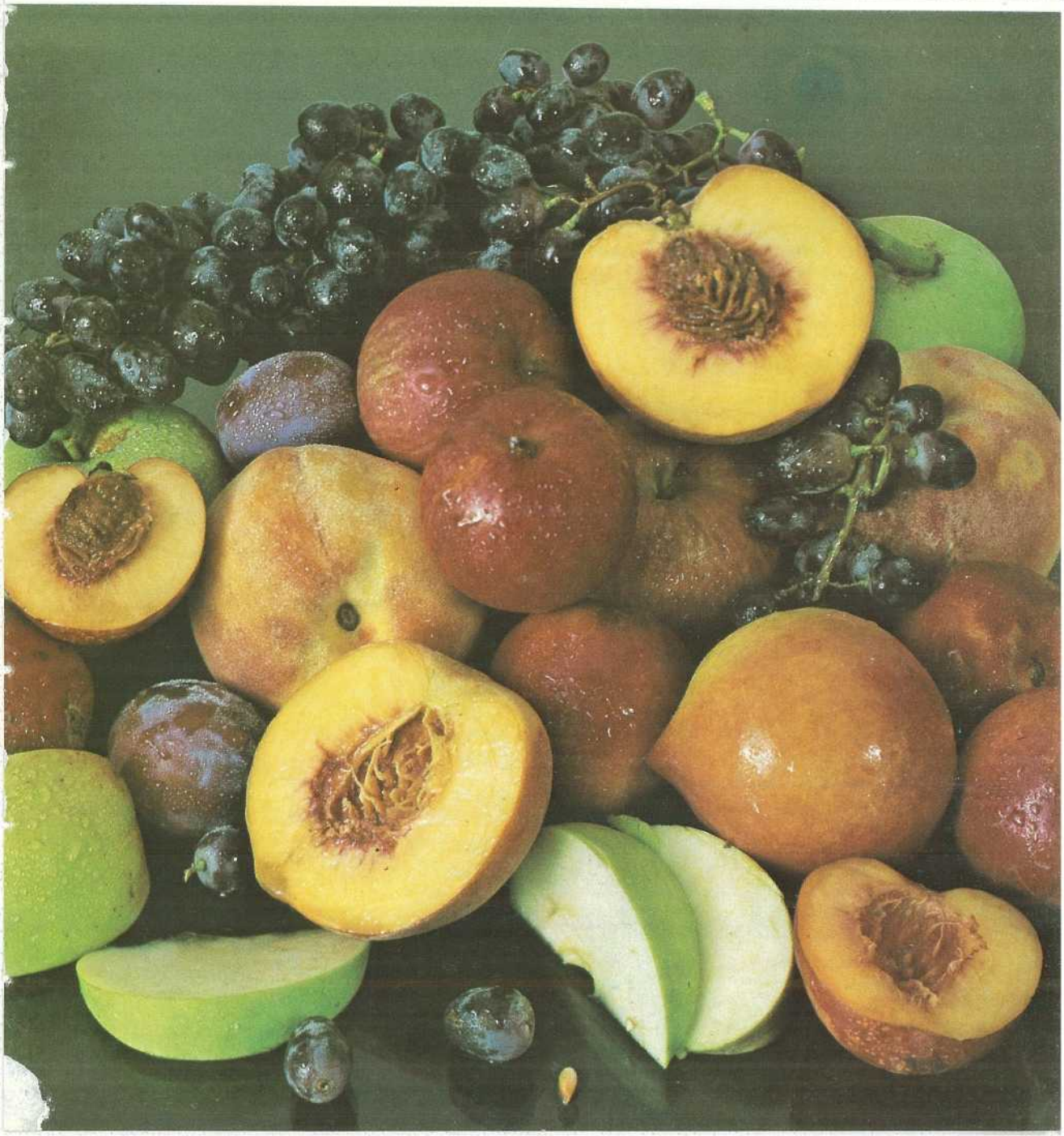
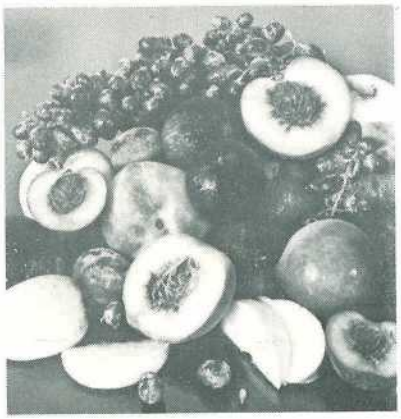
# Queensland AGRICULTURAL JOURNAL

July-August 1980, Vol. 106, No. 4



# DEPARTMENT OF PRIMARY INDUSTRIES

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

COVER: A selection of fresh fruit grow on the Granite Belt. See 'Horticultu in the Granite Belt' in this issue.

Photograph by G. Streten

# QUEENSLAND AGRICULTURAL JOURNAL

Vol. 106 No. 4 July–August 1980

Editor—P. R. Lee **ISSN 0157–7794**


# Contents




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







89618—10

# Plum growing

PLUM growing in Queensland is limited to the Granite Belt and the fringe areas of Warwick and Inglewood.

The production area during the 1977–78 season was 550 ha. The non-bearing area was 75 ha. During this season, there was an estimated production of 3 300 t with a gross value of $1·4 million. Over the last 10 years, the plum industry has been relatively stable—in 1967–68 2 740 t were produced from 510 ha.

Recent plantings are small (about 20 ha per annum) with a tendency towards early Japanese varieties.

Most plums are sold as fresh fruit in Queensland with a small percentage being sold on interstate markets. Present overseas export is very small but there is potential for trade with South-east Asia. During the 1977–78 season, 7 100 kg of Santa Rosa plums were exported to Singapore.

*Mature plum trees in full bloom.*

# in Queensland

compiled by G. Bulow, Horticulture Branch

## Origin

There are two main groups of commercial plums. They are the Japanese plum (*Prunus salicina*) and the European plum (*Prunus domestica*). Both belong to the Rosaceae family.

Japanese plums are thought to be a native of China and were introduced into Japan about 1500 A.D., while European plums have their origin near the Black Sea.

## Growth cycle

Annual Growth Cycle for Plums on the Granite Belt

| | |
|---|---|
| Dormant period | April to July |
| Bud movement | Late July to early August |
| Blossoming | Late August to late September |
| Shoot growth | September to February |
| Harvesting | Late November to late February |
| Fruit bud initiation | January to February |

*Close-up of plum blossoms in full bloom.*

## Site selection

### Soils

Plums grow on a wide range of soil types provided drainage is good. On some shallow soils, tree size may be reduced but with adequate drainage the trees grow and crop successfully.

### Aspect

Because of the risk of late frosts, a high north to north-easterly aspect is preferred. Protection from south-westerly winds and unimpeded air drainage on the lower side of the orchard provides some protection from cold damage. Low-lying areas should be avoided.

### Climatic considerations

For normal growth and cropping, plums like other deciduous fruit trees require a certain amount of chilling during the dormant period.

Chilling requirements vary according to the type of plum. Most varieties of Japanese plums have a chilling requirement in the range of 700 to 1 000 hours while European plums have a higher chilling requirement in the range of 800 to 1 200 hours.

Chilling hours are calculated by recording the number of hours the temperature remains below 7°C during the dormant winter period.

The climate of the Granite Belt provides sufficient chilling hours in most winters. Areas around Warwick and Inglewood are marginal and trees may exhibit symptoms of insufficient chilling after mild winters.

The range of chilling hours for each district is:

| | | |
|---|---|---|
| Granite Belt | .. | 800 to 1 150 |
| Inglewood | .. | 600 to 800 |
| Warwick .. | .. | 550 to 750 |

The symptoms of insufficient chilling are:

- Budshed in late winter and early spring.
- Delayed and prolonged flowering.
- Failure of flowers to develop normally leading to poor set.
- Delayed and erratic leaf development causing poor growth.

A warm spring with good growing conditions will help to overcome some of the problems caused by insufficient chilling.

The most serious climatic hazard for plum growing is caused by frosts after budburst. Spring frosts can cause severe losses of young, developing buds, blossoms, and fruitlets. Air temperatures of between −4°C and −1°C can cause damage depending on the stage of development. The most susceptible period is the young fruitlet stage just after petal fall.

Because frost is a localized problem affected by aspect, slope, and other physical features, the site selected and the flowering time of varieties to be planted are important considerations in minimizing the risk of frost losses. Some protection can be obtained through the use of sprinkler irrigation.

The Granite Belt and surrounding plum-growing areas have a summer rainfall distribution with an average total rainfall of 625 to 760 mm. Because of unreliable distribution, supplementary irrigation is desirable in most seasons.

Hail may cause localized problems in some seasons.

## Site preparation

Different situations exist on the Granite Belt for planting plums. Planting may occur in virgin ground, pasture or vegetable areas, or into replant situations.

### Clearing

When clearing new areas, one of the most important aspects is to minimize the loss of topsoil. After the initial clearing, all tree roots should be removed since decaying tree roots may be infected with *Armillaria*. It is best not to plant into newly-cleared areas but to wait for at least 12 months. In this period, vegetables or cover crops may be planted to improve the soil.

### Cultivation

Prior to normal ploughing, deep cross ripping is essential to break up any impervious clay bars that may be present. Also, blasting of rocky outcrops may be required if they are likely to impede drainage.

### Liming

Granite Belt soils are naturally acidic and liming during preplant cultivation makes it possible to incorporate lime at depth.

### Soil conservation

Contour planting is recommended on slopes greater than 3%. On steeper slopes, consideration should be given to contour planting with a permanent sod.

Grassed waterways are recommended at the ends of contours to reduce soil erosion. A suitable mixture to plant is 4 kg perennial rye, and 2 kg white clover per ha.

### Drainage

Plums are sensitive to waterlogging and, on some soils, underground drainage systems are recommended.

PVC perforated piping is laid just into the clay subsoil. Different diameter piping is available and this, with the extent of the drainage problem, determines the spacing. Generally on the Granite Belt, 65 mm diameter piping is laid at approximately 12 m spacings in a herringbone fashion.

Open-head drains above the orchard area are very useful in removing run-on water problems.

### Fumigation

When replanting an orchard it is best to fallow the area for at least one season and fumigation with DD or EDB for nematode and disease control is recommended. These fumigants are not effective at low winter temperatures so they need to be applied about April.

## Propagation

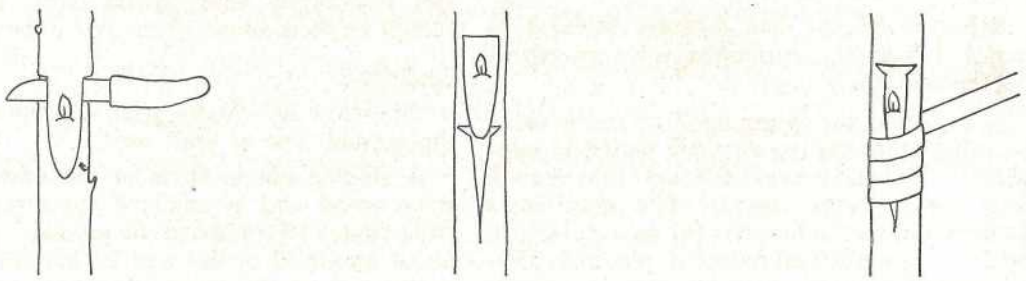
### Seedling production

To obtain sufficient quantities of seed, Nemaguard peach trees should be grown. The fruit should be disease-free, picked at the firm ripe stage, and the seed removed from the fruit before it becomes over-ripe. The fermentation process which occurs in over-ripe fruit will reduce seed germination. The seed should be washed free of all traces of flesh and allowed to air dry for several days in a cool, dry place. After drying, the seed is stored in ventilated containers in a cool, dry place until required for the chilling treatment.

A chilling period of about 3 months at 1 to 7°C is necessary before the seed will germinate.

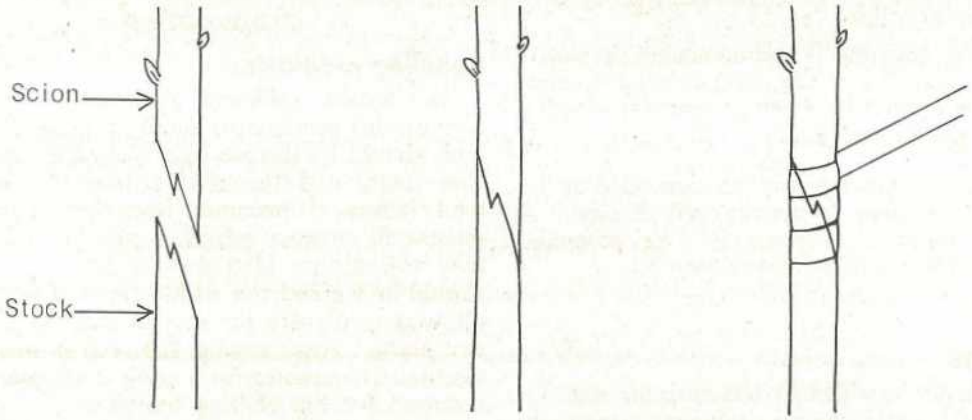
The procedure for chilling the seed is:

- Crack the stone and remove the kernel.
- Prepare a mixture of peat moss and vermiculite and drench with captan.
- Mix the kernels into the mixture in a plastic bag and leave for 2 days in a cool place. During this time, the seeds will absorb moisture and become responsive to the chilling treatment.
- Place the bag full of kernels in a cool room or crisper of a refrigerator at 1 to 7°C until about 10% of the seeds have germinated.
- Check monthly for drying out or fungus diseases and remove any diseased kernels.
- Dip in Strain 84 before planting.
- Plant the kernels into a disease-free nursery area.



Removing the bud | Inserting the bud into the 'T' | Tying off the bud

*Figure 1.*




The scion and stock are prepared. The scion and stock are pushed together. Tying off the graft.

*Figure. 2.*

During germination, the temperature of the seedbed must not exceed 23 to 25°C as exposure to higher temperatures for only a few hours may reimpose dormancy or reduce seedling vigour.

The germinating kernels can be either planted into a seedbed and grown for one season or planted directly into nursery rows. If the growth is good, the seedlings may be budded the following February. In the seedbed, the row spacings are 15 cm and intra-row spacings are 5 cm. In the nursery, the row spacings are 50 cm and intra-row spacings 20 to 40 cm.

## Selecting scion wood

The scion wood to be used should be selected from mature trees with a known good cropping record, fruit of a very good type, and from virus-tested trees.

Scion wood for late summer budding is removed from the current season's growth at the time of use.

Scion wood for spring budding and grafting is collected during the dormant period in mid-winter. The scion wood selected is the growth from the previous season. The wood must be kept dormant until ready for use. It may be wrapped in moistened paper, or placed in sawdust in sealed plastic bags and kept in a refrigerator or cool room; or it may be buried to about two-thirds of its length in moist soil in a cool, shady area.

## Propagation techniques

### Budding

Plums are normally budded. Budding can be done at almost any time of the year provided the sap is flowing and the bark lifts away cleanly. The best time to bud is in late summer/early autumn. However, some spring budding is also done.

The standard method of budding is to use a T bud (see figure 1). A T is cut on the stock with the vertical and horizontal cuts slightly longer than necessary. The bark can then be gently lifted with adequate room to slide the bud into position.

The bud with a slice of bark about 3 cm long is cut from the scion wood with a single stroke using a thin-bladed budding knife.

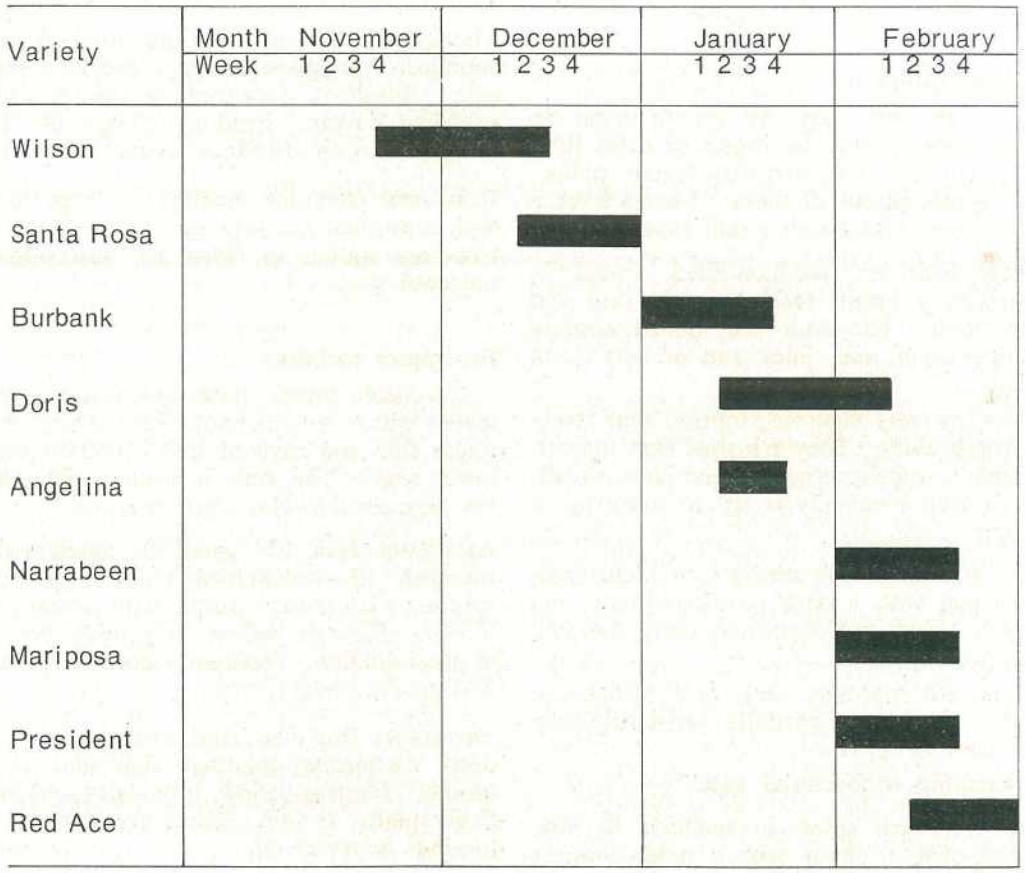
The bud is inserted in the T on the stock and tied firmly with plastic tape. Budding should be done about 15 cm above the ground.

### Grafting

The whip and tongue graft (see figure 2) is the normal type of graft used.

A sloping cut is made at the base of the scion wood and a matching cut through the stock about 10 cm above the ground. Starting about one-third of the way back from the tip of the cut on the stock, a vertical cut about 1 cm deep is made at a slight angle to the bark of the stock. A similar matching is made on the scion.

TABLE 1 AVERAGE HARVESTING PERIODS OF PLUMS ON THE GRANITE BELT




The scion is shortened to two buds, inserted in the stock and the union tied with plastic tape. The cut end of the scion piece is sealed with colgraft.

The scion wood and the stock should be about the same diameter. If this is not so, one side of the union should match exactly.

## Rootstocks

Seedling peach rootstocks have proved the most successful for plums. The seedlings are either Elberta, Golden Queen or Nemaguard. Nemaguard seedlings have a high tolerance to root knot nematodes and are the recommended rootstock.

In the past, plums have been planted on Myrobalan plum stock, but because fruit size is reduced on this rootstock it is not recommended.

