG—Angus
AIS—Australian Illawarra Shorthorn
AMZ—Australian Milking Zebu
AY—Ayrshire
BR—Belmont Red
BF—Braford
BM—Brahman
BS—Brangus
CB—Charbray
C—Charolais
CH—Chianina
COM—Commercial
DM—Droughtmaster
FS—Friesian
GS—Guernsey
HF—Hereford
JS—Jersey
LM—Limousin
M—Mixed
MG—Murray Grey
PH—Poll Hereford
PS—Poll Shorthorn
RP—Red Poll
SW—Sahiwal
SG—Santa Gertrudis
SH—Shorthorn
SM—Simmental
MA—Marchigina
DV—Devon
PD—Poll Devon
RS—Red Sindhi
PZ—Pinzgauer
AFS—Australian Friesian Sahiwal
RN—Romagnola

Certified seed protects buyers

The combination of certified seed and good husbandry produces high-yielding, uniform crops and pastures.

THE best pastures and crops start with top quality seed of the most suitable variety.

The best way to ensure that the preferred variety is sown is to use certified seed.

Certification provides buyers with a guarantee that the seed is both true to label and true to type. Yet, even when supplies of certified seed are available, a number of farmers do not take advantage of this protection. They seem quite satisfied to buy seed without the slightest idea of where it originated and without any concern as to its authenticity.

by D. S. Loch, Agriculture Branch and T. E. Friend, Standards Branch.

What is certified seed?

In Queensland, certified seed of pastures and field crops is of known genetic origin. Records are kept of its pedigree through various generations of seed multiplication from its release by the plant breeder until it is marketed as certified seed.

Breeder's seed is provided by the institution releasing the particular cultivar (cultivated variety). This is built up under strict conditions and supervision to maintain trueness-to-type. The initial generations in this multiplication process are called **basic seed** which is then sown to produce **certified seed** for general sale.

Research to produce a new cultivar can be very time-consuming and expensive. Certification protects this investment, assures seed growers that they will still have an acceptable product to sell in the long term, and enables buyers to maximize profits because they receive a guarantee as to the authenticity of a certified seed lot. Needless to say, no such guarantee exists with uncertified seed.

Seed certification schemes

Seed certification originated in Europe during the late nineteenth century. Today, various certification schemes are in operation in the more developed countries of the world. In Australia, for example, seed certification is carried out by the States and is co-ordinated nationally by the Australian Seeds Committee comprising State and Commonwealth officials.

To promote international movement of certified seeds, the O.E.C.D. (Organization for Economic Co-operation and Development) has drawn up a number of certification schemes which operate in member countries.

O.E.C.D. schemes require high standards of varietal purity and certified seed may not be more than a limited number of generations removed from breeder's seed. Most European countries require that imported seed be certified under O.E.C.D. rules and this approach is likely to become more widespread throughout the international seed trade.

The aims of certification

Individual certification schemes differ in the way they operate, though most have a common and major aim—to ensure that seed of particular cultivars remains true-to-type. Some, however, have other aims such as freedom from seed-borne diseases and high physical quality.

Trueness-to-type

In maintaining the genetic identity of any cultivar, attention must be given to ensure:

- Correct labelling.
- Minimum physical contamination by seed of other cultivars.
- No cross-pollination with compatible related cultivars.
- Restricting the number of generations of multiplication.
- Roguing of off-types.

Correct labelling

Varietal differences can sometimes be recognized from seed or plant characteristics. However, such features are only of value if they are known and used. And unfortunately, they are frequently overlooked by buyers who all too often regard the cultivar name branded on the bag as the final word on the subject.

In contrast, seed certification guarantees correct labelling. Without certification, considerable confusion of varieties can result from accidental and (in some cases) deliberate mislabelling, even with readily distinguishable cultivars. This is the case with many lines of commercial oats seed sold in Queensland.

Although Callide Rhodes grass seed is distinguishable from that of the widely sown and inferior Pioneer, many seed lots sold under the label 'Callide' in the past have either been Pioneer or have been heavily contaminated with Pioneer. A recently introduced certification scheme, however, should prevent any future occurrence of this problem and restore market confidence.

Plicatulum (*Paspalum plicatulum*) cultivars can be distinguished easily by the leaf-hair characters displayed on mature culms. Some distinction based on size and colour of seed can also be made, though this is more difficult. Nevertheless, the bulk of plicatulum seed produced in Queensland was, for many years, incorrectly labelled as 'Hartley'.

Official labels (above) are the only means by which buyers can recognise certified seed. These are sewn into the top of each bag (below) under the supervision of a seed certification officer.

A few years ago, when seed samples were 'grown on' and seed paddocks inspected thoroughly, it was found that all the seed being sold as Hartley was, in fact, the Rodd's Bay cultivar. Without the protection of certification, authentic seed of Hartley had apparently disappeared from commerce some years earlier —within a decade of its commercial release.

Excluding seed of other cultivars

An objective of any certification scheme is to exclude seeds of other cultivars, whether or not these will cross-pollinate with the certified variety.

With self-pollinated species, the minimum isolation distance need only be adequate to prevent mechanical mixtures of seeds. In the scheme operating for some guinea grass (*Panicum maximum*) cultivars in Queensland, certified areas must be separated from other *Panicum maximum* plants by a clean cultivated or regularly mown strip at least 5 m in width.

Adequate precautions must also be taken to prevent contamination by seed of other cultivars during and after harvest.

In some cases, a widely sown and/or naturalized contaminant may leave very little completely clean ground suitable for growing a particular cultivar. As a result, come contamination of certified crop areas may be inevitable. The aim is then to minimize such contamination.

This is the case with Callide and Samford Rhodes. In the past, the original cultivar, Pioneer, has been widely sown and has become naturalized. The scheme now in operation therefore aims to produce basic seed from the limited area of suitable clean country available and to use this seed to sow certified areas. Basic seed areas must contain no plants of other Rhodes grass varieties, but certified swards can comprise up to 1% of other varieties.