## Varieties

Both Japanese and European plums are grown on the Granite Belt. However, most plantings in the district are Japanese plums with the most common varieties being: Wilson 55%, Doris 15%, Santa Rosa 10%, other varieties 20%.

In the Warwick and Inglewood areas, the early variety Wilson with Santa Rosa as pollinator is being planted.

When selecting a variety to plant, it is important to consider the maturity period of each variety in order to avoid clashes in harvesting. Table 1 shows the average harvesting period for various plum varieties.

### Japanese plums

The fruit size may be up to 6 cm in diameter; shape may be round or oval; flesh colour yellow or red; and skin colour yellow, red or combinations of these. Leaves have a glossy upper surface and a dull lower surface.

WILSON fruit are medium-sized, round in shape with a bright reddish-purple skin and yellow flesh. The fruit are almost entirely freestone when ripe, juicy and of very good quality.

Trees are very vigorous, thorny, spur freely and crop heavily. They are often slow in settling down to regular cropping and have a tendency to crop biennially if left to overcrop in one year.

SANTA ROSA fruit are medium to large-sized, oval-shaped with a dark purple-red skin and red flesh. Fruit are clingstone, carry well and are of good quality.

Trees are vigorous and very upright in growth. They are partially self-fertile and fairly heavy croppers.

Susceptible to bacterial spot.

DORIS fruit are small to medium in size, roundish-oval in shape with a reddish-purple skin. Flesh is yellowish-orange tinged with red beneath the skin. Fruit are clingstone, very firm, and of good quality. The fruit transports well because of the tough skin.

Trees are vigorous, semi-spreading and very susceptible to bacterial spot.

BURBANK fruit are medium to large-sized and globular in shape. Skin colour is red over a yellowish background with lenticel spotting. Flesh is yellow, firm and of fair quality. Fruit are clingstone and carry well. Trees are very vigorous and distinctly spreading in growth habit. Flowers early but is quite cold hardy. Tolerant to bacterial spot.

NARRABEEN fruit are large and roundish-oval in shape. Skin is bright red with pronounced lenticel specking. Flesh is yellow, juicy and of very good flavour. Fruit are clingstone, firm and carry very well. Trees are very vigorous and distinctly spreading in growth habit. Flowers early but is quite cold hardy.

MARIPOSA fruit are medium to large-sized, roundish-oval shaped with a speckled purple skin. Flesh is dark red in colour and of excellent flavour. Fruit are clingstone. Trees are vigorous and produce regular heavy crops.

RED ACE fruit are medium to large in size with a mottled red skin and yellow flesh. The trees are similar to Doris and susceptible to bacterial spot.

### European varieties

European plums have dull-green serrated leaves which are relatively thick, hairy on the upper side and covered with soft hairs on the lower side. The fruit is usually blue-purple but may also be yellow, red or green.

ANGELINA fruit are small to medium-sized, roundish to oval-shaped with a prominent suture. Skin is dark purple with a heavy blue bloom. Flesh is yellow, very juicy, firm and of good quality. Trees are vigorous, spreading and produce heavy crops.

PRESIDENT fruit are large, oval-shaped with a deep red-purple coloured skin and a blue bloom. Flesh is yellow, firm, juicy and sweet. Fruit quality is fair. Trees are vigorous and produce heavy crops.

## Pollination

Since plum flowers are either self-sterile or only partially self-fertile, cross pollination is needed for good fruit set. Japanese plums will not cross pollinate with European plums nor vice versa. Table 2 shows the pollinator to be used for each of the major varieties. The blossoming shown is an average full bloom date for plums grown on the Granite Belt.

For adequate pollination there must be sufficient pollinator varieties for the main variety. The number of pollinators required is one pollinator tree in nine. The pollinator is surrounded by eight trees of the favoured variety and every third tree in every third row is then a pollinator.

TABLE 2

POLLINATOR VARIETY FOR EACH MAJOR VARIETY

| Variety | Full Bloom | Pollinator |
|---|---|---|
| **Japanese Plums—** | | |
| Mariposa | week 3 Aug to week 1 Sept. | Narrabeen, Santa Rosa |
| Narrabeen | week 3 Aug. to week 1 Sept. | Mariposa, Santa Rosa |
| Wilson | week 4 Aug. to week 2 Sept. | Santa Rosa |
| Santa Rosa | week 4 Aug. to week 2 Sept. | Mariposa, Narrabeen |
| Burbank | week 1 Sept. to week 4 Sept. | Santa Rosa, Doris |
| Doris | week 1 Sept. to week 4 Sept. | Santa Rosa, Wilson |
| Red Ace | week 1 Sept. to week 4 Sept. | Santa Rosa, Wilson |
| **European plums—** | | |
| Angelina | week 2 Sept. to week 4 Sept. | President |
| President | week 2 Sept. to week 4 Sept. | Angelina |

MINIMUM POLLINATION

| | | | | | |
|---|---|---|---|---|---|
| V | V | V | V | V | V |
| V | V | P | V | V | P |
| V | V | V | V | V | V |
| V | V | V | V | V | V |
| V | V | P | V | V | P |
| V | V | V | V | V | V |

V = Variety
P = Pollinator

Bees have a very important role in pollination. To ensure the maximum pollination under all weather conditions, hives should be placed in the orchard area. Two hives should be provided for every ha of trees. Unless absolutely necessary, sprays toxic to bees should not be applied during the blossoming period. If sprays have to be applied they should be applied in late afternoon when the bees are least active.

## Planting

Field planting occurs in mid July. After removal from the nursery, the trees should be carefully inspected. Discard stunted trees or those showing signs of crown gall or Armillaria. While waiting for actual field planting, the trees should be firmly 'heeled in' in moist, cool soil. Dip trees in Strain 84.

To plant in the field on a wide-spaced design, individual holes are dug. With close planting a furrow may be opened along the row. A small mound like an inverted cone is made in the bottom of the hole and the roots are trimmed and spread evenly around this mound.

Topsoil is added and pressed as the planting hole is filled to just below the bud union. About 10 L of water is added during the hole filling. Liberal rewatering is recommended after the tree is planted.

No fertilizer is recommended at planting because of root burning. Deep liming should be done one month before planting. Irrigation during the first season is most important for good growth. By midsummer, a light fertilizer dressing high in phosphorus may be applied. A mixture of 5:6:5 at the rate of 50 to 100 grams per tree is recommended.

## Spacing

Spacing varies with the availability of water, and the pruning system adopted. Planting plums on a dryland system requires a spacing of 6 m by 6 m. With irrigation and still using vase pruning the spacing may be reduced to 5 m by 4 m.

With contour planting, rows are generally 6 m apart, and tree spacing within the row is 4 m.

Irrigation is essential if close planting is to be adopted. The pruning and training system has to be changed from the vase system and the spacing may be reduced to 4·5 m by 3 m.

## Soil management

Soil management is managing the soil so that it will not deteriorate with continued cropping. On the Granite Belt, plums are grown on sandy loams with a low natural fertility and low

waterholding capacity. The aim of a soil management programme is to increase nutrient availability, organic matter, waterholding capacity, improve water penetration, control erosion, and reduce weed competition.

### Cultivation

The standard soil management practice during the growing season is cultivation using tines and discs. Cultivation maintains soil moisture by destroying weed growth and leaves the soil receptive to water penetration. Cultivation should not be done at flowering as a friable open soil surface is likely to increase the intensity of frosts.

Cultivation should be done only when necessary as too much cultivation quickly reduces the organic matter content of the soil. Care should be taken during cultivation so that tree roots are not damaged.

### Herbicides

For young trees (less than 3-years-old) dichlobenil will give pre-emergent control of annual grasses and broad-leafed weeds. Dichlobenil is most effective when applied to bare soil and should not be applied within 4 weeks of transplanting into the field.

Contact herbicides such as paraquat or diquat may be applied provided they are not sprayed on leaves or green bark.

For mature trees (older than 3 years) terbacil is recommended as a pre-emergent herbicide for the control of annual grasses and broad-leafed weeds. When applied to weed-free soil in early spring, terbacil will give control for up to 4 to 6 months. It will have a knockdown effect on established weeds if the rate is increased and a wetting agent is added.

For the control of perennial weeds, glyphosate is applied as a spot treatment when the weeds are growing actively. It should not be sprayed on leaves or green bark as it can be absorbed through these tissues and kill the tree.

The trade names of these chemicals are listed in appendix 1.

### Green manuring

A green manure crop will temporarily increase the organic matter content of the soil. Planting oats during February and turning it in during August is the recommended practice. Some suitable varieties to plant are Rodney, Saia, Minhafer, and Garry.

Before planting, the soil is cultivated free of weeds and 100 kg per ha of nitram and 200 kg per ha of superphosphate are applied and lightly worked into the soil. These fertilizers should be applied separately as they become soupy if mixed together. About a week later, 30 to 45 kg per hectare of oat seed is planted. Irrigation is desirable for adequate growth of a green manure crop.

### Sod culture

A permanent sod may be grown where irrigation is available. Frequent mowing of the sod is recommended so that the sod will not compete with the trees. Herbicides are applied along the tree lines.

A suitable sod is white clover and rye grass. Seed is planted at the rate of 2 kg white clover plus 4 kg perennial rye per ha. At establishment, 70 kg of nitram plus 160 kg of superphosphate is applied per ha. An annual application of fertilizer is needed.

### Mulching

Black plastic may be used in individual squares around each tree, or on close-planted areas it may be laid in strips along the row. It is important that the plastic is thick enough to prevent weed growth through it. Plastic of at least 40 micron thickness should be used. Weeds will develop around the edges of the plastic and will need to be controlled.

## Nutrition

Plums may be grown on a wide range of soil types. The soils in the Granite Belt are acidic and low in fertility.

### Soil acidity

After cultivation and heavy fertilizer applications, the soils become even more acidic. The acidity varies during the year but the soil is most acidic during summer. Very acid soils will effect nutrient availability and may cause a toxicity of manganese.

The soil should be tested every second winter and lime or dolomite applied as necessary. Applications of 2·5 tonnes of lime per ha every

few years are common practice on the Granite Belt. Lime is applied in winter and should be applied at least a week before fertilizer applications otherwise a loss of nitrogen may result.

## Nutrition

The nutrient needs of trees cannot be supplied by the soil alone. The soils are low in nitrogen and phosphorus in their natural state but often have sufficient potassium for young trees.

MAJOR NUTRIENTS

Nitrogen (N), Phosphorus (P) and Potassium (K).

Young trees: Fertilizer should never be placed in the planting hole otherwise severe root burn may occur. A light application of 50 to 100 grams per tree of a 5:6:5 NPK mixture may be applied during the summer.

For wide-spaced trees (250 trees per ha) up to 4-year-old a 15:4:11 NPK mixture is applied at the rate of 250 grams per year of age of the tree. This fertilizer is applied in a split application (half in August and half in October).

For young close-planted trees (600 trees per ha or greater) the fertilizer programme is the same as for young wide-spaced trees.

Bearing trees: For wide-spaced trees a 15:4:11 NPK mixture is suitable. For large trees, up to 2 kg per tree in August followed by 1 kg per tree in October is recommended. The first application is for early fruit growth and the later application at stone hardening is for the final sizing and for bud formation of next season's crop.

For close-planted trees the same NPK mixture is applied but the rate per tree is halved to approximately 1 kg per tree in August followed by 0·5 kg in October.

In some years, after heavy leaching rainfall, a nitrogen deficiency may occur. Up to 500 grams of nitram per tree can be applied as long as it is not during the last month before harvest or soft fruit may be produced.

NUTRIENTS

There are various other nutrients that are required for plant growth. Occasionally, a deficiency of one or more of these nutrients may occur. An application of these various nutrients every few years will ensure that deficiencies do not occur.

Calcium deficiency causes mottling and death of the leaves and a reduction in growth.

Calcium requirements of the tree are easily met by applications of lime every 2 to 3 years.

Magnesium deficiency produces a yellow mottling of leaves and retards tree growth. If a deficiency occurs it is corrected by applying dolomite instead of lime.

Boron deficiency can lead to tip dieback, leaf fall on upper shoots, and sometimes multiple branching at the top of the tree. Fruit set is reduced and fruit may crack.

To remedy a deficiency or to insure against it, borax is applied at the rate of 50 grams per tree for young trees and 100 grams per tree for mature trees. It should be sprinkled evenly around the base of trees every third year. It is very easy to severely burn trees by using high rates of borax. An alternative to ground application of borax is to apply one spray of soluble polyborate at 275 g per 100 L during October each year.

Zinc deficiency produces symptoms known as 'little leaf'. When new growth occurs on the leaders the leaves are small, internodes are short and a rosette of leaves occurs at the tops of leaders.

To correct this deficiency, a zinc sulphate spray is applied to the trees during winter at the rate of 2·5 kg per 100 L. This spray should be applied every second winter. It should not be applied within 3 weeks after pruning or zinc may move into the cuts and cause dieback. It is safe to prune 1 to 2 days after spraying if the zinc is sprayed on before pruning.

Copper deficiency causes a retardation of growth and death of tips of shoots. A soil application of copper sulphate at the rate of 100 grams per tree for young trees and 250 grams per tree for bearing trees will correct the deficiency.

Iron deficiency causes a yellow mottling of leaves, while the veins remain green. It is difficult to correct iron deficiency except by a long term programme of increasing soil organic matter.

Sulphur deficiency mainly occurs in young trees. The trees are stunted and the upper leaves are yellow or nearly white in colour. Older leaves show a yellow mottling and finally death between the veins and along leaf margins.

The use of a mixed fertilizer containing superphosphate or an application of copper sulphate at the rates mentioned for copper deficiency will correct the deficiency.

## Irrigation

Wide-spaced plum orchards on the Granite Belt will grow and crop without supplementary irrigation but yields are increased with irrigation. It is essential to have irrigation for close-planted plums.

### Water requirements

One ha of trees needs about 6 million L of water per year. With an average rainfall of 750 mm per year on the Granite Belt, for good production a ha of trees needs about 1·5 million L of trickle or about 3 million L of sprinkler irrigation per ha per year. The irrigation requirement could be double if extremely dry conditions occur.

### Irrigation systems

Sprinkler, microjet, and trickle irrigation systems are being used successfully. Overhead sprinkler irrigation systems have the advantage of frost protection where it is needed.

Microjet and trickle irrigation systems are very efficient in water use. It is important with these systems to monitor soil water levels so that waterlogging does not occur.

### Irrigation management

Moisture stress at any stage will effect the plum crop. The three stages of growth when adequate moisture is essential are:

- Pre-flowering and up to one month after flowering. Moisture stress during this period will reduce fruit set and early fruit growth.
- After stone hardening and up until fruit ripening the water requirement is highest. During this stage, cell expansion occurs and the ultimate fruit size is determined.
- Fruit bud initiation period during January and February. Moisture stress should not occur during this period as this may reduce next year's crop.

## Flowering characteristics

The flowering and fruiting habits of Japanese and European plums are quite different.

Japanese plums may flower on 1-year-old wood as well as older wood. Most of the crop is carried on 2 and 3-year-old wood. The flower clusters each contain three or more flowers.

European plums do not flower on 1-year-old wood. The laterals spur up so that 2-year-old wood has short spurs which carry the flowers. In the following seasons, flowers are borne on 2 year and older wood. The flower clusters each contain one, two or sometimes three flowers.

## Pruning and training

Pruning is conducted on an annual basis during the winter. It is done to shape the trees, strengthen the main limbs, remove excessive fruiting wood and incorrectly positioned branches, and to contain the tree to a manageable size.

Excess pruning will delay cropping, produce vigorous growth and eventually produce a strong-limbed tree. Light pruning on the other hand will induce early heavy cropping but leaders remain weaker and the final tree size may be reduced. A suitable pruning technique exists between these two extremes.

At present, most plums are pruned to the vase system but there is scope for experimentation on other forms of training plum trees.

### Young trees—vase system

During the first 3 years, pruning is done to develop tree shape. The newly planted tree should be cut off about 40 cm above ground level. Looking down on the cut off stem, the three top buds should be equally spaced. During the spring and summer these buds should be assisted to develop into three strong, even shoots. This can be done by pinching back any strong growing shoots and rubbing off any shoots lower down on the stem.

In the second winter, the three leaders are cut to about half their length leaving outside buds for continued growth.

The six leaders are pruned during the third winter so that buds on the side of the shoots will develop. This is a doubling-up process where the tree after the fourth growing season should have 10 to 12 leaders. Branches coming off at different heights are acceptable so long as there is not overcrowding and the top of the tree is reasonably spaced.

Young trees, even though growing strongly, will begin to flower before the tree is large enough to carry a crop. Therefore the general practice is to remove by hand all fruit from young trees until the third year.

## Bearing trees

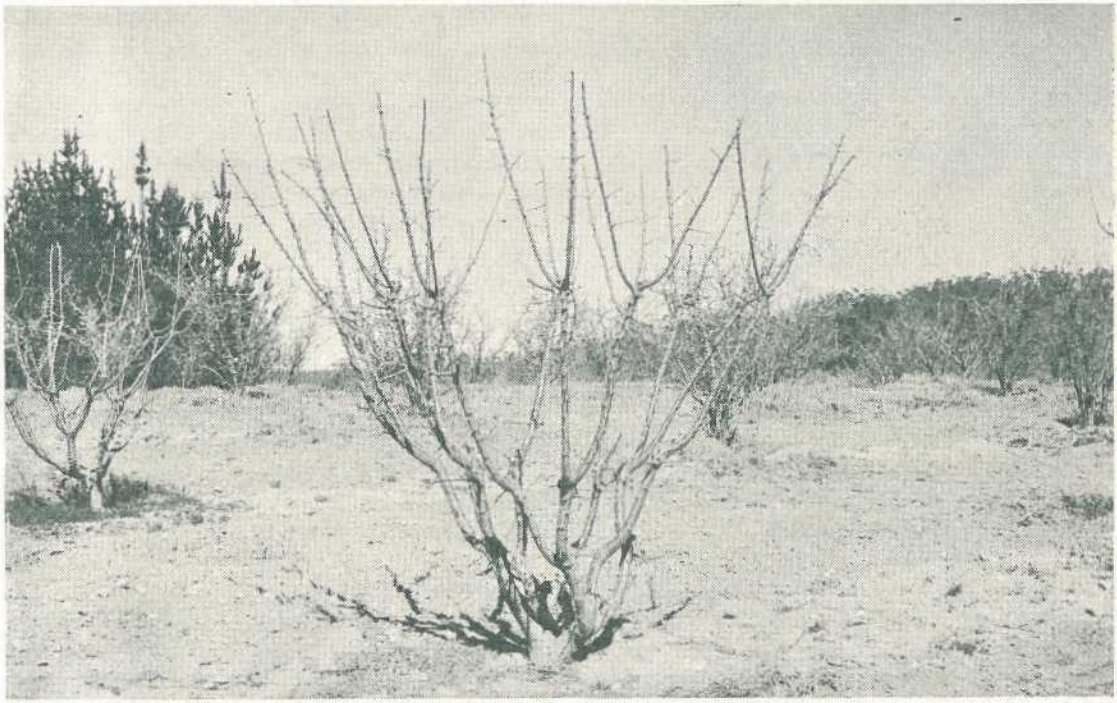
Plums generally produce an adequate amount of new growth. This wood is pruned back or removed to maintain a balance of spurs and new growth.

Terminal shoots on leaders or subleaders can be induced to produce fruiting wood by leaving them unpruned or by only tipping them. This can be done when the tree has reached sufficient size and there is a need to slow down the growth.

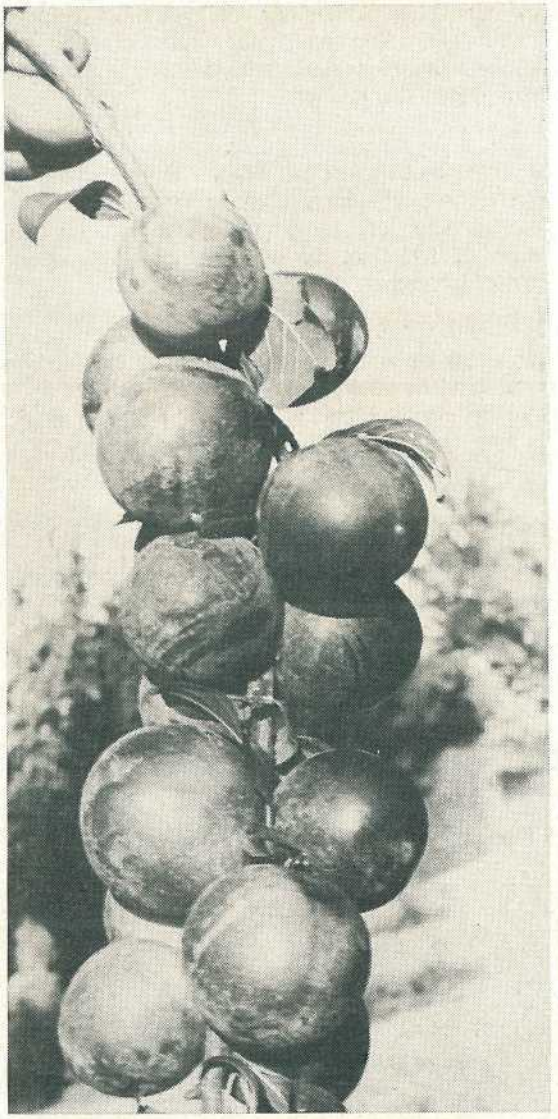
Laterals on spur-bearing shoots may occur at any position on the tree. Unless removal is necessary to ensure good fruit size, these laterals are left unpruned. The laterals are removed for renewal wood after a season or two of cropping.

Fruiting spurs if left to continue cropping can grow up to 15 cm long. When they attain such lengths they are not very fruitful. It is best to remove these spurs when they begin to lose their fruitfulness. This is usually after 3 or 4 years.

A mature vase-pruned plum tree may have from 10 to 16 leaders and subleaders with a mixture of young and old fruiting laterals and spurs.



*A vase-pruned plum tree.*



*A very heavy set of plums. Thinning would have assisted fruit size.*

## Re-working

As the demand for a certain variety changes, it may become necessary to re-work trees to a more profitable variety. As well, if a block of one variety is not receiving sufficient cross-pollination re-working one tree in nine to a suitable pollinator is the most effective method of improving cropping.

The strap graft is the most suitable method for grafting medium-sized limbs. Leaders forming the framework of the tree are used provided that they are not larger than 5 cm in diameter. Smaller limbs and laterals can also be grafted by using the strap graft, whip and tongue graft, cleft or peg graft.

## Thinning

In a heavy blossoming year, only 1% of flowers needs to set to produce a reasonable crop. Given sufficient pollinators and good pollination weather, overset can be a problem especially with Japanese varieties. Fruit size will be reduced without adequate thinning and the following year's crop will be less through poor flower bud development.

Thinning of fruit so they are spaced about 5 cm apart will produce good-sized fruit. Hand thinning may be done when the fruit are the size of a thumbnail.

An alternative to hand thinning is to spray with a chemical thinner. DNBP (dinitrobutylphenol) is applied at full bloom. It is a caustic spray, kills the pollen, stops fertilization and reduces fruit set. It should be applied only to those trees with a heavy blossom and late in the afternoon as it is toxic to bees.

The varieties recommended for spray thinning are the Japanese varieties Wilson, Burbank and Mariposa. Hand thinning is usually necessary even after spray thinning.

Some hand thinning on most plum varieties is of benefit especially where large clusters of fruit occur.

## Pests

Pests of plums vary seasonally. Annual sprays are required for Queensland fruit fly and San Jose scale. Spraying for other pests such as aphids, mites, rutherglen bug and light brown apple moth may be needed depending on the season.

### Queensland fruit fly

The adult flies are about 7 mm long, brown, wasp-like, and have yellow markings on the thorax and abdomen. The females lay eggs in the fruit with the sting appearing as a small discoloured spot often with juice oozing from

it. Fruit rot diseases are introduced with the eggs and the flesh of the fruit is destroyed by the tunnelling maggots and the development of fruit rot.

Rainfall and high humidity during fruit ripening favour fruit fly.

A fortnightly spray schedule of fenthion starting 6 weeks before fruit maturity gives adequate control of the Granite Belt. More sprays may be required in other warmer areas.

### San Jose scale

The female is a sedentary, soft-bodied, sap-sucking insect covered with a dark, hard scale. The insect is about 1 mm in diameter. Scales are most commonly seen on the bark where they appear ash in colour. Low scale populations reduce the vigour of trees but high populations may cause the death of leaders and young trees. Scale-infested trees often ooze gum. A winter oil spray gives good control.

### Aphids

Both the black peach aphid and the green peach aphid may cause damage. The aphids are small, soft-bodied, slow-moving, sap-sucking insects. They may have wings or be wingless. Winged aphids are up to 3 mm long. In winter, the shiny black, oval-shaped eggs of the green peach aphid may be found on bark around buds. Winter oil sprays will kill these eggs.

The black peach aphid may be present on both the roots and above ground parts of the tree during winter. Sprays during spring control these aphids.

In spring, aphids feed on the new foliage and fruit causing discolouration and curling on the new leaves, and shedding of leaves and small fruit. The tips of affected shoots may die back.

Apply endosulfan or vamidothion in early spring if aphids are present.

### Light-brown apple moth (LBAM)

The adult moths are brown and have a wing span of about 20 mm. The green larvae grow to about 25 mm long and are found in silken shelters between leaves and fruit. They are recognised by their fast, wriggling movements and their habit of parachuting on a strand of silk when disturbed. The larvae skeletonize leaves and chew irregular-shaped excavations in fruit surfaces.

Azinphos methyl or carbaryl are applied during the season when damage is observed.

### European red mite

Adults are about 0·5 mm long, dark red in colour and globular-shaped spider mites. During winter, tiny orange to red eggs can be found on the bark of trees near buds.

### Two spotted mite

Adults and nymphs are about 0·5 mm long, yellowish spider-like mites with two dark spots on the back.

Both types of mites can build up to high populations during hot weather and cause severe leaf mottling and premature leaf drop.

Cyhexatin provides good control. Propargite is recommended during cool weather. If wettable sulphur is being used for rust, it will also suppress mites.

### Rutherglen bug

Adults are active, dark grey, rectangular-shaped bugs, about 4·5 mm long, and have two pairs of silver-grey wings. The bugs feed on weeds and migrate in large numbers on to trees when the weeds suffer moisture stress during hot weather. The bugs pierce and suck sap from the fruit and cause localized internal browning.

Fenthion is recommended if rutherglen bugs are a problem.

Common and trade names of the chemicals recommended are listed in appendix 1.

## Diseases

Successful plum growing depends on the control of diseases caused by fungi, bacteria, viruses and nematodes.

### Fungi

SHOT HOLE is an annual problem. It causes dark, round spots on the leaves which enlarge and finally fall out giving the leaves a ragged shot hole appearance. Small purplish spots may also occur on the fruit.

*Bacterial spot is a major disease of plums.*

Lime sulphur at bud movement and leaf fall is needed to control shot hole. Copper fungicides are reasonably effective and are recommended instead of lime sulphur where bacterial diseases are also present. Regular spraying with dithianon, thiram, or wettable sulphur is needed during the growing season.

BROWN ROT causes blossom blight, twig dieback and fruit rot in some years. The symptoms seen are blossoms turning brown, wilting and dying, twigs showing brown spots and gumming, and fruit showing signs of a soft, brown rot. Masses of grey and brown spores grow in concentric rings in the rotting area on the infected fruit.

Plums are less susceptible to brown rot than other stone fruit but with cool, moist weather during spring and warm, wet weather during fruit maturation, brown rot can become a problem. The most susceptible plum varieties are European varieties and late-harvested Japanese varieties.

A protectant fungicide programme using captan or iprodione during the flowering and fruit maturation period is recommended. In some situations, spraying with a systemic fungicide such as benomyl, tiophanate methyl or triforine may be required.

RUST is an annual problem. It affects the leaves by producing pale yellow spots on the tops of leaves and masses of brown spores under the leaves.

Rust is controlled by regular spraying with thiram, diathianon or wettable sulphur. After harvest, these sprays should be continued or premature leaf drop will occur.

ARMILLARIA root rot is a sporadic disease. The shoestring fungus lives on the roots and crowns of trees. After a few years and particularly after a stress period the trees will suddenly wilt and die.

Control measures rely upon removal of all decaying tree roots after the initial clearing and the use of methyl bromide fumigation if a tree is to be replanted into an infected site.

## Bacteria

BACTERIAL SPOT is widespread throughout the district and is difficult to control. The bacteria remain in the sap of the tree from year to year. The symptoms seen on the leaves are angular, greenish-yellow spots which sometimes drop out the centres similar to fungal shot hole. However, the shot hole caused by bacterial spot is very ragged and angular compared to fungal shot hole. Other symptoms include dark, greasy, elongated cracks in annual shoots, gumming and dark, greasy spots with star cracking on the fruit.

The varieties Doris, Red Ace, October Purple, Shiro, Mariposa and Santa Rosa are susceptible.

Copper fungicides at bud movement and leaf fall are the recommended sprays.

BACTERIAL CANKER causes leaf spot, shoot death, gumming, long cracks in limbs and sometimes flattening of limbs.

Copper fungicides (preferably Bordeaux) are recommended at bud movement and leaf fall, and at least one spray during the winter

period. Bacterial canker will spread during the dormant period whereas bacterial spot does not.

CROWN GALL is a serious disease of nursery trees. It causes galls to grow on the roots or at any place where the stem or crown has been damaged or cut near ground level. The galls reduce tree vigour and may even cause death of the seedling.

All seeds before planting and all nursery trees after removal from the nursery should be dipped in the bacterial biological control agent Strain 84. Control is not possible once trees have been planted out in the field.

### Viruses

PRUNUS NECROTIC RINGSPOT is the most common virus found in plums. It is spread by budding and grafting infected wood. The evidence of the virus in the tree is the tatter leaf and line pattern symptoms. Tatter leaf is similar to shot hole except the leaves have a more ragged, tattered appearance. Line pattern symptoms are seen as thin yellow or white lines throughout the leaf. All plum varieties are susceptible to the virus and may show symptoms.

In general, yield reduction by prunus necrotic ringspot virus is small. However, in some cases it may be large, so during propagation only virus tested scionwood should be used.

### Nematodes

ROOT KNOT nematodes cause small swellings on the roots. The knots in the roots interrupt sap flow and reduce tree vigour.

ROOT LESION nematodes cause premature death to fine roots. This reduces tree vigour.

Other nematodes including ring, stubby root, and dagger may also affect tree vigour.

Preplant treatments with DD or EDB are recommended especially on preplant land, or on land where nematode populations are known to be high.

Common and trade names of chemicals recommended are listed in appendix I.

### Soursap

Even though no disease organism can be linked with the soursap disorder it is included in this section on diseases because of its significance.

The effect of soursap is seen in spring when limbs or even whole trees fail to leaf out properly. The leaves are generally small and variable in their stage of development. After a period of 1 to 2 weeks the cambium layer below the bark goes brown and the limb dies.

Associated with these symptoms, there is a characteristic alcoholic odour of fermenting sap and the release of sap through the bark.

The cause of this disorder is a severe chilling (frost or even icy winds) after the sap has moved in the spring. When the trees are dormant they can withstand considerable cold, but once their chilling requirements have been met and the trees begin to move they lose their resistance to cold. After a severe chilling, the sap is apparently frozen the cells die, and fermentation of the cellular contents occurs.

The only treatment once the trees show signs of soursap is to cut into the bark of the tree. This 'ripping' process is done using a sharp knife and the bark is cut from the crotch of the tree right up along all branches.

Other suggestions to reduce the chance of soursap occurring are:

- Avoid cold, exposed sites at planting or areas where cold air cannot drain away.
- Avoid poorly-drained areas as trees that suffer from waterlogged conditions are more susceptible to cold injury.
- Fumigate before planting into replant land and apply lime and fertilizer to maintain healthy trees. However, excess nitrogen can lead to 'soft' buds susceptible to cold injury.
- Avoid early pruning as this reduces the cold hardiness of trees. This occurs especially in young trees where severe pruning removes a large percentage of wood and hence a large percentage of the sugars from the tree. During the pruning season, the older trees should be pruned before the younger trees.
- Avoid excess cultivation especially during the bud movement to flowering stage. Freshly cultivated soil increases frost intensity.
- Provision of overhead sprinklers for frost protection is beneficial in low areas.



89618—11

## Harvesting

Plums are harvested in the Granite Belt from late November to late February. The harvesting periods for the different varieties are shown in the section on varieties.

### Maturity

The fruit are harvested when fully mature but not over-ripe. Maturity for Japanese plums is based on a colour change in the skin of the fruit from green to a creamy-green colour. Red colouring then begins at the tip end of the fruit. For English plums, the skin colour changes to a dark purple and the flesh becomes lighter in colour and more juicy. Most Japanese varieties develop colour after picking while the European varieties do not.

The amount of colour allowed to develop before picking depends on whether the fruit are to be sold on local or distant markets. The minimum acceptable colour development before picking for the different varieties is:

*A crop of good-sized Wilson plums.*

*Harvesting plums.*

JAPANESE PLUMS

Wilson—tip colour
Santa Rosa—three-quarter colour
Doris—half to three-quarter colour
Burbank—tip to one-quarter colour
Narrabeen—three-quarter colour
Mariposa—one-third to half colour
Red Ace—half to three-quarter colour

EUROPEAN PLUMS

All varieties—full colour

Plum trees are usually picked over three times. This allows the smaller immature fruit to size up before repicking.

The fruit are picked into picking bags and transferred into shallow bins approximately 40 cm in depth. By picking on size, it is also possible to pick and volume fill cartons in the field.

Since the temperatures at picking times are usually high, the fruit should be kept in the shade until transferred to the packing shed.

### Yield

Yields vary greatly from year to year depending upon seasonal conditions. A certain amount of biennial bearing occurs if there is an extremely heavy crop and insufficient thinning is done.

On an average, wide-spaced trees begin to crop in the fifth year and are in full production by the ninth year. The average yields that could be expected are:

Year 5—2 000 kg per ha or 8 kg per tree
Year 6—3 000 kg per ha or 12 kg per tree
Year 7—5 000 kg per ha or 20 kg per tree
Year 8—8 000 kg per ha or 30 kg per tree
Year 9—10 000 kg per ha or 40 kg per tree

Mature vase-pruned, wide-spaced plum trees have an expected life of about 20 to 30 years.

Close-planted plums yield earlier (third year) and attain full bearing earlier (fifth or sixth). Because the amount of bearing wood is greater per ha, it is expected that overall yields will be greater, especially in the early years of cropping.

## Grading and packing

Most plums are sold through the normal marketing channels as fresh fruit. The standards and packaging given refer to the fresh fruit market trade.

### Grade standards

The Fruit and Vegetable Packing Regulations state that plums must be sound, clean, well-formed, not shrivelled, mature but not over-ripe, free from broken skins, and of the one variety in the one package. The minimum size is 30 mm for Wilson plums and 35 mm for all other varieties.

### Sizing

VOLUME-FILLED PLUMS may be sold sized or unsized. If sized the categories are:

'small'—fruit 30 mm or greater in diameter but less than 35 mm in diameter.

'medium'—fruit 35 mm or greater in diameter but less than 45 mm in diameter

'large'—fruit 45 mm or greater in diameter.

WHEN PLUMS ARE NOT VOLUME-FILLED, the categories are:

'30 mm'—fruit 30 mm or greater in diameter but less than 35 mm in diameter

'35 mm'—fruit 35 mm or greater in diameter but less than 40 mm in diameter

'40 mm'—fruit 40 mm or greater in diameter but less than 45 mm in diameter

'45 mm'—fruit 45 mm or greater in diameter but less than 50 mm in diameter

'50 mm'—fruit 50 mm or greater in diameter but less than 55 mm in diameter

'55 mm'—fruit 55 mm or greater in diameter but less than 60 mm or greater in diameter

'60 mm'—fruit 60 mm or greater in diameter.

### Gazetted packages

The approved containers for marketing plums are:

| Name of Package | Material Used in Construction | Internal Dimensions (mm) | | | Volume (litres) |
|---|---|---|---|---|---|
| | | Length | Width | Depth | |
| Quarter Package | Wood or Fibreboard | 350 | 260 | 100 | 9·1 |
| 9 litre Stone Fruit Package | Wood or Fibreboard | 350 | 210 | 125 | 9·2 |
| *9 litre Produce Package | Wood or Fibreboard | 365 | 270 | 95 | 9·4 |
| Standard Tray Package | Wood or Fibreboard | 450 | 290 | 100 | 13·1 |
| Half Dump Package | Wood or Fibreboard | 450 | 215 | 180 | 17·4 |
| Half Standard Package | Wood or Fibreboard | 450 | 290 | 135 | 17·6 |
| *18 Litre Produce Package | Wood or Fibreboard | 365 | 270 | 185 | 18·2 |
| Shallow Half Tray Package | Wood or Fibreboard | 500 | 300 | 135 | 20·3 |
| Deep Half Tray Package | Wood or Fibreboard | 500 | 300 | 145 | 21·8 |
| Returnable Plastic Crate B | Plastic—top | 470 | 305 | 275 | 35·3 |
| | —bottom | 430 | 265 | | |


*Volume-filled plums in an 18L produce carton.*

The preferred packages are shown with an asterisk (*). The 18 L produce package holds approximately 10 kg of plums.

### Marking of packages

The following information must be marked on packages containing plums for sale:

- The word 'plum' or the abbreviation 'plm'
- The name of the variety
- If the plums are sized, either the word 'small', 'medium', or 'large' OR the measurement used to mean that size.
- If the plums are unsized the word 'unsized'.
- Name and address of the grower and agent.

## Economics

The plum marketing period reaches its peak during December and January. On an average during this period 10 000 to 25 000 half boxes per week are sold through the Rocklea Markets at Brisbane.

Prices per half box vary from $3 to $10 depending on the quality and quantity of plums available.

The cost of production varies greatly from farm to farm. Of the total variable costs the orchard operating costs amounts to about 20%, while the harvesting cost is about 40%, and the marketing cost another 40% of the total. For the exact figures on the cost of production and marketing a D.P.I. pamphlet 'Costs and Returns—Plums' is available.