Preventing cross-pollination

With cross-pollinated crops, the required isolation distance must be much greater if pollination (and therefore genetic contamination) by compatible cultivars is to be kept to a minimum. The necessary distance can vary, depending on whether or not the species involved is insect or wind-pollinated, and on

Cleanliness of harvesting and other machinery used in producing and processing certified seed is an important step in avoiding varietal contamination.

the need to permit efficient production of certified seed. In practice, however, it is generally greater than 100 m.

For grasses, wind-pollination is the usual means and can operate over a considerable distance. In Queensland, therefore, minimum isolation distances for setaria have been set at 400 m for basic seed and 200 m for certified areas. Similarly, crossing plots producing certified hybrid maize seed must be at least 200 m from any maize plant (other than the male parent) which is a potential source of pollen.

Restricting the number of generations of multiplication

Where cultivars are highly self-pollinating, a **pure line** system of certification can be used as there is little chance of variation from one generation to the next. Important examples of this system are the certification of subterranean clover (*Trifolium subterraneum*) and annual medics (*Medicago* spp.) in southern States of Australia.

With cross-pollinated cultivars (for example, Callide and Samford Rhodes grass, Narok setaria) some limitation on the number of generations for multiplication is necessary by means of a **pedigree system.** Of course, sufficient generations must be allowed for a practical build-up of cultivars, but at the same time, these must be restricted to minimize the risk of genetic drift leading to cultivar degeneration.

Roguing of off-types

Off-types can creep into a cultivar during multiplication, thereby changing its genetic identity. This can occur even during the three to four generations of build-up under certification.

To maintain a cultivar as close as possible to the material tested and released by the breeder, off-types must be rogued before they can flower and contaminate the new generation.

Freedom from seed-borne diseases

In Queensland, freedom from certain seed-borne diseases is the main objective of certifying navy bean seed to be used for the production of the approved grade of seed which enters commerce. Seed crops will be rejected for certification if halo blight, common bacterial blight, bacterial brown spot, or anthracnose appear in any part of the crop at any time during its growth, or if more than 1% of plants are infected with bean common mosaic virus.

Physical quality of seed

Physical quality refers to the degree of freedom from inert matter, weed seeds and seeds of other crops, and to germination. Standards of physical purity and germination are prescribed for each species in State seeds regulations.

The physical quality standards for certified pasture seeds are the same as those laid down by the seeds regulations. However, in the case of certain crop seeds, higher germination is required for certified seed. For example, the minimum germination requirement for certified hybrid maize seed is 90% compared with 80% in the regulations.

When is a cultivar certified?

In Queensland, seed certification schemes are available for the following pasture and field crop species, but the amount of seed certified under any scheme is dependent on demand:

Stylos	*Stylosanthes* spp.
Leucaena	*Leucaena leucocephala*
Rhodes grass	*Chloris gayana*
Setaria	*Setaria sphacelata* var. *sericea* (formerly S. *anceps*)
Guinea grass	*Panicum maximum*
Hybrid maize	*Zea mays*
Oats	*Avena* spp.
Cowpeas	*Vigna unguiculata*

Although not considered in this article, seed certification is also available in Queensland for some horticultural crops:

Tomato	*Lycopersicon esculentum*
French beans	*Phaseolus vulgaris*

Navy beans, being of the same species as French beans, were included provisionally in that certification scheme but are now being grown under a separate scheme.

Because seed certification schemes are expensive to administer, it is Queensland policy to certify only those plants whose identity and freedom from seed-borne diseases could not be maintained otherwise, or which are difficult or impossible to recognize.

In addition to full seed certification, however, there are other, less stringent schemes used with less difficult species to promote the orderly production and sale of seed of known quality. These involve varying degrees of co-operation between the seed industry, commodity boards, and the Department of Primary Industries, and include the Approved Oats Scheme, the Soybean Pure Seed Scheme, and the sale of selected seed by various marketing boards.

Production of certified seed

Procedures used in the production of certified seed show how the pedigree of the final product is recorded and how quality is maintained, so that the aims of certification are achieved in practice.

Crop establishment

Specified planting stock must be used in the production of certified seed. In general, this must be basic seed, but there are exceptions.

The grower must retain the labels from this stock seed so that the cultivar and class of seed sown can be identified. The checking of these labels is an important step in the official documentation of pedigree.

Inspections

Various inspections may be carried out to ensure that the crop fulfils the requirements of the appropriate certification scheme. These include:

- Inspection of the area before crop establishment to ensure that it is free of contaminant plants and that isolation is adequate.
- One or more field inspections during crop development to detect any off-types or plants of other cultivars and to ensure freedom from disease if necessary.
- Inspections of harvesting and seed processing machinery to minimize the risk of contamination by seed of other cultivars, and with navy beans, to ensure disinfection when necessary.

Labelling

The label on a bag of certified seed is important because it indicates to the buyer that the seed lot has met all the requirements of certification. Labels are serially numbered to facilitate record keeping and are issued by the Department of Primary Industries. One of these is sewn into the top of each bag under the supervision of a seed certification officer. This is done in such a way that labels cannot be re-used without detection.

No seed from any registered area can be called 'certified' until it has been properly labelled.

Cost of certification and certified seed

Certification does involve some additional care and expense in growing the crop. However, part of the administrative cost of certification is borne by the State Government and therefore by the community as a whole.

Fees are payable by the grower of certified seed, but these are small and add very little directly to the cost of certified seed (for example, 5·0c per kg for pasture species, 1·7c per kg for maize, and $11.00 per ha for navy beans).

A difference between the price of certified and uncertified seed of the same cultivar reflects buyer recognition of the advantages of using certified seed which is guaranteed true-to-type. It also gives some repayment to the grower for the extra care and expense involved in growing disease-free seed of superior varietal purity.