## APPENDIX 1

### Common and Trade Names of Chemicals

| | Common Name | Trade Name |
|---|---|---|
| **Insecticides** | azinphos methyl | Co-Thion, Gusathion |
| | carbaryl | Sevin, Carbaryl, Bugmaster |
| | cyhexation | Plictran |
| | endosulfan | Thiodan |
| | fenthion | Lebaycid |
| | propargite | Omite |
| | vamidothion | Kilval |
| **Fungicides** | benomyl | Benlate |
| | captan | Captan |
| | copper oxychloride | Copidul, Cupravit, Cuprox |
| | dithianon | Delan |
| | iprodione | Rovral |
| | lime sulphur | Lime Sulphur |
| | thiophanate methyl | Topsin |
| | thiram | Thiotox, Thiram |
| | triforine | Saprol |
| | wettable sulphur | Cosan, Kumulus, Thiovit |
| | Bordeaux is a mixture of copper sulphate and hydrated lime | |
| **Fumigants** | DD | D-D Soil Fumigant |
| | EDB | EDB Soil Fumigant |
| | methyl bromide | Dowfume |
| **Herbicides** | dichlobenil | Casoron |
| | diquat | Reglone |
| | glyphosate | Roundup |
| | paraquat | Grammoxone |
| | terbacil | Sinbar |
| **Fertilizers** | copper sulphate | Bluestone |
| | soluble polyborate | Solubor |
| | 5:6:5 NPK mixture | Q5 |
| | " " " | 4 Gran |
| | 15:4:11 NPK mixture | Crop King 88 |
| | " " " | Hi-Blend 15:3:10 |

## CHANGING YOUR ADDRESS?

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

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

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

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

# Brucellosis tested swine herds as at 31-7-80

| | |
|---|---|
| Aboriginal and Islanders Advancement Department, Cherbourg. | LW |
| P. & N. Batterham, Raby Park, Ingelwood. | L, LW |
| R. A. & B. E. Bool, Rossvale Stud, M.S. 223, Nobby. | LW, L |
| D. J. Brosnan, Bettafield, Mt. Murchison, via Biloela. | LW, L |
| N. J. Cotter, Olaroy, Goomeri. | LW |
| G. F. & A. M. Dean, Home Creek, Wooroolin. | LW, LB |
| E. Diete, 'Ettrock', Ingoldsby. | X |
| Mrs. O. F. Douglas and Son, Greylight, Goombungee. | W |
| C. P. & B. J. Duncan, Colley, Flagstone Creek, Helidon. | LW |
| J. A. & B. L. Duncan, Ma Ma Creek. | LW |
| L. Fletcher, 'Par-en-eri', P.O. Box 143, Mundubbera. | LW, L |
| I. S. & D. E. Forster, Westbrook. | HB |
| K. P. Fowler, Northlea Stud Farm, Hogg Street, P.S. 1436, Toowoomba. | L, LW |
| M. R. & J. E. Fowler, 'Donna Lyn', M/S 195, Pittsworth. | LW |
| N. E. P. & M. P. Fowler, care of Kewpie Enterprises, Kingaroy. | L, LW, X |
| K. H. & B. Franke, Delvue, Cawdor. | LW |
| W. A. Freeman, Trevlac, Rosewood. | LW |
| N. E. & J. Geysing, Oakhurst, via Maryborough. | LW |
| S. C. Goodwin, Windera, M.S.F. 571, Murgon. | L |
| D. F. & R. F. Goschnick and W. M. & K. J. Pearce, 'Echoes', Bancroft, via Monto. | LW |
| T. C. & E. A. Gosdon, Naumia, Dalby. | L, LW |
| D. G. Grayson, Wodalla, Killarney. | L, LW |
| A. H. & R. N. Grundy, Markwell Piggeries, M.S. 499, Toowoomba. | L, LW |
| H.M. Prison, Etna Creek, via Rockhampton. | LW |
| H.M. State Farm, Numinbah. | LW |
| H.M. State Farm, Palen Creek. | LW |
| G. R. Handley, Locklyn Stud, Lockyer. | B |
| P. & R. K. Hinchliffe, Oakview, Milman, via Rockhampton. | L, LW |
| R. F. & V. D. Hudson, Rondel, Hogg Street, Wilsonton. | L, LW |
| K. B. & I. R. Jones, 'Cefn', M.S. 544, Clifton. | LW, L |
| C. & D. I. Kajewski, Glenroy, Glencoe, via Toowoomba. | LW, L |
| R. E. & M. D. Kajewski, 'Robmar' Stud, Acland. | L |
| A. R. Kanowski, Exton, Pechey, via Crows Nest. | LW |
| S. E. Kanowski, Miecho, Pinelands, via Crows Nest. | T |
| E. R. Kimber, Tarella, M.S. 805, Mundubbera. | LW, B |
| I. E. & C. C. Kimber, 'Splenda View', Coalstoun Lakes, M.S. 698, Biggenden. | L |
| V. F. & B. L. Kruger, Greyhurst, Goombungee. | LW |
| V. & C. A. Kuhl, 'The Mounts', Boodue, M.S. 222, Oakey. | LW |
| R. R. & L. M. Law, 'Summerset', M.S. 757, Kingaroy. | LW, L |
| R. S. & R. I. Learmont, 'Scotlea', P.O. Box 102, Monto. | LW |
| C. J. Lorenz, M.S. 499, Toowoomba. | L |
| T. J. Lucas, M.S. 243, Nanango. | LW |
| A. L. Ludwig, Beauview, Cryna, via Beaudesert. | B |
| K. Mathieson, Ideraway, Gayndah. | LW |
| W. Neuendorf, M.S. 794, Kalbar. | B |
| Nielson Nominees, 'Miandetta', M/S 162, Warwick. | X |
| D. O'Connor, Rollingstone. | L, LW, X |
| G. R. & B. J. Patch, 'Kiara', Bell. | L, LW X |
| L. A. Peters, Moonlight, Bongeen. | L |
| Queensland Agricultural College, Lawes. | B, LW |
| V. V. Radel, Braedella, Coalstoun Lakes. | LW |
| Research Station, Biloela. | LW |
| Research Station, Hermitage. | B |
| A. B. Robin, Blaxland Road, Dalby. | LW, L |
| G. Rosenblatt, Rosevilla, Biloela. | L, LW |
| A. F. & V. M. Ruge, Alvir Stud, Biggenden. | LW |
| C. Scikluna and Sons, Coondulla Stud, Robertson Park, Murray Upper. | L, LW |
| D. W. & L. J. Sharp, 'Arolla', Lavella, via Millmerran. | LW, L |
| Smyth and Heness, Moorilla, Goomeri. | L, LW |
| Strang and Little, Bonna Road, Bundaberg. | LW, L |
| L. B. & L. J. Trout, 'Caminda', Crawford, via Kingaroy. | L, B |
| Westbrook Training Centre, Westbrook. | B |
| L. J. Willett, Wongalea, Irvingdale, M.S. 232, Bowenville. | LW, L |
| K. Williamson, Cattermul Avenue, Kalkie, Bundaberg. | LW, L |

**KEY**

Landrace—**L**
Berkshire—**B**
Hybrid—**HB**
Wessex—**W**
Large White—**LW**
Tamworth—**T**
Crossbreed—**X**

# Drenching beef cattle on brigalow country . . . does it pay?

*by P. Corlis, Beef Cattle Husbandry Branch*

TRIAL work was carried out at Mr R. Sparke's property 'Wirranda' via Moura to measure the effect of anthelmintic treatment on liveweight performance of weaners when grazing improved Brigalow pastures.

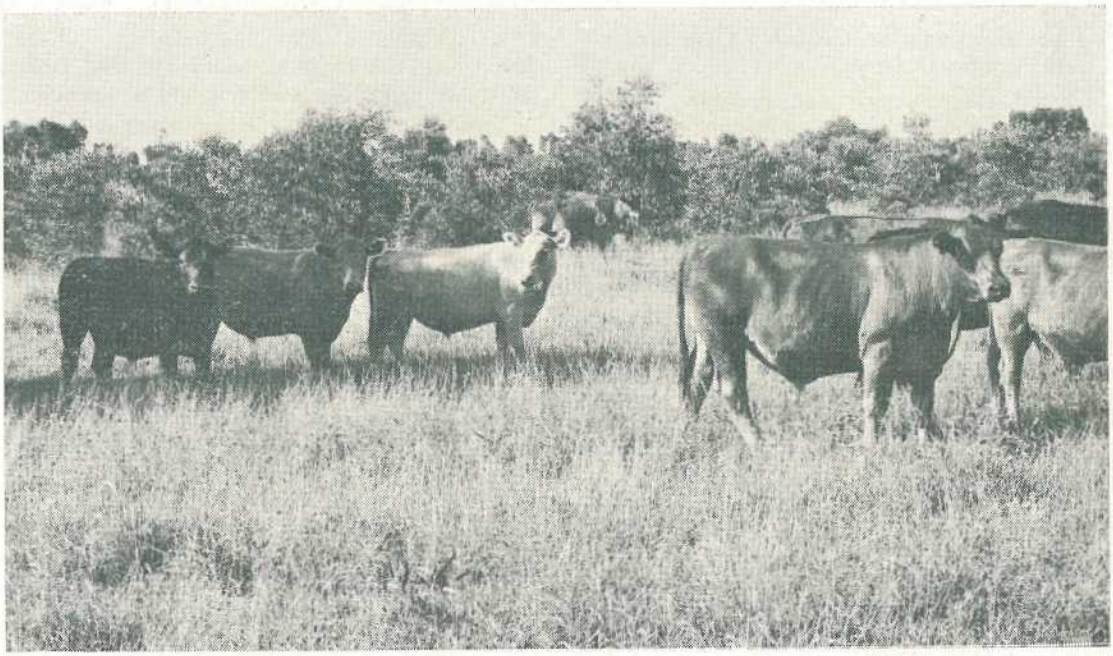
Weaner steers were drenched at the recommended dose rate on 26 July 1978 and thereafter at 4-weekly intervals until 19 December 1978. The final weight was taken on 24 May 1979 to measure any compensatory effect.

A small response was recorded in the Murray Greys during the period 26 July 1978 to 29 September 1978 and maintained to 19 December 1978. However, over the whole period 26 July 1978 to 24 May 1979 no significant difference was recorded between the drenched and control Murray Greys.

There was a nil response to drenching in the Brahman-cross Murray Greys. However, breed differences were generally in the direction expected and the Brahman cross Murray Grey gained 37% more weight than the Murray Grey over the whole period.

It is a common practice to drench weaners and yearlings in the Brigalow area. In some cases, calves are drenched at branding time.

Work carried out at the National Cattle Breeding Station 'Belmont' has shown that drenching had no economically significant effect on liveweight gains of Brahman cross



*Brahman-cross Murray Greys (right) and Murray Grey steers (left) were used in the trial.*

British cattle. It also showed that parasites had little or no effect on gain while the animals were gaining weight rapidly and it was only after deteriorating pasture conditions that a significant treatment effect became evident. Treatment had the largest effect on British breed cattle.

The standard of nutrition appears to have an influence on the effect of infection rather than on infection itself. Well-fed animals are better able to tolerate worm infestations than those on low nutritive levels. Because nutritive levels are usually satisfactory on improved Brigalow country, chemical control of internal parasites in the Brigalow areas has to be questioned.

## Trial design

Twenty-nine Murray Grey steers and 30 Brahman cross Murray Grey steers grazed the same Rhodes-Buffel grass pasture at a beast to 0·8 ha from 26 July 1978 to 24 May 1979.

## Treatments

- 15 Murray Grey Steers—control.
- 14 Murray Grey Steers—anthelmintic treatment.
- 15 $F_1$ Brahman cross Murray Grey Steers—control.
- 15 $F_1$ Brahman cross Murray Grey Steers—anthelmintic treatment.

Fasted liveweights were recorded and a random sample of worm egg counts was taken before the trial started which gave a low of 40 e.p.g. to a peak of 1 880 e.p.g. Larval differectation indicated a predominance of Cooperia 81%, Haemonchus 16% and Ostertagia 3%.

## Results

Table I shows the effect of treatment and breed on liveweight gain.

Drenching had no effect on the liveweight gain of the Brahman cross Murray Grey steers. Drenching had a significant effect on the Murray Grey steers during the 26 July 1978 to 20 September 1978 period. There was no effect to drenching during the three other subperiods. This initial response in the Murray Grey was maintained throughout the duration of the trial. Apparent difference over the whole period was not significant statistically because this was mainly due to a couple of unusual individual gains. Therefore, there was no evidence that this difference is due to treatment.

The major portion of the advantage to the Brahman cross Murray Grey was during the period 19 December 1978 to 24 May 1979. The gain by the Murray Grey and Brahman cross Murray Grey was 25 kg vs 54 kg respectively. Although breed differences were significant in all periods, the data imply that the British breed cattle are more likely to respond to drench particularly during the winter and early spring months.

Given current information and results of this work, it seems pointless drenching Brahman-cross animals in this environment. Indications from the Belmont work are that British cattle are more likely to respond to drenching.

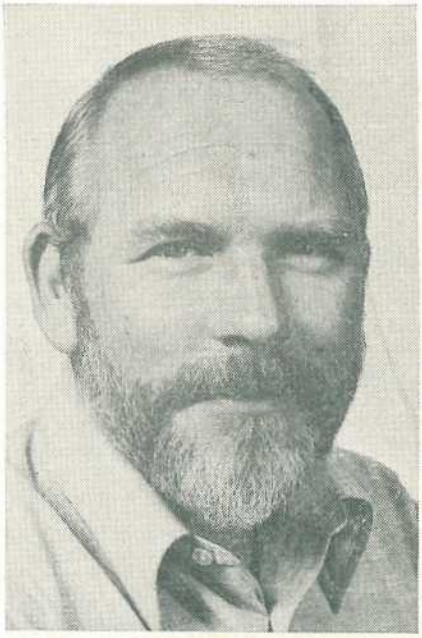
Timing of drenching is important with reference to nutritional status of pasture. At this stage, it is only possible to justify drenching British cattle as weaners in April or May and again early in the Spring if pasture quality is lacking.

**TABLE 1**

TABLE 1 SHOWS THE EFFECT OF TREATMENT AND BREED ON LIVEWEIGHT GAIN

| Class | No. | 26/7/78 to 20/7/78 56 days | 26/7/78 to 19/10/78 85 days | 26/7/78 to 19/12/78 146 days | 26/7/78 to 24/5/79 302 days |
|---|---|---|---|---|---|
| Overall mean .. .. .. | 59 | 21 | 37 | 79 | 119 |
| Murray Grey drenched .. | 14 | 23 | 40 | 83 | 107 |
| Murray Grey control .. | 15 | 15 | 28 | 68 | 94 |
| Brahman X M.G. drench .. | 15 | 25 | 42 | 85 | 138 |
| Brahman X M.G. control .. | 15 | 23 | 38 | 81 | 136 |

# Pig raising in Queensland



by P. H. Fearon, Pig and Poultry Branch

DURING the last 15 years, many changes have occurred in the Queensland pig industry.

There are fewer pig producers, a greater number of pigs, and therefore the average number of pigs per farm is increasing. There are about 100 piggeries with 100 or more sows.

Recent developments in housing and management of pigs enable the handling of more pigs per labour unit than was possible in the past.

Intensive methods of housing pigs, while enabling one man to manage up to 160 sows and their progeny, increase capital requirements considerably. To obtain a satisfactory return on this capital, high standards of piggery accommodation and management are required.

New production methods have encouraged a degree of specialization in the industry. Many grain-growers or dairy farmers also operate moderate to large pig units as a special part of their overall enterprise. The piggery produces a large portion of total farm income, and continues to do so even when other farming ventures may be limited by climatic conditions.

The reliance on pigs for income has been carried a step further by a number of producers who specialize in rearing pigs. The piggery illustrated in plate 1 is an example from which the farmer's sole income is derived from pigs.

## Breeds

The two major breeds in use are the Large White and Landrace. They are kept as purebreds in stud herds or used in crossbreeding in commercial herds. Occasionally Berkshire or Wessex Saddleback pigs are included in crossbreeding, with the Canadian Duroc being a possible future introduction.

Many commercial producers maintain crossbred sow herds which are mated to purebred boars to obtain the better reproductive performance and overall vigour of crossbred females.

In some commercial herds, on-farm performance testing is used for the selection of replacement breeders. Only the leanest of the fastest growing boars and sows are retained, regardless of breed type, providing they are physically sound and functional.

These pigs are then mated at random regardless of family. The likelihood of inbreeding is very low, providing brother is not mated to sister, son to mother or father to daughter. It is advisable to bring in one high-scoring tested boar from outside, per 100 sows, once a year.

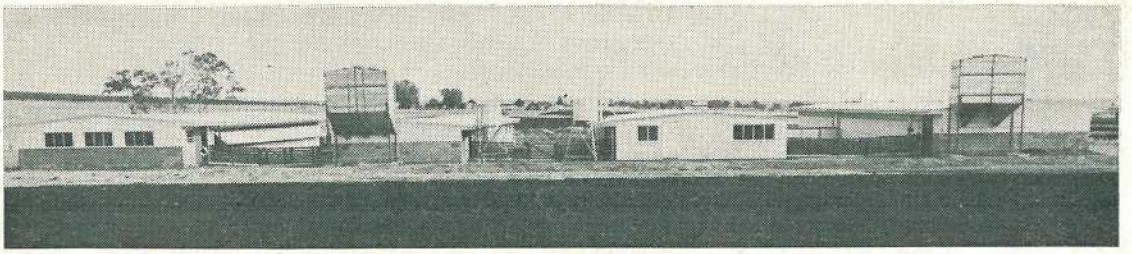


*Plate 1. A modern commercial piggery showing (from left to right) the dry sow and boar shed, farrowing house, weaning and follow-on shed with office, and the grower shed.*

Some stud breeders performance test boars and gilts on the farm and/or test boars through the Department's Boar Testing Station at Rocklea. Stud breeders place more emphasis on type than do commercial breeders.

There is now a trend towards the use of purebred and crossbred males and females from breeding companies in other States.

Quality of breeding stock is essential to secure good growth and a lean carcass. The use of above average performance-tested boars is a means of achieving this and commercial producers make good use of these boars when available.

The extra cost of proven boars is more than offset by the increased returns through improved production and better carcass quality.

## Housing

Intensive systems of housing pigs, with concentration of pigs and labour in a small area and under cover, have generally replaced paddock rearing systems. Few pigs are now run in paddocks.

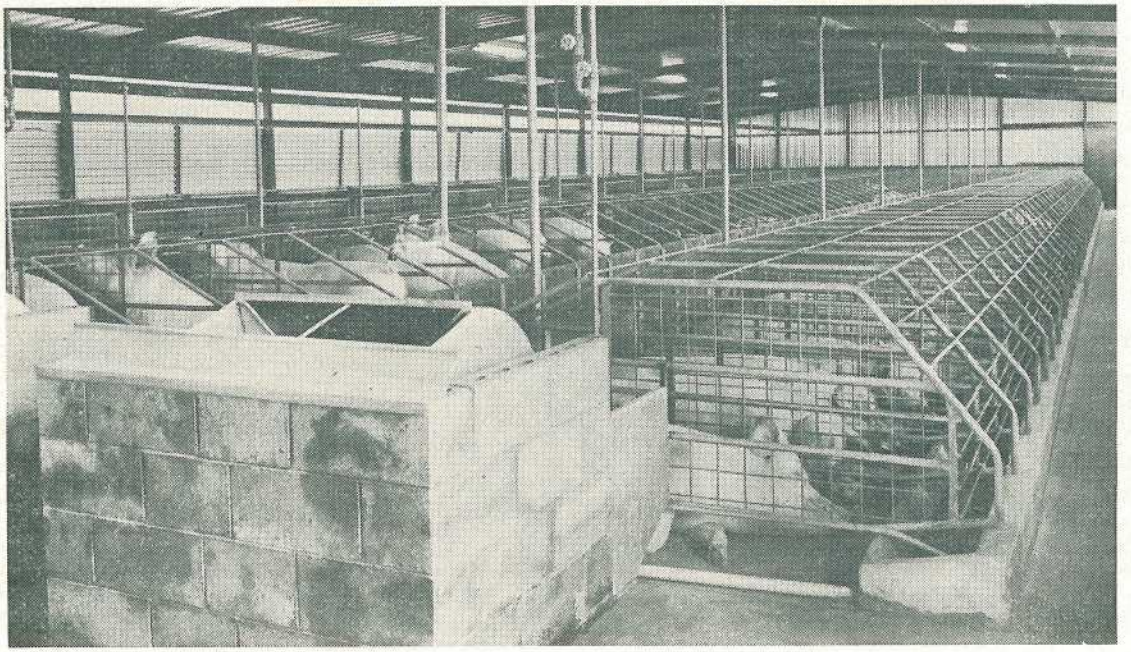


*Plate 2. Internal view of a dry sow shed.*

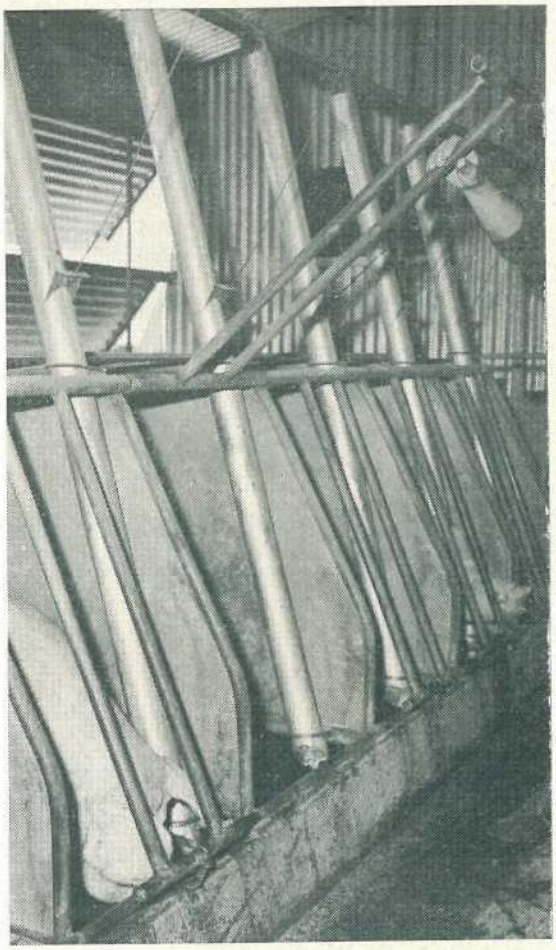


*Plate 3. Front view of a free-standing stall showing the front exit gates.*

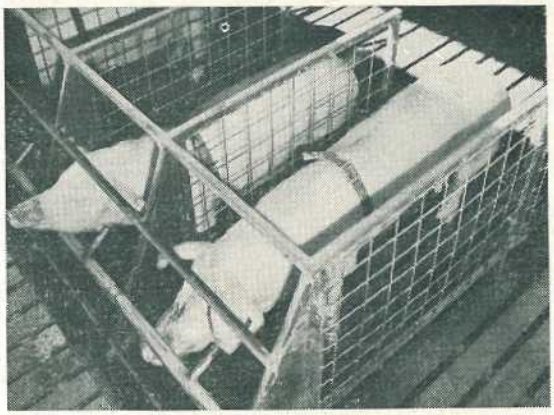


*Plate 4. Overhead view of girth tether stalls. Note the 'drinking straws' mounted over the feeding trough.*

The grazing of pigs in paddocks, in rotation, was intended to provide some of the food required and ensure healthy surroundings and exercise. However, in many instances, provision of good quality grazing throughout the year was not possible or was neglected. Consequently, the pigs were running on bare ground infested with eggs and larvae of internal parasites.

Under modern conditions, the only pigs which are sometimes run in paddocks are sows and/or replacement gilts. The gilts may be run outside from selection at bacon weight until a few weeks before farrowing. Where good grazing, fencing and labour are provided, dry sows may also be run in paddocks until shortly before farrowing. Adequate shade is essential in the paddocks.

## Dry sow and boar accommodation

The majority of medium to large piggeries house their breeding stock intensively.

The two most common systems used to confine sows are FREE-STANDING STALLS and TETHER STALLS

Each of these systems has advantages and disadvanages when compared, but both are preferable to free range especially if close control of each sow is required. Holding sows in stalls stops bullying and ensures a greater degree of individual management of each sow in the breeding herd. This results in increased sow productivity.

Boars are usually held in pens, but can be kept in free-standing stalls, provided they are exercised regularly. It is also good practice to exercise sows, especially those with signs of stiffness and sore feet. Daily exercise for a week or so before farrowing is often advisable.

Boars, whether stalled or in pens, should be located so that they are close to, and can communicate with newly-weaned sows. This allows them to be within sight, sound, smell and preferably touch, of the boar.

## Farrowing accommodation

There are many different designs of farrowing pens. However, all designs incorporate a farrowing crate, or rails for the protection of the piglets.

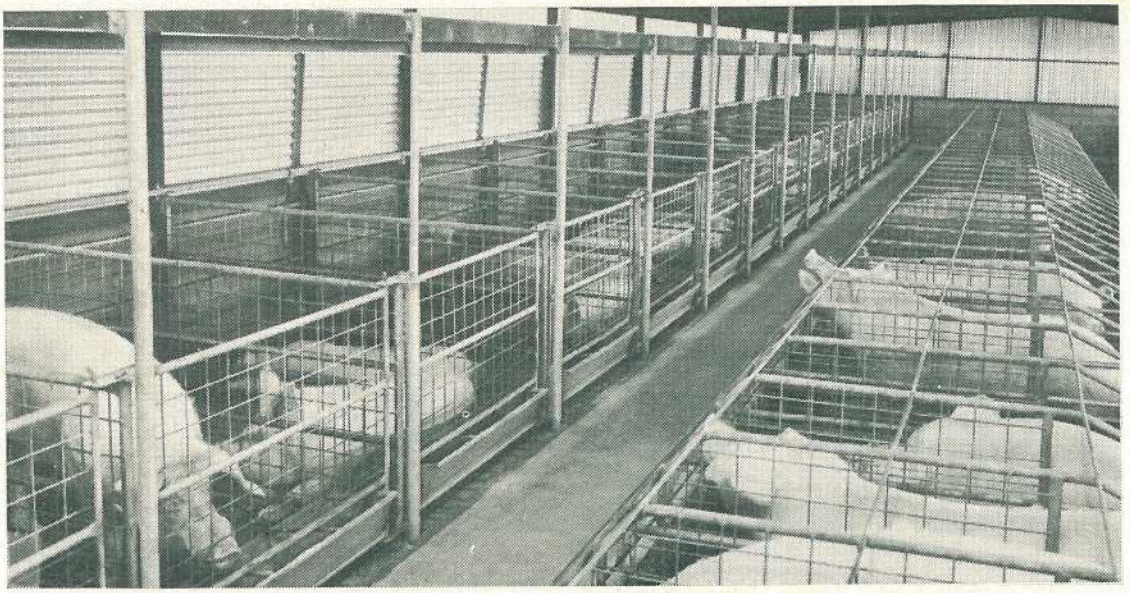


*Plate 5. A view of the boar, gilt and post-weaned sow pens.*

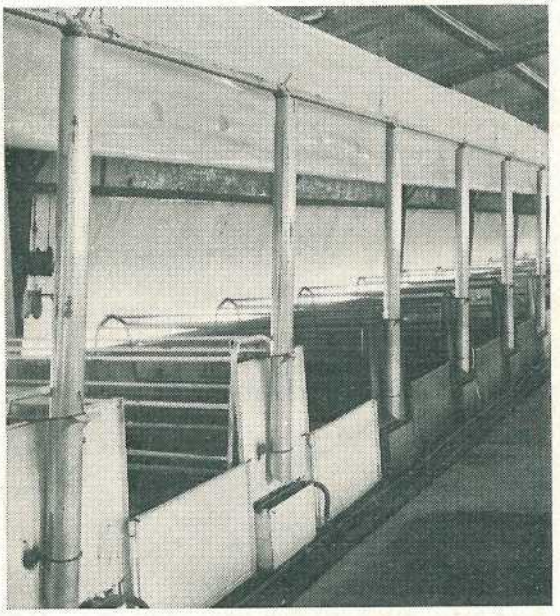


*Plate 6. In-line fully slatted farrowing pens. Note the plastic tube for even distribution of warm air and semi-automatic sow feeders.*

*Plate 7. Zig-zag partly slatted farrowing pens. In this case, the sows are tethered so the crate sides can be low.*

Plate 8. An effective creep feeder suspended 25 mm clear of the floor. The mesh slats at the rear help to keep the pen clean and dry.

Plate 9. Gas heaters directing heat down over the piglets.

Plate 10. Infra red or white lamps directing heat down on the creep area. In this case, it is probably too hot directly under the heat lamp as the piglets are lying outside the area of direct heat.

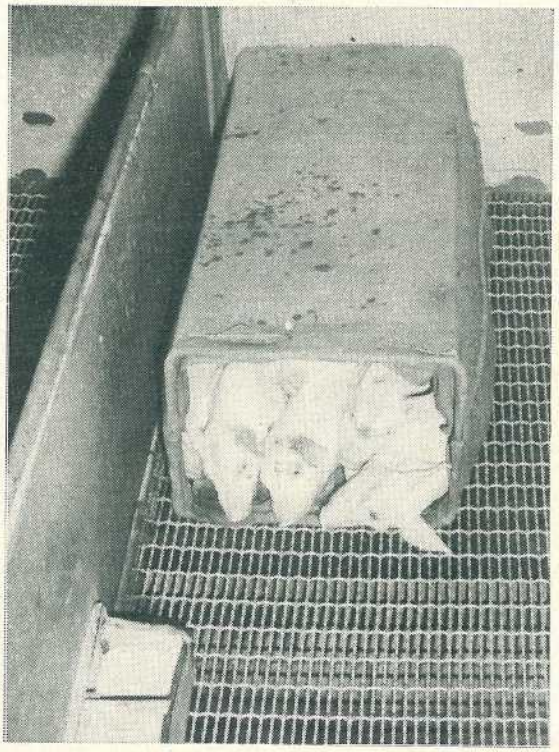


Plate 11. Interior of an in-line fully slatted farrowing pen, with piglets huddling in the bag tent.

*Plate 12. Double-deck weaner cages in a well-insulated building.*

## Creep area

Every pig farmer must plan for creep feeding of litters at some stage. It is difficult to produce strong, well-grown weaners without the assistance of creep feeding. Creep feed must be of high quality and fed fresh at all times.

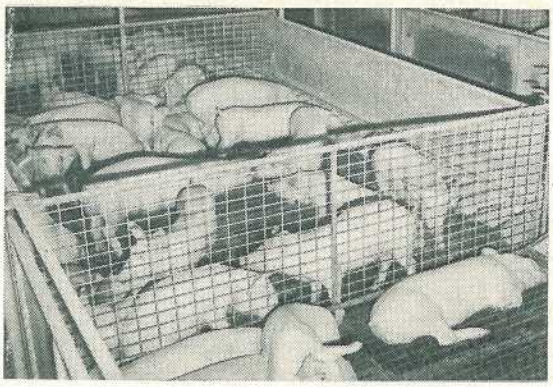
There are various methods of providing a creep area where piglets are safe from overlying, and have access to creep feed and warmth.

## Heating

Very young piglets require a temperature of between 27° and 32°C. Heating of the creep area may be essential for all or part of the year, depending on the season and the location of the piggery.

A heated portion of the creep area entices the piglets away from the sow, reducing the risk of crushing. The piglets are also comfortable and contented, and so make best use of their food; deaths are reduced and setbacks from chilling seldom occur. Piglets are stronger and less subject to scouring.

*Plate 13. Flat deck weaner pens with fully slatted steel mesh flooring in a space heated shed.*



*Post weaning follow-on pens for pigs from 8 to 16 weeks of age (fed ad lib). The shed is well insulated.*

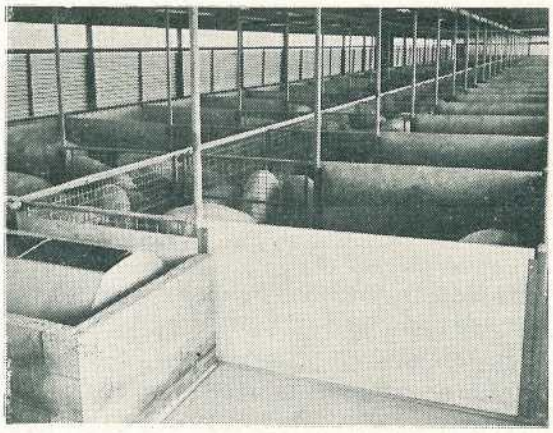
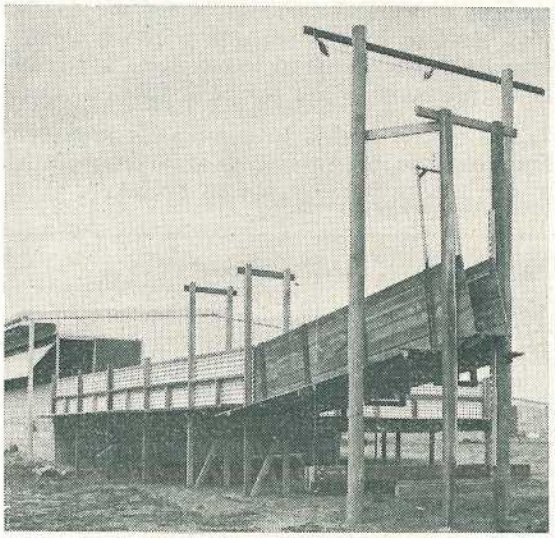
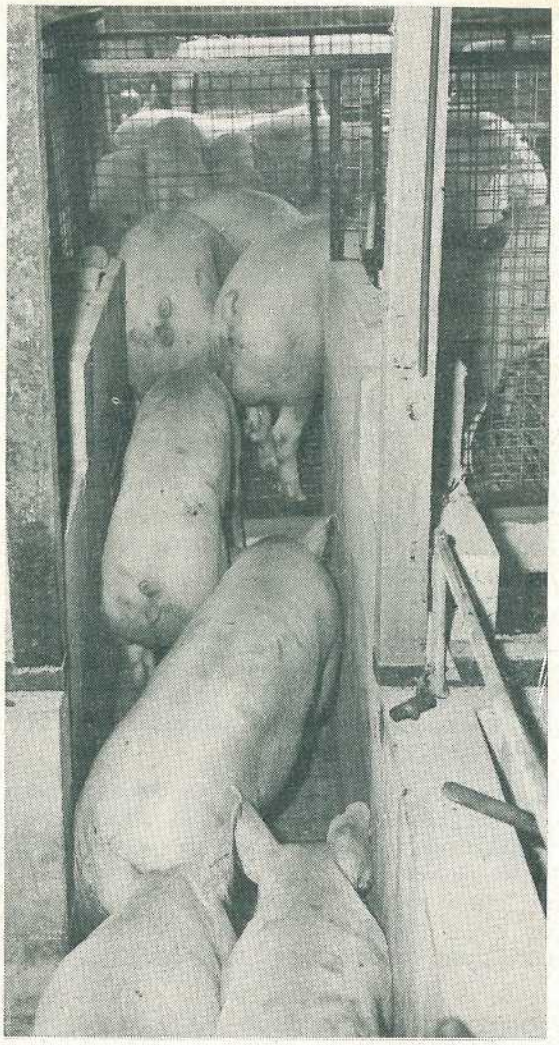


*Plate 15. Partly slatted grower pens with central slat area. Mesh divisions over the slats encourage pigs to dung and urinate over the slats.*



*LEFT. Plate 16. A two-tier loading ramp, with drafting and holding yards between shed and ramp.*



*ABOVE. Plate 17. A short, solid loading ramp with a concrete floor and block walls. It is constructed from the same material as the grower pens.*

Several forms of creep heating are employed, such as overhead heating (lamps or heaters) or underfloor heating (wires laid in the concrete floor). Whichever system is installed, it must not cause draughts in the creep area.

Solid sides or bag creeps are necessary to exclude floor level draughts. It is often necessary to have a solid lid over the heated creep area to stop the heat source drawing cold air up over the piglets.

### Early weaner accommodation

Well designed pens and sheds, with adequate control over the shed environment, are essential if maximum benefits are to be gained from weaning at 3 to 5 weeks of age. These designs ensure that pigs weaned early are comfortable and not subjected to other stresses which may lead to serious setbacks in growth.

Weaning at 3 to 4 weeks increases the likelihood of obtaining more than two litters a year per sow. By weaning earlier than the traditional 8 weeks, more pigs can be produced annually without an increase in the size of the sow herd.

A recent development is the weaner cage and flat deck weaner pen, in which early weaned pigs are held until 8 to 10 weeks old, at which time they are transferred to grower or follow-on pens. Properly constructed pens or cages provide comfortable and sanitary conditions for rearing young pigs.

### Grower accommodation

Pens for growing pigs range from the solid concrete floor type with a dunging race to partly and fully slatted floor pens.

The partly slatted floor pen, with floor feeding of dry feeds, is commonly used. Under ordinary climatic conditions, dirty floors are unlikely to occur in well-ventilated buildings correctly designed and stocked at the appropriate rate. The slatted portion is usually one-third of the total floor area.

In the hot northern coastal and inland regions, fully slatted floors are recommended. Fully slatted floors are also recommended where the adoption of a liquid feeding system is contemplated.

In a fully slatted floor pen, the whole floor is slatted and a feed trough is required. This design permits slightly higher stocking rates. It is cooler for pigs in hot weather, but colder than a solid floor in winter.

Various forms of pen arrangement and sizes are used in grower sheds. However, solid pen division walls are recommended (for all pens) unless the shed is very well insulated to reduce floor draughts and pneumonia problems. In partly slatted pens, the solid walls need only to be over the concreted floor area with a mesh or similar division over the slatted area.

### Loading pigs

A very important and often neglected aspect of piggery design is the provision of a good loading ramp for the despatch of market pigs and cull breeding stock.

The loading ramp must be narrow (max. 600 mm) and have a solid floor and sides. This reduces the likelihood of pigs turning around while being loaded.

If pigs are to be loaded directly from the shed on to a truck or trailer, the ramp and the truck or trailer should be in the shade. Pigs tend to balk when going into a lighter area than they are used to—causing a pile up and frustration to the person loading them.

The author wishes to express his appreciation to those pig producers who co-operated by permitting photographs to be taken.

# Improved control of grape grey mould

*by J. B. Heaton, Plant Pathology Branch*

GREY mould, caused by the fungus *Botrytis cinerea,* is a serious disease of grapes on the Granite Belt being next in importance to downy mildew and black spot.

Control depends on thorough spraying with a recommended fungicide during two susceptible growth stages of the crop, the first during flowering and the other in the month before harvest.