Narok setaria, for example, currently enjoys a high reputation as a superior pasture cultivar and there is strong demand for certified seed of Narok. However, this would almost certainly not be the case if the protection of seed certification had not been provided when Narok was released in 1969. This seed is expensive because the cultivar is a shy seeder. Certification, however, has removed the obvious temptation to mislabel less valuable seed of inferior setaria cultivars and has also protected Narok from cross-pollination with these cultivars.

Conclusions

In the seed market, buyers generally get the quality they pay for. Yet many seek only to buy the cheapest seed, regardless of how dubious its pedigree or its physical quality may be. Certified seed is generally somewhat more expensive but offers the buyer value for money. When the protection and advantages of certification are considered, no one can really afford not to use certified seed if it is available.

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.

The financial feasibility of processing individually quick frozen strawberries

AS a result of a bumper crop of strawberries in Queensland in 1978, many growers were concerned that local processors were unable to accept all of this surplus production as it became available.

Production was estimated by the Committee of Direction of Fruit Marketing to be 990 t, a 25% increase on the 1977 crop. Processing strawberries which account for two-thirds of this increase (that is approximately 130 t) could not be fully absorbed by the existing processing facilities. This has resulted in an inquiry into alternative outlets so that farmers may gain a satisfactory return on their total crop.

The Department of Commercial and Industrial Development undertook an investigation into the feasibility of establishing such an outlet in the form of an individually quick frozen (I.Q.F.) strawberry processing facility. This would utilize the surplus and supply the Queensland market with whole frozen strawberries all-year-round.

Present market situation

I.Q.F. strawberries are not processed in Queensland at present. They are, however, imported in reasonably large quantities mainly from Mexico and California, with increasing quantities from New Zealand. An estimate of the annual demand for this type of strawberry in Queensland has been put at 50 t. This figure comprises direct imports of 33 t and an estimated 17 t of interstate imports.

Preliminary trials

Before undertaking a complete financial analysis, some preliminary trials were undertaken to establish the suitability of the local varieties for processing as I.Q.F. strawberries. A cryogenic technique was used to freeze the strawberries. After being stored in this condition for 1 month, samples of the local and imported products were thawed under identical conditions. The quality and colour of the local strawberries were more than comparable to the imported products.

Financial analysis

After these encouraging results, a full costing and financial analysis was undertaken for a facility to supply the Queensland market. In determining capital and production costs a number of assumptions were made. Simply, they were that the factory would be an extension of an existing processing operation and many costs would be absorbed into the existing company structure and therefore only incremental costs considered.

The capital cost of a facility capable of processing 50 t of strawberries was estimated at approximately $48,000. This cost includes a portal frame building of 120 m^2 incorporating an air-conditioned packaging room and a cold room with a capacity of 127 m^3. Other equipment included in the estimate was a snap freezer, refrigerator, spray washer and packaging apparatus. The estimate also includes an allowance for design costs and unforeseen expenditure.

A financial analysis of this project was undertaken using the net present value technique, based upon the capital expenditure and production costs outlined above. The net present value of any project is found by discounting the total future net cash inflows at the cost of capital for the firm over the lifetime of the project, and deducting from the resulting present value the initial cash outlay. If a project generates a positive net present value, it is acceptable.

by Susan Lowrie and B. T. Tellam, Department of Commercial and Industrial Development.

A sensitivity analysis using different discount rates and selling prices was performed and is summarized in table 1. This analysis revealed that based on a raw material cost of 50 cents per 500 g, a wholesale selling price of $1.10 per 500 g is the minimum price which generates a positive net present value, at a discount rate of 11%.

The specific discount rate to be used in this project would depend on the debt/equity structure of the firm undertaking the project. A further analysis using the net present value technique for different plant capacities revealed that the minimum size plant would be 20 t with a wholesale price of $1.30 per 500 g.

Taking the existing prices of the imported products as a guide, the mark-up available to the retailer is in the order of 27 to 47% using the minimum wholesale price of the 50 t plant. This range would be acceptable to most retailers.

Summary

The investigation into I.Q.F. strawberries was centred mainly on the feasibility of producing 50 t of the product which was believed could be marketed easily in Queensland as there was an existing demand presently satisfied by overseas and interstate imports.

The viability of this project was confirmed in the financial analysis which showed that a 50 t plant could be operated profitably if the wholesale price was $1.10 per 500 g at a discount rate of 11%. It was also noted that the profitability of the facility could be enhanced by the use of the plant in processing other fruits outside the harvesting period for strawberries.

Further information and a full copy of the report titled 'The financial feasibility of processing individually quick frozen strawberries' are available from: The Director, Department of Commercial and Industrial Development, P.O. Box 183, North Quay, Brisbane, Q. 4000.

TABLE 1

NET PRESENT VALUE ($'000)

FOR PLANT OF 50 TONNES CAPACITY

Wholesale Price per 500g ($)	At Discount Rate %							
	9	10	11	12	13	14	15	I.R.R.
1·00	−35·0	−35·6	−36·1	−36·6	−37·0	−37·5	−37·9	−12·9
1·10	3·8	1·8	0·0	−1·8	−3·4	−5·0	−6·4	11·0
1·15	23·1	20·4	18·0	15·6	13·4	11·3	9·3	20·6
1·30	80·3	75·5	71·1	66·9	63·0	59·2	55·7	47·7

I.R.R. = Internal Rate of Return.

The Hakeas of South-eastern Queensland

IN 1797, a German botanist named Heinrich Schrader, described three plants from eastern Australia belonging to the same genus which he named Hakea in honour of a contemporary German patron of botany, Baron von Hake.

Hakeas are always woody shrubs or small trees. They have alternate leaves which vary greatly in shape. Some are firm and terete, like needles, and end in a pungent point. Others are flat and vary in length, breadth and shape. Their margins can be entire or marginal teeth may be present. In Western Australia, there is even one Hakea with leaves shaped like mussel shells with the margins bordered by short, prickly teeth.

All have small, narrow, relatively inconspicuous flowers in the axils of the leaves in oblong, cylindrical or short racemes or crowded together into large, dense globular clusters looking like pin cushions. Although the hakeas of South-eastern Queensland have white or pale creamy-yellow flowers, in other parts of Australia, particularly in Western Australia, the flowers can be pink, orange, mauve or some shade of red.

Hakea belongs to the same family as Banksia and Grevillea. Their flowers are similar in structure, with four perianth parts joined into a slender tube ending in a globular or ovoid limb which is often oblique. The tube splits along one side releasing the style but the stigma remains still tightly enclosed in the limb.

by Beryl A. Lebler, formerly of Botany Branch.

Finally the perianth segments separate completely, the stigma is released and the style straightens out. The fruit is a hard, usually woody capsule which splits into two valves releasing two flattened seeds usually with a broad membranous wing at the upper end. It is more or less decurrent along only the upper surface or down both margins but in a few hakeas it completely surrounds the seed.

The inner face of the seed, which lies against the other seed, is flattened and the outer is convex and fits into a corresponding hollow in the face of the valve. Warty bumps are often found on the outer surface of the capsule. In many species there is one very prominent bump at the end of each valve, so that before the capsule splits open it appears to have two short horns.

Hakeas are found only in Australia. Five hakeas are native to south-eastern Queensland: *Hakea gibbosa, H. florulenta, H. eriantha, H. plurinervis* and *H. dactyloides.*

Hakea gibbosa

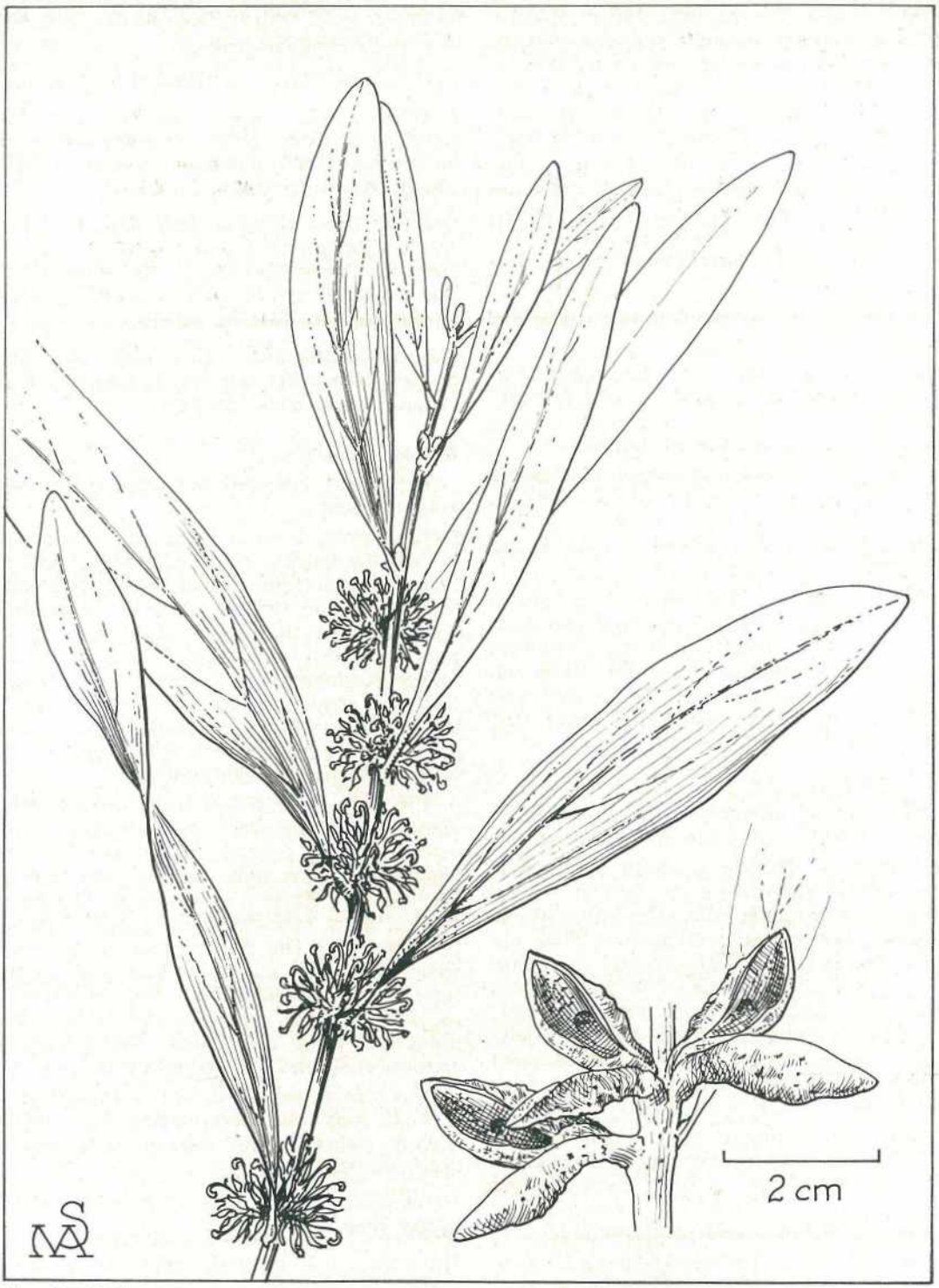
The Latin adjective *gibbosa* means swollen on one side or humped. It describes the shape of the fruit.

DESCRIPTION. This is a dense, much-branched shrub which can grow to a height of 3 m. Its leaves are dark green and needle-like and end in pungent points. The leaves can be 12 cm long and less than 0·2 cm in diameter, but the leaf size varies in plants from different localities. The flowers are in axillary clusters along the twigs, sometimes in each leaf axil, in others confined to the terminal leaves.

Usually each cluster consists of four to five flowers. Individual flowers are on pink stalks about 0·24 cm long with a sparse covering of short, white hairs. The flowers are glabrous and usually white, though occasionally with a faint pink flush. Fully developed buds are less than 0·5 cm long.