Hygiene in the vineyard and the packing shed is necessary to prevent build-up and minimize carry-over of the fungus on crop residues such as prunings and old bunches in the field and bunch trimmings and reject bunches in the packing shed.

The disease is favoured by cool, moist weather during flowering in November and bunch ripening in late summer. Losses before and after harvest may be severe even in grapes held in cold storage. The fungus is active at temperatures as low as 0°C.

## The disease

Grey mould is a common surface mould which grows on dead or living plant tissue in cool, wet weather. The mould produces grey masses of spores.

## Spread

Spores of the fungus from old, diseased canes or bunches left on the trellises or from diseased vine prunings are spread by wind to grape blossoms and, during cool, wet weather infect the petals. The fungus grows through the old petal tissue and produces spores which infect adjacent grape blossoms and young berries. It then remains latent in the berries until they ripen. The fungus occasionally infects leaves and canes in mid season when vines are wrapped around the trellis wires.

If cool, wet weather occurs in the month before harvest, the fungus becomes active and spreads rapidly. Rotten berries become covered with the characteristic growth of grey mould. Clouds of spores may be seen near affected bunches when they are shaken by the wind or disturbed by pickers.

The fungus is often spread rapidly through the vineyard by wind and rain and, in particular, may infect any mechanically injured bunch (for example, from bird injury). Further spread of the disease may follow, as berry injuries occur and become infected during the harvest, trimming and packing of bunches. In containers, the fungus spreads from fruit to fruit resulting in 'nests' of rotted fruit.

## Research

In 1977–78 a trial was carried out in Waltham Cross grapes at Ballandean in the Granite Belt to determine the effectiveness of benomyl, captafol, iprodione, vinclozolin and thiaphanate-methyl in controlling grey mould. The effect of spray timing was also tested to establish whether two sprays during blossoming improved the control achieved by two sprays in the month prior to harvest.

All fungicides gave very good control of grey mould from 7 days before harvest to 10 days after harvest, and there was a trend for improved control where blossom sprays were applied.



89618—12

Benomyl, captafol, thiophanate-methyl and vinclozolin have been registered for control of grey mould of grapes in Queensland and are now included in the spray schedule.

In addition to applying the recommended sprays, hygiene measures are also required to ensure satisfactory control. During harvest, it is essential to avoid skin damage to the berries when cutting the bunches and during packing in the field. The same care is required in the packing shed and all discarded grapes should be removed daily and the packing benches cleaned with a disinfectant such as sodium hypochlorite.

Use of double-layer polyethylene-coated paper in which sodium metabisulphite is incorporated as a topping paper in grape packages is recommended for grapes held in cold storage prior to local sale or export. This impregnated paper produces sulphur dioxide which inhibits the development of grey mould.

SPRAY SCHEDULE 1980–81

| Times of Application | Fungicide, Trade Name | Rate/100 L water |
|---|---|---|
| 1. At capfall (1 to 10% bloom) | Benomyl 50% (Benlate) | 100 g |
| 2. 10–14 days later | *or* Captafol** 50% (Difolatan 50 Flocol) | 200 ml |
| 3. 3–4– weeks before harvest* | *or* Thiophanate-methyl 70% (Topsin M) | 200 g |
| 4. 1–2 weeks before harvest* | *or* Vinclozolin 50% (Ronilan) | 100 g |

* Use 1 000–1 100 L of the spray per ha.
** Captafol is registered for use on table grapes only.

# New containers for tick fever vaccine

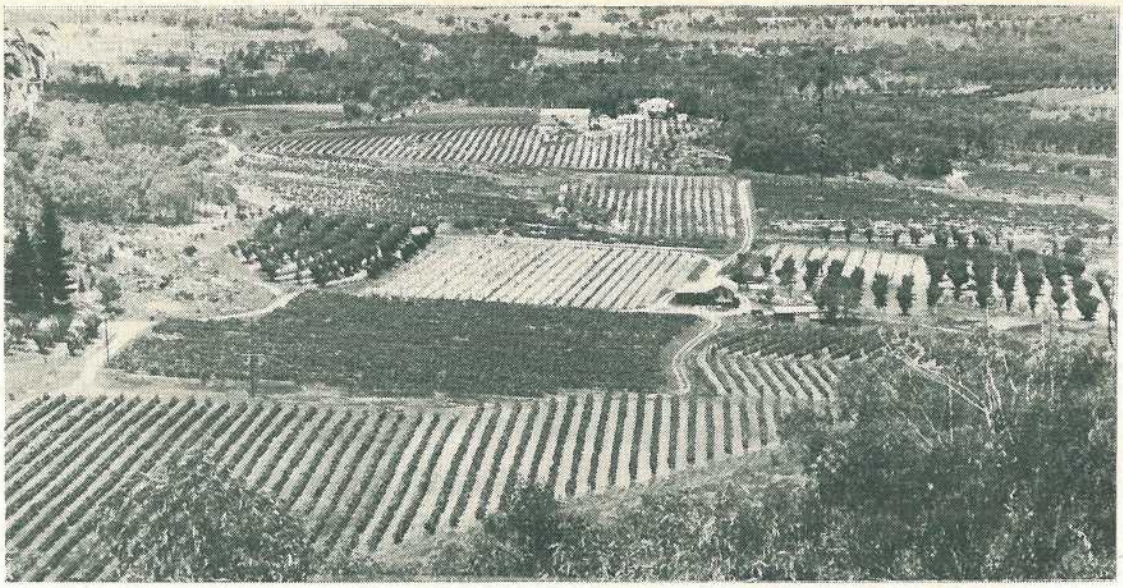
New tick fever vaccine containers will be used by the Department of Primary Industries' Tick Fever Research Centre at Wacol, Brisbane.

Hard polypropylene containers will replace the soft PVC bags now in use. The changeover which commenced on August 1 should be completed by mid 1981.

With the change in packaging, consignments will be supplied in either 25 or 50-dose sizes. However, while the changeover is being completed, consignments might contain both types of packs.

The new packs are designed for use with either repeating or single shot syringes and should be more convenient to use.

They will include an instruction leaflet giving general information on the vaccines (which remain unchanged) plus instructions on usage and on the after-care of vaccinated cattle.



# Horticulture in the Granite Belt

ALTHOUGH the Granite Belt is only five degrees latitude south of the Tropic of Capricorn, its altitude of 800 to 940 m ensures a temperate climate.

This climate is sufficiently cold during the winter to satisfy the chilling requirements of deciduous fruit trees.

The Granite Belt is the only area in Queensland where apples and pears are grown commercially. With the exception of small areas of apricots around Warwick and Inglewood and low chilling peaches near Brisbane, all of the stone fruit in Queensland is also grown in the district. Grapes are an important crop with about 80% of the vineyards in the State established in the Granite Belt. The district is also the principal source of vegetables for Queensland markets during summer.

The Granite Belt is an extension of the New England Tableland region. It extends from Dalveen in the north to Wallangarra in the south and from the New South Wales border in the east to the traprock country in the west. The district is approximately 50 kilometres long and 25 kilometres wide.

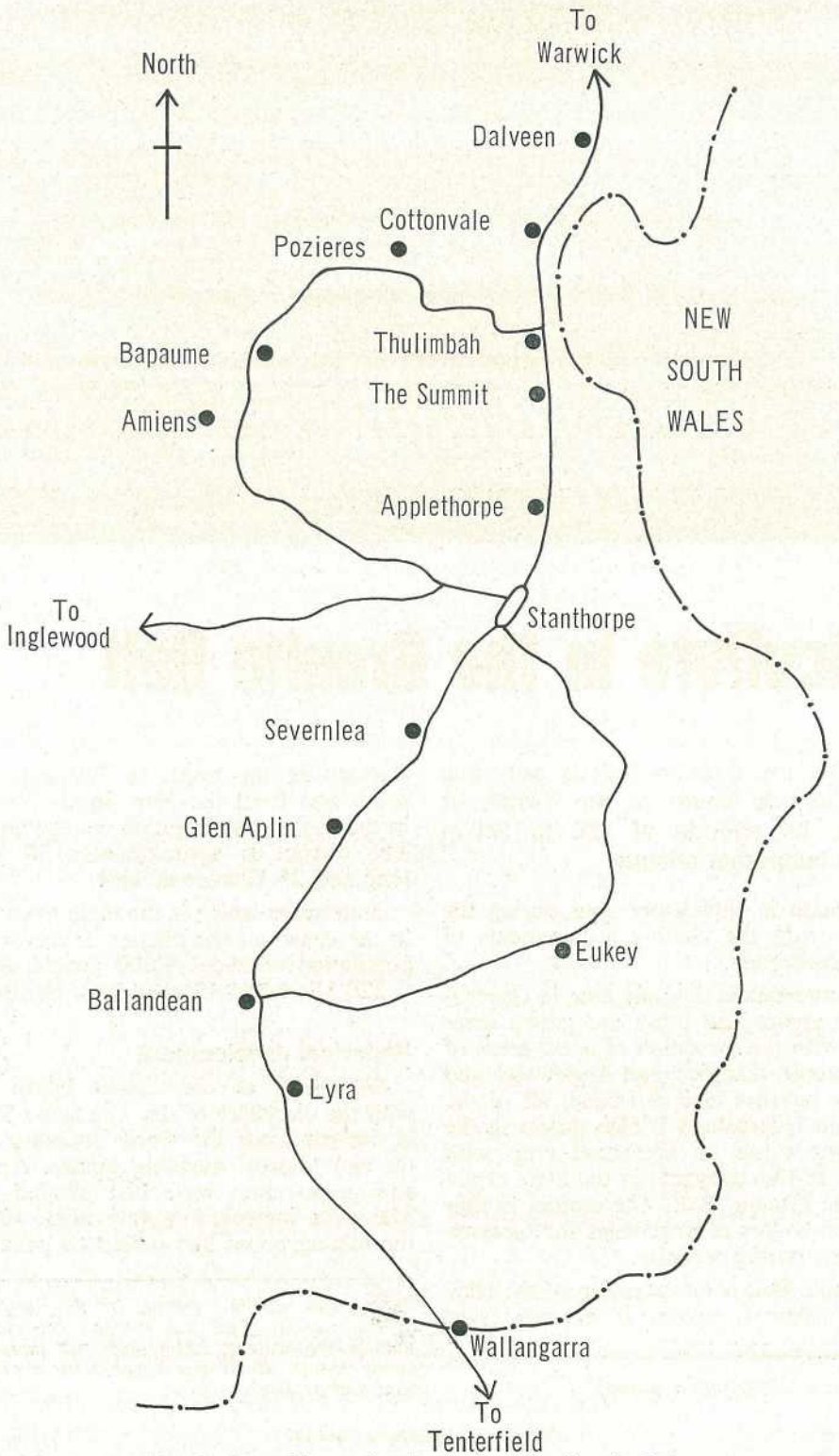
Stanthorpe which is the main town is located in the centre of the district. It serves a district population of about 9 000 people. Stanthorpe is 220 kilometres by road from Brisbane.

## Historical development

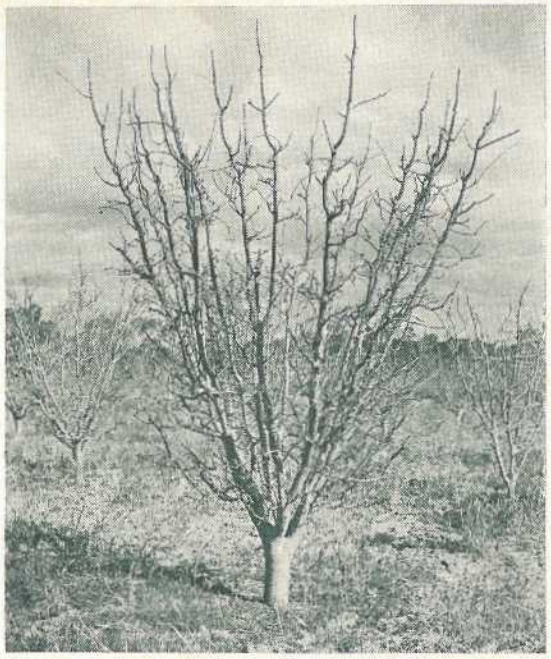
Settlement of the district began in 1872 with the discovery of tin. The name Stanthorpe is derived from the word 'stannum' meaning tin and 'thorpe' meaning village. Apple trees and grape vines were first planted in 1873. The area increased greatly after 1880 when the mining boom had passed its peak.

*Photograph above. Farms in the southern end of the Granite Belt are located on the hillsides and in the valleys. The soils are coarse-grained sandy loams which are suitable for growing stone fruit and grapes.*

*by S. N. Ledger, Horticulture Branch*




*Map 1. Townships and main roads of the Granite Belt.*



*Deciduous fruit trees drop their leaves and remain dormant during winter. Winter temperatures in the Granite Belt are sufficiently cold to satisfy the chilling requirements of apples, pears, and stone fruit. If chilling is insufficient, leaf and flower buds open erratically over a long period during spring.*

After the first World War, considerable development took place in fruit production because of the establishment of Soldier Settlement Projects. New townships were established and given names such as Pozieres, Amiens, Bullecourt, Bapaume, and Fleurbaix to commemorate the battles in which Australian troops took part.

## Climate

Winter temperatures are sufficiently cold to satisfy the chilling requirements of apples, pears, and stone fruit. Winter chilling requirements are measured by the total number of hours below 7°C. The chilling requirements of most varieties fall in the range of 600 to 1 200 hours. If chilling is insufficient, leaf and flower buds open erratically over a long period during spring. This leads to poor growth and cropping.

The first heavy frost each year can be expected in the first week of May and the last in the third week in September. Light frosts may occur up to 3 weeks before the first heavy frost and up to 6 weeks after the last heavy frost. Heavy frosts during September and October can cause considerable losses to fruit crops. Stone fruit are more susceptible to damage than apples and pears because they flower earlier.

*Dryland farming with the trees spaced 6 m apart on the square is the traditional method of growing fruit trees in the Granite Belt. In recent years, there has been a swing to irrigation and closer planting.*

TABLE 1

CLIMATIC DATA—STANTHORPE

| Month | Average Maximum Temperature (°C) | Average Minimum Temperature (°C) | Average Rainfall (mm) |
|---|---|---|---|
| January | 27·2 | 15·0 | 100 |
| February | 26·4 | 15·1 | 95 |
| March | 24·4 | 13·1 | 61 |
| April | 22·5 | 10·2 | 38 |
| May | 17·9 | 4·8 | 38 |
| June | 14·8 | 2·5 | 54 |
| July | 14·1 | 0·7 | 44 |
| August | 16·0 | 1·7 | 36 |
| September | 19·3 | 4·9 | 49 |
| October | 23·1 | 8·7 | 73 |
| November | 25·7 | 11·8 | 70 |
| December | 27·1 | 13·7 | 97 |
| TOTAL | .. | .. | 755 |

TABLE 2

HORTICULTURE CROP ESTIMATES, GRANITE BELT, 1978–79

| Crop | Area (hectares) | Production (tonnes) | Value ($M) |
|---|---|---|---|
| Apples | 5 290 | 38 900 | 10·5 |
| Pears | 575 | 3 100 | 0·8 |
| Peaches | 675 | 1 900 | 1·2 |
| Plums | 625 | 1 800 | 1·5 |
| Nectarines | 210 | 500 | 0·5 |
| Apricots | 200 | 550 | 0·5 |
| Grapes | 1 250 | 5 000 | 3·0 |
| Tomatoes | 370 | 7 000 | 2·5 |
| Cabbages | 200 | 5 000 | 0·3 |
| Cauliflowers | 60 | 1 000 | 0·2 |
| Brussell sprouts | 20 | 300 | 0·2 |
| Celery | 70 | 4 000 | 1·5 |
| Lettuce | 30 | 1 400 | 0·5 |
| Zucchini | 40 | 400 | 0·2 |
| Capsicum | 30 | 600 | 0·2 |
| Green beans | 40 | 200 | 0·1 |
| Other vegetables | 60 | 1 000 | 0·2 |
| TOTAL | 9 745 | 72 650 | 23·9 |

The annual rainfall varies from 750 to 850 mm with most of the rain falling in summer. This is near the minimum required for commercial production of apples, pears, and stone fruit. Increases in production can be obtained with irrigation. Irrigation is essential for growing vegetables.

Up to 60 thunderstorms occur each year in the Granite Belt. Hail may accompany many of these storms especially during early summer. Hail belts are usually narrow and vary from year to year. No one area could be classed as hail free and a year seldom passes without some part of the district suffering losses of fruit from hail.

The climate data for Stanthorpe is contained in table 1.

## Soils

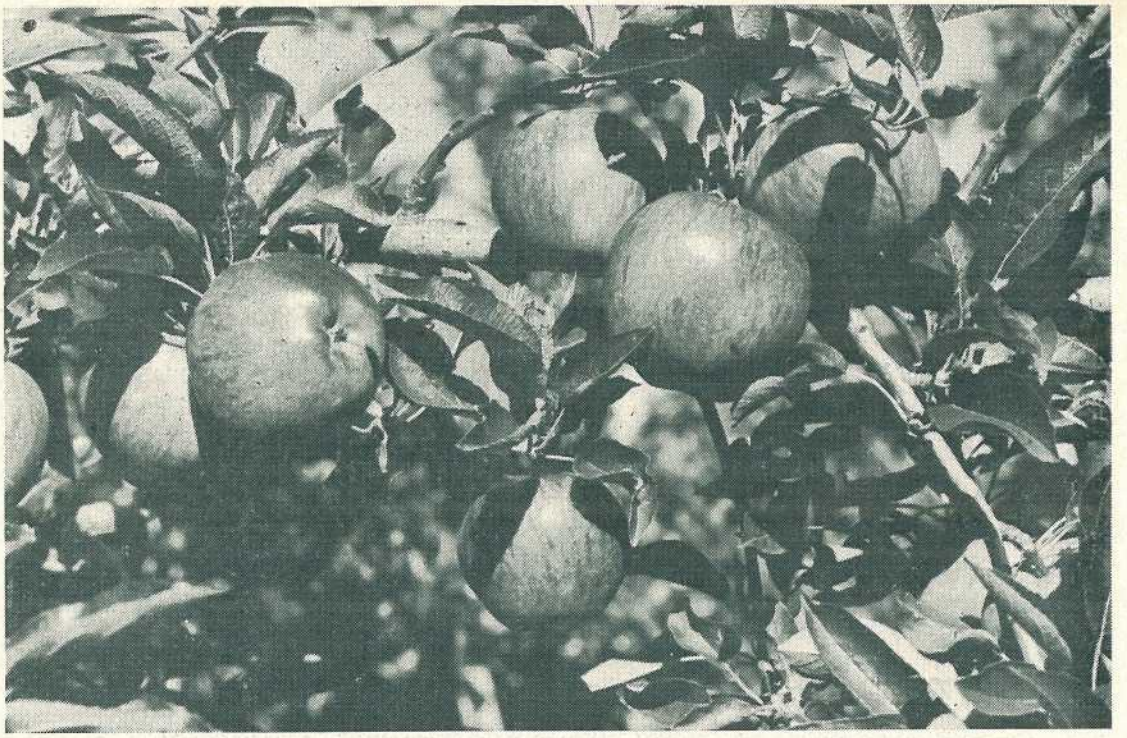
The soils of the district are acid sandy loams which have poor fertility and water-holding capacity. Medium to fine-grained sandy loams overlying a permeable clay subsoil occur in the northern part of the district. The soil depth is generally shallow and in some areas it is only 20 cm. On the hillsides and valleys in the southern end, the sandy loams are coarse-grained and deeper.