When the flower splits, the style curves out in an arc. In a fully-opened flower it is straight except for the end. This remains hooked with an oblique, flattened stigmatic disc at the tip. Initially, the style is white but it becomes flushed with deep pink.

Hakea gibbosa



Hakea florulenta

Fully-opened flowers look rather spidery, with four narrow segments spread outwards. The spoon-shaped tips of the tepals curve to one side of the flower and the style curves out to the opposite side. When the perianth falls, the light green glabrous ovary is easily seen.

The fruit is grey, very hard and woody, about 3·75 cm long and as thick. It splits into two valves which spread widely. At the end of each valve is a small, pointed horn. The seeds have black, membranous wings like gauze or crepe.

FLOWERING TIME. It flowers during winter and spring.

HABITAT. It is common on the coastal lowlands, in wallum and also in open forest and tea-tree swamps, and on the slopes of the isolated peaks on the border ranges.

DISTRIBUTION. It is found only in New South Wales and Queensland from as far south as Port Jackson to as far north as the Elliott River on the mainland and Fraser Island offshore.

GENERAL REMARKS. This hakea is in cultivation. It is often used by landscape architects where a plant is needed as a barrier to prevent the passage of people or animals. It is not used to any great extent by home gardeners because of the spiny leaves, small flowers and very persistent woody pods.

Hakea florulenta

The specific epithet for this hakea is a Latin adjective which means flowering profusely.

DESCRIPTION. This is a shrub to 2·75 m, either slender and erect or bushy with several stems from a common base. The leaves spread from the stem, usually vertically. They are firm in texture, somewhat glaucous in colour, oblong-elliptical in shape, 7·5 to 12·5 cm long and usually 1 to 2 cm wide. The leaf tip is blunt and the midrib and several widely-spaced oblique pinnate veins show as paler coloured lines. The leaves taper into a short petiole.

Axillary floral clusters can contain as many as 40 flowers. Each is on a slender green pedicel, 0·5 cm long. A fully developed bud is usually about as long as the pedicel. The flowers are glabrous and creamy-white.

The fruit is greyish-black, about 2·5 cm long and 1 cm wide. The outer surface is more or less covered with bumps and the fruit ends in a short incurved beak.

FLOWERING TIME. It blooms in early spring.

HABITAT. This hakea grows in wallum swamps, in damp places in open eucalyptus forests, and is also common on sandstone hills and in fissures in granite boulders.

DISTRIBUTION. It was first described from 'about Moreton Bay' and appears to be confined to Queensland to as far north as the Burrum River and as far west as Mt. Norman on the southern Darling Downs.

GENERAL REMARKS. This plant has been brought into cultivation but is generally overlooked by the home gardener.

Hakea eriantha

The Latin adjective *eriantha* means with woolly flowers.

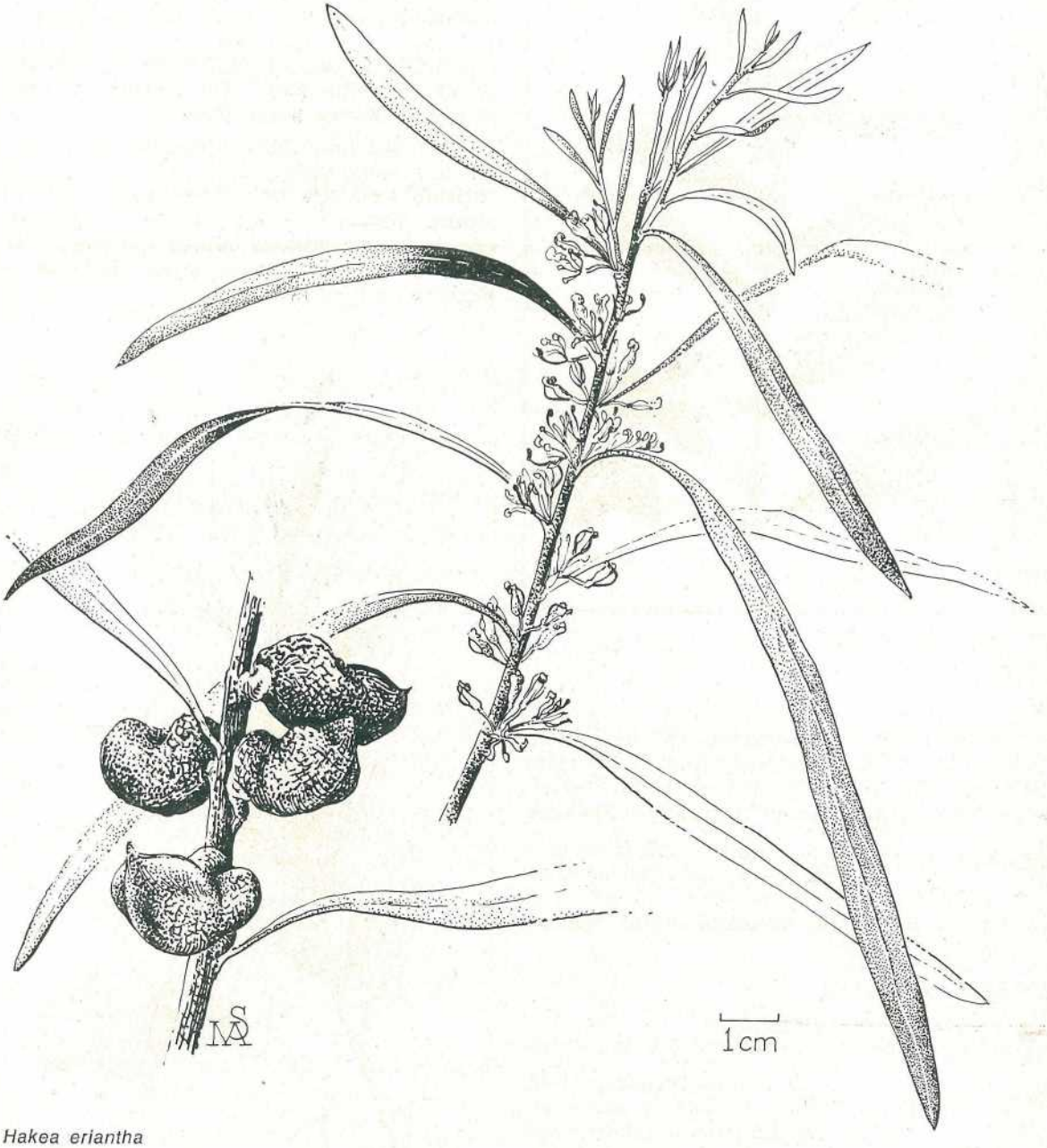
DESCRIPTION. This is a bushy shrub or tree to 3 m in height, often with three or four slender stems from ground level. The upper branches droop slightly. The leaves are held vertically and the young shoots are sticky-pubescent with short, appressed hairs. Adult foliage is glabrous. The leaves are lanceolate and some tend to be falcate. They are firm in texture but rather thin, bluish-green to dull green in colour, up to 15 cm long and 1·5 cm wide and taper to both ends.