## Horticulture crops

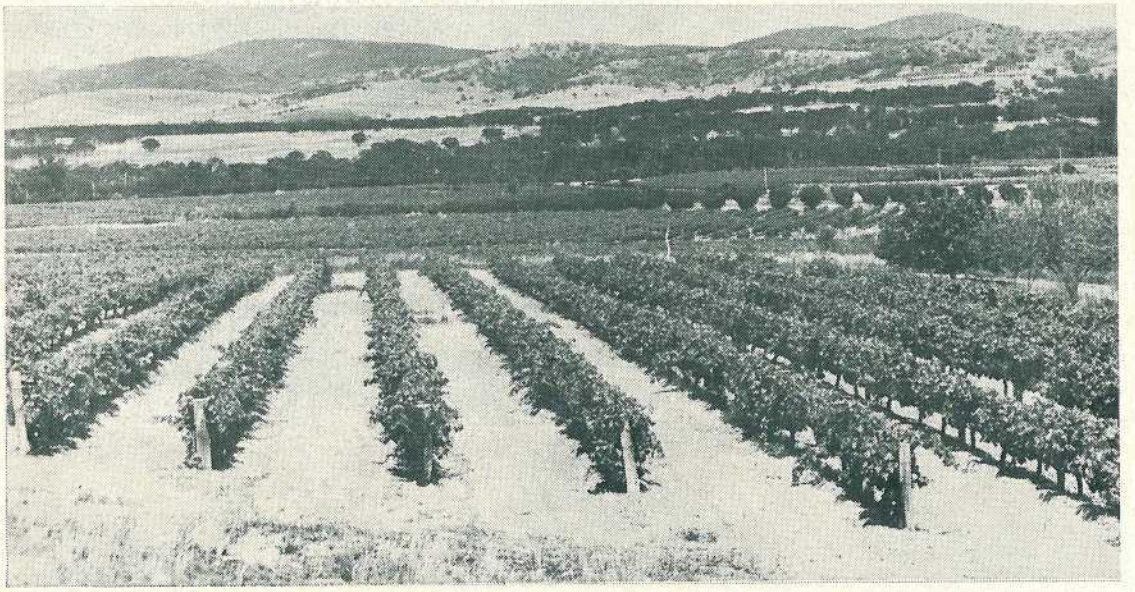
Fruit and vegetable production in the Granite Belt is summarized in table 2. The main crop is apples. Other crops grown are pears, stone fruit, grapes, and vegetables. Very few properties specialize in the one crop. Common combinations are apples, pears, and stone fruit; stone fruit and grapes; and vegetables with any one or more of the other crops.

Most apples and pears are grown in the northern part of the district where the rainfall is higher. Stone fruit are more susceptible to waterlogging than apples and pears and are therefore grown in the well-drained, deep soils of the district.

*Fruit is harvested by hand with the aid of picking bags. Bulk bins are filled in the field and transported to the packing shed.*



*The Delicious apple variety amounts to 36% of production. These apples mature from mid February to mid March.*



*About 80% of the grapes in Queensland are grown in the Granite Belt. Most vineyards in the area are established in the southern end of the district around Ballandean.*

South of Stanthorpe around Severnlea and Glen Aplin is an important stone fruit area as the hillsides provide protection against spring frosts. The main grape growing area is further south around Ballandean. Rainfall during harvest causes berries to split and problems with grey mould. Ballandean receives less rain during the harvesting period than other areas. Vegetables are grown throughout the district.

The size of orchards depends on the crop grown. Where apples are the main crop the average orchard size is 16 ha while for stone fruit average size is 8 ha. The average size of vineyards is also 8 ha. There are about 500 growers in the Granite Belt whose main enterprise is fruit growing while another 80 growers depend on vegetables as their main source of income.

## Pome fruit

The apple is the main crop grown in the Granite Belt. Production varies each year but the annual average is about 2 million 18 kg cartons. The main varieties are Granny Smith (40%), Delicious (36%) and Jonathan (13%). Granny Smith is a late-maturing variety of excellent quality suitable for both cooking and dessert purposes. Delicious is a midseason variety, maturing from mid February to mid March. Delicious and its strains are the most important dessert apples. The Delicious strains have improved colour and include Hi Early, Royden Red, and Starkrimson.

Jonathan is an early to midseason variety maturing from early February. There are several other varieties grown to meet special requirements. The most common is Gravenstein which matures in mid January and is suitable for dessert and cooking purposes. The early-maturing varieties even though only a small proportion of the total production are important as the Granite Belt is the earliest maturing district in Australia.

Dryland farming is the traditional method of growing apples with the trees planted 6 m apart on the square. Yields range from 1 to 10 cartons per tree (480 to 2 400 cartons per ha). Under good management, a four cartons per tree average can be expected over the whole orchard. Full production is achieved from trees 10 to 30 years of age.

*Muscat Hamburg is an early-maturing grape variety. The berries are large, oval, black in colour and have a thin skin.*

In recent years, there has been a swing to irrigation, especially trickle irrigation. Increased production is achieved with irrigation through improved fruit size. The latest trend is to close planting of apple trees. With close planting, yields are higher and pruning, spraying, and harvesting are easier and cheaper. Returns are earlier with close planting as cropping commences in the third year after planting compared to the seventh year for wide spacing.

With the use of cool storage, apples can be marketed throughout the year. About half of the crop is sold fresh and the rest is stored either in commercial or privately-owned cool stores. The total capacity in the district for ordinary cool storage is 750 000 cartons while the controlled atmosphere capacity is 330 000 cartons. About 55% of the apples are sold through the Rocklea markets in Brisbane, 15% to other Queensland markets, 15% to New South Wales, and 15% are processed. About 50 000 cartons are exported each year to Hong Kong and South-east Asia.

Pears are a sideline crop which can be profitable when prices are high. Packhams Triumph, William Bon Chretien, and Winter Cole are the main varieties. Packhams Triumph is the best variety for storage with a maximum storage life of about 5 months. Most of the William Bon Chretien are processed for canning.

## Stone fruit

Peaches, plums, nectarines, and apricots are the stone fruit grown in the Granite Belt. The traditional method of growing stone fruit is dryland farming with a tree spacing of 6 m on the square. As with apples, there has been a trend to irrigation and close planting. Most of the stone fruit are sold fresh on the Brisbane market. A small quantity is processed by the Golden Circle Cannery.

Peaches are harvested from early December to mid February. The established varieties in order of maturity are Starking Delicious, Halehaven, Southland, Blackburn Elberta, Dripstone Elberta, J. H. Hale, and Golden Queen. The new yellow-fleshed varieties—Cardinal, Hiland, Maygold and Coronet, which were introduced from the United States, have become popular. They mature from early to mid December and return good prices.

Plum varieties are either Japanese or European in origin. Most plantings in the Granite Belt are of the Japanese type with the common varieties being Wilson (55%), Santa Rosa (10%), and Doris (15%). Wilson matures first from late November to mid December, followed by Santa Rosa in mid to late December and Doris in mid to late January. The late maturing varieties Narrabeen, Mariposa, and Red Ace are increasing in demand.

Goldmine is the main nectarine variety grown. It matures about the middle of January. The Nectared series of varieties introduced from the United States are having a considerable impact on the market. They are yellow-fleshed and highly-coloured and mature in sequence at about weekly intervals from mid December.

Apricots are harvested from mid November to late December. The main varieties in order of maturity are Glengarry, Newcastle, Divinity, Bulida, Beauty, Trevatt and Moorpark.

## Grapes

The harvesting period for grapes extends from mid January to mid April. The main varieties in order of maturity are Muscat Hamburg, Waltham Cross and Purple Cornichon. Cardinal, a new, early-maturing variety is showing promise. Yields range from 600 to 1 700 cases per ha. Under good management, a 900 to 1 100 cases per ha average can be expected over the whole vineyard. Most of the crop is sold fresh on the Brisbane, Newcastle, and Sydney markets.

Increasing interest is being shown in the wine industry. The standard of wines is improving each year as more wine is made from wine grape varieties. Trials have shown that the traditional wine grape varieties such as Shiraz, Cabernet Sauvignon, and Rhine Riesling grow well in the Granite Belt. In 1979, 200 000 L of wine were made from 60 ha of wine grape varieties. As well, 280 000 L of wine were made from table grape varieties.

## Vegetables

A wide range of vegetables is grown in the Granite Belt. The most important crop is tomatoes. Picking starts in January and continues until the first heavy frost usually in late April or early May. The main varieties grown are Grosse Lisse, Tropic, and Flora-Dade.

With the introduction of more adaptable varieties, the harvesting periods for cabbage, cauliflowers, and Brussels sprout are extending. Cabbages are cut almost all the year round except for July and August. Harvesting of cauliflowers extends from October to July with February to May being the main period. Brussels sprouts are picked from March to October.

The temperate climate of the Granite Belt enables celery to be grown during the summer months. Cutting starts in November and continues until July. The other main vegetables grown are zucchinis, capsicums, lettuce, and green beans.

# Electric fencing for feral goats

*by D. R. Niven and D. J. Jordan, Sheep and Wool Branch*

A four-wire electric fence was successfully used to contain 100 feral goats in a 4 ha paddock on 'Nimboy', Cooladdi.

The goats made no attempt to escape from the paddock though feed was extremely limited and they were hungry. The owner of 'Nimboy', Mr Les Landsberg said, "I was pleased that the goats were contained so satisfactorily, considering the condition of the paddock. I thought they would take fence and all in a rush for better feed".

## Training the goats

Before any attempt is made to contain goats inside an electric fence, they have to be trained to the effects of electricity. This can best be done by placing them into a small electrified training yard inside an existing cattle yard. At 'Nimboy', three wires were used in the training yard. The spacing was: ground to first live wire, 15 cm; first live wire to earth, 15 cm; earth to second live wire, 22 cm. This fence was positioned 1 m inside the cattle yard fence.

When faced with the electric fence, the goats attempted to go through the inviting space between the wires, rather than jump over them. However, they quickly learned to stay

*A training yard for feral goats. A three-wire electric fence is erected inside a cattle yard.*

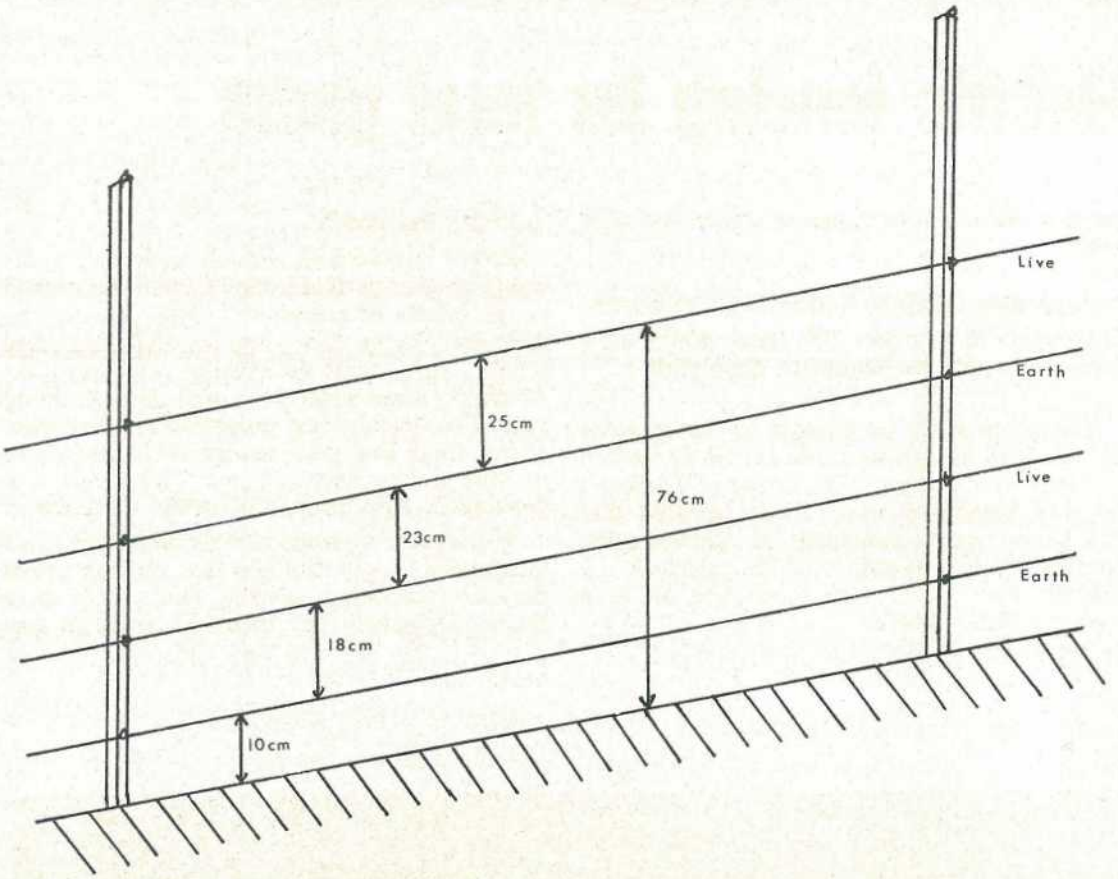



*Diagram 1. A four-wire electric fence used to contain goats.*

clear of the fence altogether and within 2 days only one or two goats were escaping. By the seventh day, all of the goats were sufficiently trained to be placed in a 4 ha paddock.

## Goat paddock

Three sides of a 4 ha paddock were fenced with four strands of 2·5 mm high tensile plain wire to a height of 76 cm. The extra wire gave a better earth than was obtained with three wires in the training yard. The wire spacing on this fence was: ground to earth, 10 cm; earth to first live, 18 cm; first live to second earth, 23 cm; second earth to second live, 25 cm. Because of the dry conditions a satisfactory earth was not obtained unless the animals touched an earth wire. Steel fence posts were spaced 10 m apart.

On one side of the paddock an existing plain wire fence was electrified. The wires most closely approximating the above-mentioned spacings were connected into the circuit. Live wires were insulated where necessary. A 'Gallagher' 12 volt battery fence energizer was used to electrify the fence.

The paddock at 'Nimboy' consisted almost entirely of hopbush, a species the goats did not relish, and at the high stocking rate (25 goats per ha) there was little other feed available. During their 20-day confinement, the goats deteriorated considerably in condition but made no attempt to escape through the electric fence.

This exercise has shown that while it is difficult to contain feral goats within conventional fencing they can be held successfully inside an electric fence.

# Dairy accounting scheme helps farmers in the South Burnett

A dairy accounting scheme has highlighted variations in production costs for South Burnett dairy farmers.

As a result of the scheme, members have been able to budget more accurately for the future and make better farm management decisions.

Traditionally, most farmers have relied heavily on intuition when making management decisions. With costs rapidly increasing, business or farming survival has demanded a more accurate approach.

The dairy accounting scheme (D.A.S.) has been able to give this information in a way that is easy to understand.

## Starting the scheme

South Burnett dairy farmers have been attending discussion group meetings for several years. From these they have gained more knowledge and experience of improved farming methods. In addition to discussion topics on nutrition, herd improvement and general management, economics has been discussed in detail. Farmers and local departmental officers saw a need for a simple farm accounting system which was management oriented.

The D.A.S. commenced in the South Burnett on the 26 August 1974. The dairy husbandry officer outlined the necessary details for the formation of the scheme at a discussion group meeting at Wondai and at group meetings in Kingaroy and Nanango later that year.

*by W. B. Oliver and G. J. Busby, Dairy Field Services Branch*

Dairy officers report on trends and annual results to dairy farmers at the end of each financial year. This has always proved to be a valuable discussion topic at discussion group meetings. Eighteen farmers participated in the scheme in 1979.

## The information recorded

Farmers record both physical and financial data each month.

### Physical data

The physical data required are—litres of milk and kilograms of butterfat produced, number of cows milking, butterfat test, number and description of stock sold and/or purchased.

### Financial data

Only variable production costs are recorded. These include: feed, seed, fertilizer, chemicals, harvesting and casual labour, electricity, fuel, water and irrigation costs, herd recording and artificial insemination costs, dairy requisites, veterinary expenses, cartage and levies, cattle sales and purchases, agistment and sundries.

## Compiling returns

Most members compile records each quarter for the preceding 3 months. This is done quickly from cheque book butts, cash books, invoices and factory payment slips.

It takes a farmer about 15 minutes to complete a monthly return. The information is treated confidentially.

Annual results are compiled from these quarterly figures. Examples of annual accounting summaries for dryland farms and irrigated

**TABLE 1**

AN EXTRACT FROM D.A.S.—DRYLAND FARMS ANNUAL SUMMARY 1978/79

| Item | 1 | 8 | 16 | 18 | District Average |
|---|---|---|---|---|---|
| *Return: cents/L | 10·75 | 10·81 | 10·3 | 11·2 | 11·1 |
| *Return: $/kg B.F. | $2.69 | $2.58 | $2.81 | $2.47 | $2.56 |
| Costs: cents/kg B.F. | | | | | |
| Feed | 21·5 | 18·2 | 59·0 | 9·0 | 34·3 |
| Fertilizer | 17·7 | 8·9 | .. | 10·9 | 8·1 |
| Harvesting and casual labour | 9·4 | 3·5 | 8·4 | 4·2 | 5·8 |
| Seed | 10·0 | 2·1 | 3·6 | 5·4 | 4·8 |
| Chemicals | 3·0 | .. | 0·3 | .. | 0·5 |
| Fuel | 19·7 | 9·2 | 10·7 | 8·4 | 8·9 |
| Electricity | 10·7 | 11·7 | 18·6 | 7·0 | 10·0 |
| Water | .. | 0·3 | .. | .. | 0·7 |
| H.R. and A.I. | 4·0 | 0·3 | .. | 2·9 | 1·2 |
| Dairy requisites | 4·8 | 3·0 | 4·0 | 2·3 | 2·9 |
| Health | 4·4 | 0·8 | 13·1 | 2·0 | 3·5 |
| Cartage | 20·0 | 19·0 | 22·7 | 16·4 | 18·2 |
| Levies | 4·6 | 7·2 | 7·4 | 3·7 | 5·5 |
| Agistment | .. | .. | .. | .. | 1·3 |
| Sundries | 1·0 | .. | 1·3 | .. | 1·2 |
| Total variable costs | 130·8 | 84·2 | 149·1 | 72·2 | 106·9 |
| Variable costs as % of milk income | 48·6% | 31·4% | 53·1% | 29·2% | 41·8% |
| Feed and Fertilizer as % of milk income | 14·6% | 10·1% | 21·0% | 8·0% | 16·6% |
| Cattle sales, $ | 4 366 | 1 124 | 7 453 | 3 518 | 3 471 |
| Total production Litres | 143 383 | 138 062 | 146 206 | 321 033 | 182 774 |
| Butterfat | 5 733 | 5 777 | 5 344 | 14 493 | 7 960 |
| Average test % | 3·88% | 4·06% | 3·55% | 4·38% | 4·23% |
| % Supplied as market milk | 24·4% | 23·4% | 23·6% | 22·6% | .. |
| Average number of cows | 52 | 44 | 71 | 73 | 59 |
| Maximum number of cows | 59 | 49 | 90 | 93 | 74 |
| Production average/cow, L | 2 757 | 3 137 | 2 103 | 4 398 | 3 162 |
| *Gross return, average cow | $296 | $352 | $211 | $492 | $351 |

* Included deferred and winter pays, excludes cattle sales.

farms are shown in tables 1 and 2 respectively. There is considerable benefit gained by comparing quarterly reports and annual reports for the year against similar quarterly and annual periods of the preceding year and against budgeted future figures.