The only evident vein is the midrib which shows as a lighter green line. Obscure pinnate veins are also present but are hard to see. Flowers develop only on the new growth. They are in clusters of up to six flowers in the leaf axils, each flower on a slender pedicel 0·5 cm long. The flowers split on the lower side and the style curves out through the opening. Both the pedicel and the outer surface of the perianth are covered with short, appressed, white, silky hairs. The flowers are creamy-white and faintly perfumed.

The fruit is reddish-brown in colour, up to 3·5 cm long and just under 2 cm broad, slightly incurved, and ends in a very small upturned beak.

FLOWERING TIME. This hakea flowers in spring time.

HABITAT. It is common on rocky mountain slopes.



Hakea eriantha

Hakea plurinervis

DISTRIBUTION. It grows in all the eastern mainland States. In Queensland, it has been found only in the mountains of the McPherson Range and on the stony hills north of Helidon.

GENERAL REMARKS. Although this plant is in cultivation and can usually be obtained from nurseries specializing in native plants, it is better suited to the mountain regions than to the coastal plains.

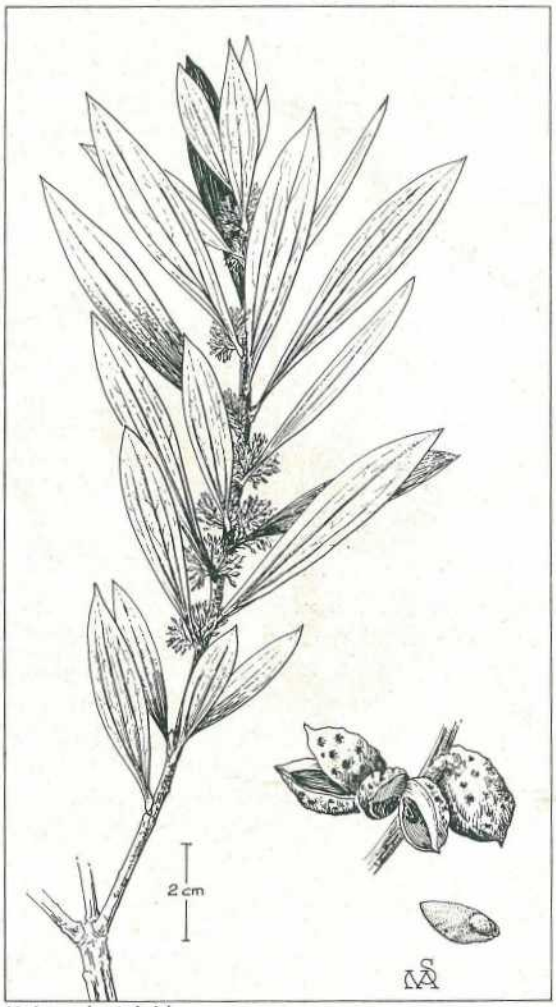
Hakea plurinervia

The specific epithet is a Latin adjective meaning many-nerved and refers to the leaves.

DESCRIPTION. This is an open-branching shrub to 3 m high. The green, leathery leaves are lanceolate to falcate, and taper to the base and the tip. They are up to 13 cm long and 25 cm wide. Their most striking feature is the venation. Up to seven parallel veins show clearly as paler green lines on both surfaces.

This is one of the most floriferous hakeas in South-eastern Queensland. Clusters of flowers are often found down the main stems as well as on the flowering branches. The dense, rounded clusters like pin cushions in the leaf axils can be as much as 1·5 cm across. The tiny, white flowers are on slender stalks which are flushed with pink. The flowers are said to have a strong, heavy scent.

When the tube splits along the lower side, the thin white style arches out. Finally, the perianth separates into four narrow, spoon-shaped segments. When the style straightens out the stigma projects beyond the flower. It ends in a white conical stylar tip with a thickened ring at the base.



Hakea dactyloides

Below the flowering portion of the stem, the fruits of the previous season can be seen. They are about 3 cm long and 2 cm across, grey to brown in colour with streaks of raised dark brown blotches and end in an incurved conical beak.

Usually only one or two fruits mature in each inflorescence and the capsules curve downward to the side of the leaf beneath the inflorescence. Two seeds are released when the fruit opens.

FLOWERING TIME. This hakea flowers profusely in spring.

HABITAT. It grows mainly on sandstone ridges in open eucalyptus forest.

DISTRIBUTION. It is found only in Queensland to as far north as Cardwell on the coastal lowlands and Herberton on the Atherton Tableland.

GENERAL REMARKS. This hakea is also in cultivation and would be a worthy addition to any garden because of its distinctive dark green leaves and the profusion of usually pure white flowers.

Hakea dactyloides

A combination of two Greek words which means finger-like is used as the specific epithet for this plant. It describes the clusters of mature fruits before they split open.

DESCRIPTION. This is a shrub to 3 m high with rigid leaves which are dull green or deep green. They are linear-lanceolate to oblong-lanceolate and end in a pointed tip. Three prominent longitudinal veins are easily seen. A network of finer veins connects the longitudinal veins to each other and to the margins. Silky hairs cover the young, growing shoots but the leaves become glabrous as they age.

The small flowers are creamy-white to pale yellow and are very numerous, making the flowering portion of the plant look like leafy-interrupted spikes. The flowers are glabrous but the pedicels are silky-hairy. This can be seen only with magnification. When the flower opens fully, the erect style can be seen. It ends in an erect stigmatic cone which is thickened at the base. The fruits can be up to 2·5 cm long, about 1·5 cm wide and are either slightly rough or quite smooth. They end in a small, straight beak.

FLOWERING TIME. It flowers profusely in spring time.

HABITAT. It grows in fissures in granite boulders on mountain slopes, on ledges and in crevices on cliff faces, and in rocky granite soil on elevated plains.

DISTRIBUTION. This hakea is found in all the eastern mainland States to as far north in Queensland as the isolated peaks in the McPherson Range and near Stanthorpe on the southern portion of the Darling Downs.

GENERAL REMARKS. This hakea can usually be found at nurseries specializing in native plants, but like *Hakea eriantha* it does better at higher altitudes than on the coastal plains.

Field key to the Hakeas in South-eastern Queensland

1.	Leaves terete, pungent-pointed; flowers glabrous	*Hakea gibbosa*
	Leaves flat, lanceolate to oblong-lanceolate	2.
2.	Leaves with midrib prominent or all venation rather obscure	3.
	Leaves with more than one longitudinal vein; flowers glabrous	4.
3.	Leaves lanceolate, obtuse, with midrib only prominent; flowers glabrous	*Hakea florulenta*
	Leaves lanceolate, acuminate, all venation rather obscure; flowers pubescent	*Hakea eriantha*
4.	Leaves lanceolate, oblong-lanceolate to falcate with about 7 longitudinal veins prominent on both sides	*Hakea plurinervia*
	Leaves linear-lanceolate to oblong-lanceolate with 3 longitudinal veins prominent and connected by anastomosing venation	*Hakea dactyloides*

Nutritious lunchtime snacks

HERE is the partnership of Australian cheddars and vegetables in a trio of nutritious lunchtime snacks.

Serve them with crusty wholemeal breads and bowls of steaming home-style soups. Adapt them, if you like, to the suppertime occasion, or even serve the two-cheese peppers as a dinner entree.

Try a pizza filling baked into a round of Middle Eastern bread, peppers bursting with a rice filling, or a tomato corn sauce disguised by a puffed crispy crust—yours for the making and yours to enjoy.

Eastern pizza bread

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

4 rounds of Middle Eastern bread

2 tablespoons butter

1 large onion, thinly sliced and broken into rings

1 small green pepper, seeded and thinly sliced

2 large cloves garlic, crushed

375 g tomatoes, peeled, seeded and chopped

500 g zucchini, washed and cut into 1 cm diagonal slices

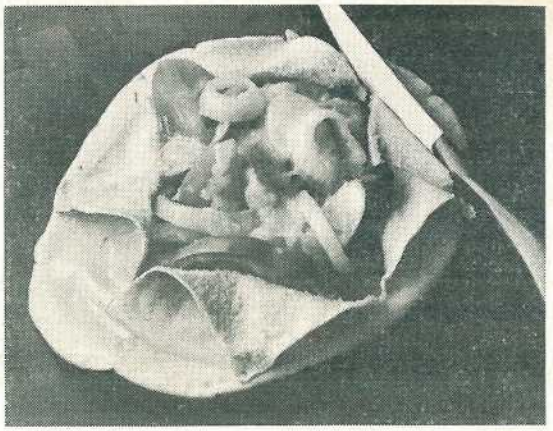
1½ teaspoons salt

½ teaspoon black pepper

2 cups coarsely grated Australian matured Cheddar cheese

4 eggs

Recipes produced by the Dairy Foods Advisory Bureau



Eastern pizza bread.

Using a pair of scissors, cut a cross through the centre top layer of each bread round to within about 2 cm of the edge. Fold back the four points to make a hollow in the centre. Melt butter in a heavy-based frypan. Add onions, green pepper and garlic and cook until onion becomes transparent. Remove and reserve. Add zucchini to pan and cook until tender and lightly browned. Return onion and pepper to pan with tomatoes and seasonings. Combine thoroughly. Spoon mixture evenly into the hollows of the bread. Scatter cheese on top. Break an egg into each hollow and pierce the yolk. Fold corners back over the mixture. Brush the top of the bread with a little extra melted butter. Wrap each round in aluminium foil. Bake at 180° C for 30 minutes. Serve piping hot as an accompaniment to soups, or as a snack by itself. Serves 4.

Crusty tomato puffle

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

2 teaspoons butter

1 large onion, thinly sliced

1 x 425 g can whole peeled tomatoes, drained thoroughly, juice reserved

1 x 310 g can creamed sweetcorn

1½ cups coarsely grated Australian semi-matured Cheddar cheese

1 teaspoon salt

black pepper to taste

Heat butter in a frypan till foaming subsides. Add onion and cook till tender but not brown. Roughly chop tomatoes and combine with corn, cheese and seasonings. Spoon into an ovenproof casserole dish approximately 25 x 16 x 7 cm. Sprinkle onions on top. Top with pancake crust (see below). Bake at 220° C for 30 minutes. Serves 4 to 6 as a light luncheon or supper.

PANCAKE CRUST

½ cup panjack mix
2 eggs, separated
½ cup reserved tomato juice

Blend panjack mix, egg yolks and tomato juice together. Whip egg whites till stiff and glossy. Gently fold into panjack mix.

Two-cheese peppers

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

4 firm, medium-sized green peppers
2 teaspoons butter
1 medium onion, finely chopped
½ cup celery, finely chopped
½ cup carrot, grated
½ cup cold cooked rice
1 cup Australian matured Cheddar cheese, coarsely grated
1½ cups Australian Ricotta cheese
1 teaspoon thyme
1 teaspoon rosemary
1 teaspoon salt
pepper to taste

Rinse, then dry peppers thoroughly. Cut a 1 cm slice from the top of each pepper and discard. Remove seeds and membrane. Melt butter in a small frypan till foaming subsides. Add onion, celery and carrot. Stir over heat until vegetables become transparent. Cool. Combine with remaining ingredients. Carefully spoon into hollow peppers. Place, cut side up, on a baking tray. Make a halo of alfoil to support the base if peppers will not stand upright. Bake at 180° C for 30 minutes. Accompany with a tossed salad and crusty wholemeal bread. Serves 4.

A new steel mesh silo for on-farm grain storage

by N. A. Hamilton, Agriculture Branch

SINCE the article on steel mesh silos for on-farm grain storage was published in the May–June issue of the *Queensland Agricultural Journal*, a new steel mesh silo has been released.

This new silo has been developed to discourage farmers from constructing double-diameter double-height and double-diameter single-height mesh silos. The use of double-diameter silos is not recommended by the manufacturer. Double-diameter silos are considered unsafe particularly if they are incorrectly constructed or unevenly loaded and unloaded.

The new silo, known as the '3000', has a capacity of 80 t or 3 000 bushels.

The specifications for the new silo are:

Designation	Length (m)	Height (m)	Wires and spacing (mm)	Cost (as at 1/8/80)
GSM 33 KG 4	23·025	2·4	4·0 @ 75 × 4·0 @ 75	$150.85

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Apricot varieties

APRICOT growing in Queensland is limited to the Granite Belt and fringe areas of Warwick and Inglewood.

Most apricots are harvested between early November and mid January.

On the Granite Belt, the most important variety is Trevatt. In the warmer areas, Glengarry and Newcastle are grown because of their early maturity.

Glengarry (plate 1)

Fruit are medium to large-sized and oval in shape. The fruit are of fair quality and are the first to be picked, maturing from early to late November on the Granite Belt, and about mid October in the Warwick district.

The trees flower during late July and are susceptible to frost damage in many areas of the Granite Belt.

Glengarry apricot fruit may be damaged by a virus called Glengarry spot. Only virus-free trees should be planted.

Newcastle (plate 2)

Fruit are small to medium in size, round in shape, and of fair eating quality. Ripe fruit are difficult to handle as they bruise and mark very easily.

The fruit mature from late November to mid December.

Early Divinity (plate 3)

Fruit are medium to large-sized, of good quality but become over-ripe and soften very quickly.

The fruit mature from late November to mid December.

Bulida (plate 4)

Fruit are medium to large-sized, round, firm, very attractive and of good quality.

The fruit mature from late December to late January.

Trevatt (plate 5)

Fruit are medium to large-sized, round, attractive and of excellent quality.

The fruit mature from mid to late December.

Trevatt is the most important apricot variety grown on the Granite Belt.

Moorpark (plate 6)

Fruit are medium-sized, oval, with a very attractive skin colour and excellent flavour. The major disadvantage with Moorpark is that one side of the fruit may remain green while the other ripens normally.

The fruit mature from mid to late December.

by G. Bulow, Horticulture Branch

Apricot varieties

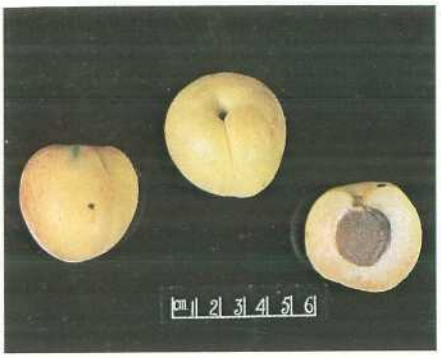

Plate 1. Glengarry—fruit are medium to large. Mature early to late November.

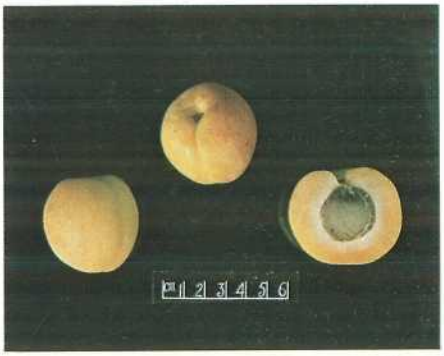

Plate 2. Newcastle—fruit are small to medium. Mature late November to mid December.

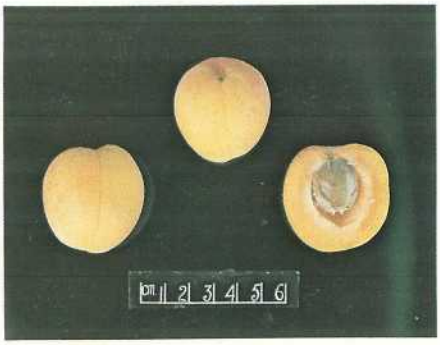

Plate 3. Early Divinity—fruit are medium to large. Mature late November to mid December.

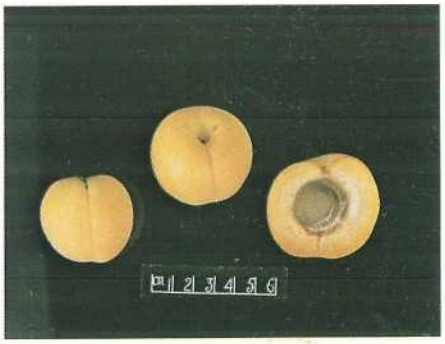

Plate 4. Bulida—fruit are medium to large. Mature late December to late January.

Plate 5. Trevatt—fruit are medium to large. Mature mid to late December.

Plate 6. Moorpark—fruit are medium-sized. Mature mid to late December.