## Output

At the close of the financial year, four output sheets are printed. These are:

- Income and expenses sheet showing the amount earned and spent each 6 months and total yearly figures.
- Variable production costs for dryland farms.
- Variable production costs for irrigated farms.
- A production sheet showing yield per cow per day.

From the variable production cost sheets, each farmer knows his return and the amount spent on variable items per litre of milk or kilogram of butterfat. Total variable costs and feed and fertilizer costs are also calculated on a percentage basis to allow further comparison.

## Interpretation of information

Because the financial cash-flow information is prepared quickly, farmers can identify problems and make decisions to alleviate or take advantage of the situation.

Guidelines for interpretation of the information have now been established, as follows:

- Feed and fertilizer costs should not exceed 25% of gross milk income.
- Dairy requisites should not exceed $60 per milking unit.
- Total variable costs should not exceed 50% of gross milk income.
- Production for single family farms should approximate 220 000 L of milk or 9 500 kg of butterfat.
- Expenditure on health or veterinary requisites will indicate the level of mastitis, parasite control, etc.
- The amount spent on herd improvement will indicate the likely genetic progress that may be possible.
- Casual labour costs will be evaluated and farmers will be made aware of the trade-off between money spent this way compared with loan repayment on a capital item. A $6 000 wage bill could be used to repay a $36 000 capital works loan.

**TABLE 2**

AN EXTRACT FROM D.A.S.—IRRIGATED FARMS ANNUAL SUMMARY 1978/79

| Item | 10 | 15 | 4 | 13 | District Average |
|---|---|---|---|---|---|
| *Return: cents/L | 10·99 | 11·21 | 10·86 | 11·71 | 11·23 |
| *Return: $/kg B.F. | $2.49 | $2.62 | $2.57 | $2.46 | $2.56 |
| Costs: cents/kg B.F. | | | | | |
| Feed | 34·1 | 55·6 | 4·8 | 52·2 | 35·9 |
| Fertilizer | 13·3 | 7·2 | 24·7 | 7·1 | 14·0 |
| Harvesting and casual labour | 2·7 | .. | .. | .. | 0·7 |
| Seed | 4·1 | 1·9 | 11·4 | 9·5 | 7·1 |
| Chemicals | 0·5 | 2·0 | .. | 0·1 | 1·1 |
| Fuel | 6·4 | 20·0 | 10·2 | 6·8 | 11·5 |
| Electricity | 14·0 | 7·3 | 4·3 | 6·8 | 8·0 |
| Water | .. | 7·2 | 4·4 | .. | 2·4 |
| H.R. and A.I. | 0·8 | 3·3 | 3·2 | 3·6 | 2·5 |
| Dairy requisites | 3·2 | 6·1 | 5·0 | 3·1 | 3·8 |
| Health | 4·1 | 10·1 | 2·2 | 3·5 | 4·9 |
| Cartage | 17·3 | 20·1 | 18·0 | 16·7 | 18·2 |
| Levies | 6·9 | 6·2 | 3·0 | 7·1 | 5·8 |
| Agistment | 2·5 | .. | .. | .. | 0·4 |
| Sundries | .. | 3·3 | 0·1 | 1·1 | 0·9 |
| Total variable costs | 109·9 | 150·3 | 91·3 | 117·6 | 117·2 |
| Variable costs as % of milk income | 44·1% | 57·4% | 35·5% | 47·8% | 45·8% |
| Feed and fertilizer as % of milk income | 19·0% | 23·9% | 11·5% | 23·5% | 19·5% |
| Cattle sales, $ | 2 688 | 8 870 | 9 109 | 3 050 | 5 044 |
| Total production Litres | 234 293 | 341 662 | 429 443 | 250 173 | 276 949 |
| Total production Butterfat | 10 344 | 14 612 | 18 107 | 11 919 | 12 105 |
| Average test % | 4·29% | 4·15% | 4·09% | 4·63% | 4·24% |
| % Supplied as market milk | 22·7% | 23·1% | 23·1% | 24·1% | .. |
| Average number of cows | 63 | 91 | 112 | 76 | 76 |
| Maximum number of cows | 74 | 105 | 149 | 84 | 91 |
| Production average/cow, L | 3 719 | 3 755 | 3 834 | 3 292 | 3 667 |
| *Gross return, average cow | $409 | $421 | $416 | $386 | $411 |

* Includes deferred and winter pay, excludes cattle sales.

Comparisons can be made between farms and with the average figure. The range of costs is also indicated. Significant fluctuations are highlighted.

### Other uses

Although there are limits to comparisons between districts, the scheme has enabled comparison of factory policies on levies, cartage rates and pricing. It has also provided useful information for industry authorities.

Information from the scheme is extremely useful when compiling cash flow budget sheets for loan application.

Annual results and trends are discussed at discussion group meetings. Non-accounting group members are also invited to participate in analysing trends. Consequently, changes have been evident even on non-accounting group member farms.

### Conclusion

The D.A.S. was a most valuable innovation benefiting farmers, dairy officers and others associated with the industry. It offers a form of record keeping not previously available to dairymen. In the past, the only accounting system available was taxation or financial accounting. This scheme compiles financial information for use in every day farm decision making.

# Age classification of beef cattle

*by K. Maynard, Slaughtering and Meat Inspection Branch*

LIVESTOCK have traditionally been aged by noting the number and type of teeth cut. For finer definition, the degree of wear to the teeth should also be considered.

Although not a truly objective measurement of age, it is generally regarded as the most practical means available.

Carcasses can likewise be allocated on approximate age by examination of teeth at slaughter.

Beef carcass classification calls for carcasses to be placed in groups, or dentition categories, based on the number of permanent incisors erupted (that is, zero, two, four, six or eight).

Two, four and six tooth categories are easy to define, but experience has shown that mistakes can be made in selecting the zero and eight categories.

It is obviously very important not to confuse yearling carcasses (zero), with mature or aged carcasses (eight).

To help overcome problems in that area, this article and the colour photographs will be available to people involved in classification.

### Structure and arrangement of teeth

A tooth has two parts—the crown which is the exposed portion, and the root which is imbedded in the gum and jaw socket. The junction of the crown and root is called the neck and is often marked by a distinct constriction.

Each tooth is made up of four tissues (plate 16).

These are:

- The pulp—a soft tissue well supplied with blood and nerves. It occupies the pulp cavity in the centre of the tooth.
- Dentine—a hard, yellowish-white substance covering the pulp. This makes up the bulk of most teeth.
- Enamel—a hard, bluish-white substance covering the dentine of the crown.
- The cement—covers the dentine of the root and can be seen as dark markings on the sides and between the folds of the "cheek teeth".

Teeth are divided into three groups:

- Incisors, the biting teeth. They are located in the anterior parts of the jaws. Ruminants have incisors in the lower jaw only, their counterpart in the upper jaw is a hard dental pad.

They are not firmly imbedded in their sockets, the considerable movement thus permitted minimizes damage to the dental pad.

- Canines. These are absent in ruminants but are obvious as tusks in mature pigs.
- Cheek teeth. This is the common name for molars and pre-molars. These are situated in the maxillae (upper jaws) and the rami of the mandible or lower jaw. Cheek teeth are extruded from their sockets to compensate for wear caused by their grinding action.

The adult ox has a total of 32 teeth. Their distribution is expressed in the following formula:

$$2 \times \left(\frac{0}{4} I - \frac{0}{0} C - \frac{3}{3} P - \frac{3}{3} M\right) = 32$$

The top line represents one side of the upper jaw, the bottom line one side of the lower jaw. The letters stand for I = incisors, C = canines, P = pre-molars and M = molars.

Incisors and pre-molars are preceded by deciduous teeth commonly known as temporary or milk teeth. The formula for the deciduous teeth is:

$$2 \times \left(\frac{0}{4} DI - \frac{0}{0} DC - \frac{3}{3} DP\right) = 20$$

They erupt prior to or within a couple of weeks of birth.

Dentition categories are usually determined by examination of incisors and the appearance of individual teeth, whether deciduous or permanent, is similar.

Viewed from the front, they are broad and shovel-shaped although the temporaries have a pronounced outward curve. Permanents tend to be more straight-sided. Temporaries also have a smooth, lustrous surface giving them a pearly appearance. Permanents are larger, lack lustre and develop vertical grooves called striations (plates 1 and 2).

Both sets are arranged in a similar fashion, fanning out from the centre line.

When viewed from above, temporaries display a distinct spacing. Permanents, because they are much larger and occupy a not very much larger area, are crowded and tend to overlap (plates 3 and 4).

Even in well worn specimens, temporaries usually appear to be more widely spaced than permanents (plates 5 and 6, 7 and 8).

Unlike cheek teeth, incisors are not extruded from the gums to compensate for wear. In the normal course of events, the deciduous members are shed as the corresponding pair of permanents erupt.

Examples will frequently be seen where the necks of permanent incisors are exposed. This is due to shrinkage of the gums rather than extrusion of the teeth. Necks of permanents are thicker than temporaries (plate 15).

Sometimes incisors are missing as a result of injury and often due to old age. However, it would be unusual to see more than one or two missing because of injury. In cases where only a few well worn remnants are left it can be assumed that the animal is old (plate 14).

Times at which teeth erupt vary between species and also within species. Breed and nutrition have an effect on how early or late teeth are cut.

# Age classification

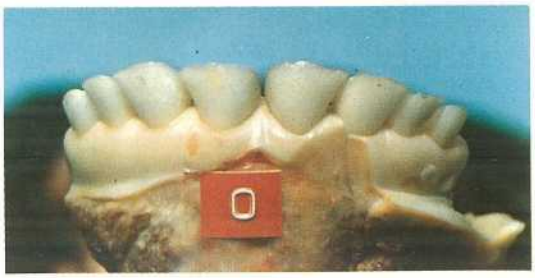



Plate 1. Category zero—deciduous incisors, temporary or milk teeth. Smooth and lustrous (pearly). Small, shovel-shaped but with a pronounced outward curve.

Plate 2. Category eight—permanent incisors. Large, shovel-shaped, straight-sided. Lacking pronounced outward curve of temporary. Lack lustre, vertically grooved (striated).

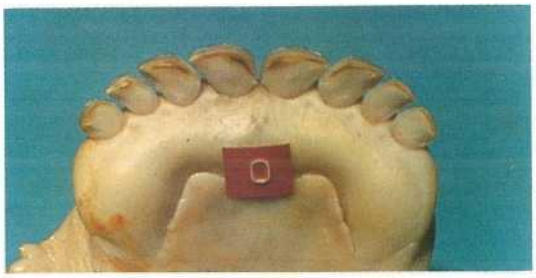



Plate 3. Category zero—dorsal view. Outward curve more apparent. Distinct spaces between teeth.

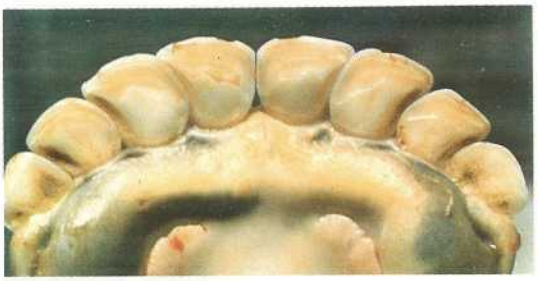


Plate 4. Category eight—dorsal view. Teeth obviously larger than temporaries, crowded, no spaces between teeth, overlap creating fan-like effect.

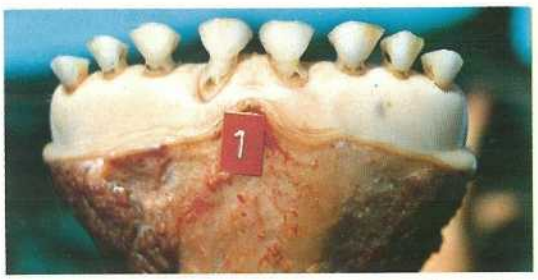



Plate 5. Category zero—crowns well worn but still pearly. Permanents growing in gums are forcing temporaries up, exposing necks. The central pair will soon be shed. Note the pronounced constrictions between crowns and roots (necks).

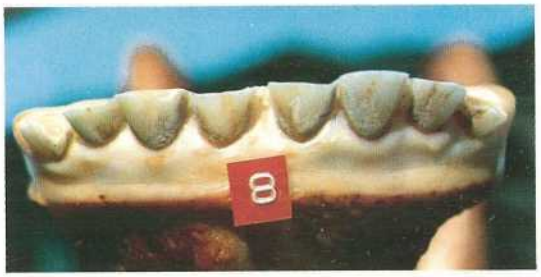



Plate 6. Category eight—crowns well worn but still set deep in gum. They are not extruded to compensate for wear as are the cheek teeth.


Plate 7. Category zero—the dorsal view shows very pronounced spacing.


Plate 8. Category eight—dorsal view. There is much less space between these compared to temporaries with a similar degree of wear.

# of beef cattle

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

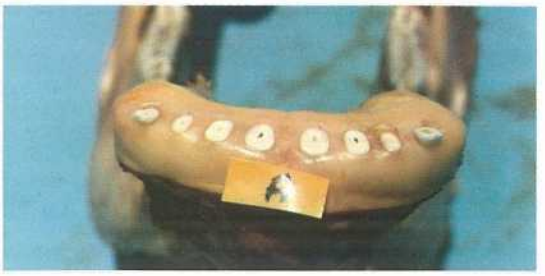


Plate 9. Category zero—temporaries flush with gums due to excessive wear. Remnants usually still white and gums full. This can easily be confused with category eight with a similar degree of wear.

Plate 10. Category eight—permanents flush with gums. This is due to excessive wear or many years of normal wear. Remnants are usually yellowish and gums lack the fullness of comparable zero categories.

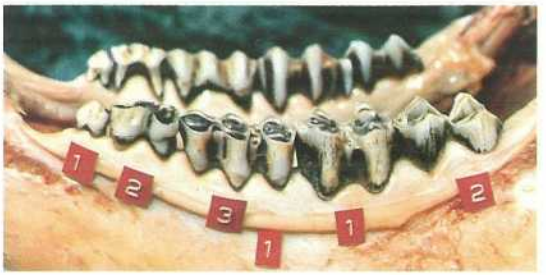



Plate 11. Category zero—five cheek teeth. From left: first, second and third deciduous pre-molars; first and second molars. Sixth cheek tooth not erupted (note the third deciduous pre-molar is tri-cuspid).


Plate 12. Category eight—six cheek teeth. From left: first, second and third pre-molars; first, second and third molars (note the third pre-molar is bi-cuspid).

Plate 13. Category four—large permanents contrast with remaining temporaries. Two and six tooth categories display a similar contrast.

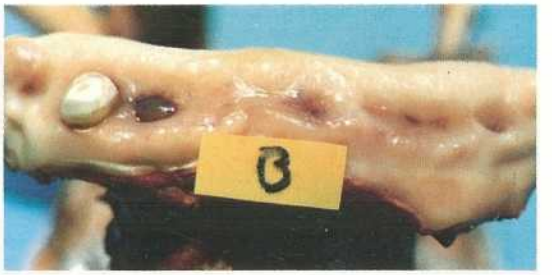



Plate 14. Category eight—all but one incisor shed due to extreme old age. Not likely to be confused with category zero. When temporaries are shed, gums are swollen by embryo permanents.

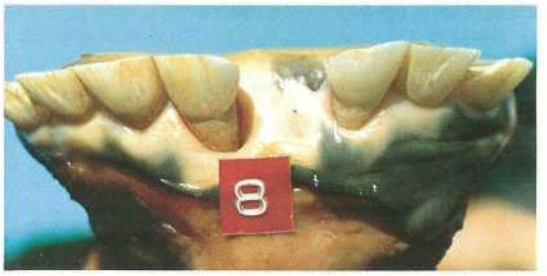



Plate 15. Category eight—permanent incisors, necks exposed, one lost. Note the necks are much thicker than the necks of temporaries. The necks are exposed because the gums are shrinking.

Plate 16. Longitudinal section of permanent incisors. Note the sharp angles on the biting surfaces. This is caused by wear. Also note the layer of enamel covering the dentine of the crowns. The pulp has been removed from the lower specimen exposing the cavity. The rule is calibrated in mm.

TABLE 1

THE OX

| Tooth | Temporary | Permanent |
|---|---|---|
| First incisor | birth to 3 weeks | 1½-2 years |
| Second incisor | birth to 3 weeks | 2-2½ years |
| Third incisor | birth to 3 weeks | 3 years |
| Fourth incisor | birth to 3 weeks | 3½-4 years |
| First pre-molar | birth to 3 weeks | 2-2½ years |
| Second pre-molar | birth to a few days | 1½-2½ years |
| Third pre-molar | birth to a few days | 2½-3 years |
| First molar | | 5-6 months |
| Second molar | | 1-1½ years |
| Third molar | | 2-2½ years |

Table 1 is commonly quoted in textbooks. This table is based on British breeds on a high level of nutrition. It may also apply to British breeds on similar rations in parts of Australia.

Experiments carried out by the D.P.I. at Swans Lagoon and Brian Pastures Research Stations indicate that the permanent incisors and presumably cheek teeth of Queensland cattle on native pastures erupt at much later times.

The information prepared from data collected in those experiments is shown in table 2.

TABLE 2

| Permanent incisors | Range | Average Age |
|---|---|---|
| First pair | 22-30 months | 26 months |
| Second pair | 27-40 months | 33 months |
| Third pair | 33-48 months | 40 months |
| Fourth pair | 40-60 months | 50 months |

This emphasizes even more dramatically that the dentition category is only an approximation of age.

Usually, when allocating a dentition category, only the incisors need be examined.

The contrast between the large permanent incisors and the small remaining temporaries easily identifies the two, four and six tooth categories (plate 13).

It is also relatively easy to tell the difference between a full set of temporary incisors and a full set of permanents by noting the size, shape, spacing and smoothness of the teeth.

It is not so easy when incisors are worn flush with the gums. This condition is common in both young and aged animals (plates 9 and 10).

It may be due to many years of normal wear or a relatively short period of abnormal wear such as could occur from grazing on sandy soils.

Experienced people still may be able to tell the difference by appraisal of the carcass but this may not always be possible or convenient.

To maintain objectivity in such cases, it is necessary to examine the cheek teeth.

Reference to table 1 shows that the first pair of permanent incisors erupt at from 1½ to 2 years. The second pair erupt at from 2 to 2½ years. The third molar (sixth cheek tooth) also erupts at from 2 to 2½ years (plate 12).

Therefore, in cases where incisors are worn flush with the gums, the presence of the sixth cheek tooth places the carcass in category eight. Its absence indicates the yearling category zero.

Examination of the molar teeth is impracticable unless cheeks and/or tongue have been removed. If age has to be assessed before that time, a more accessible reference is the third cheek tooth (plate 11).

The third temporary pre-molar (Dp3) is a three-pointed tooth (tri-cuspid). Its permanent replacement (P3) is a double tooth (bi-cuspid).

The table shows that P3 erupts at from 2½-3 years even later than M3 and at about the same time as the third pair of permanent incisors.

Estimating the age of a carcass by its teeth is obviously not an exact science, but a carcass can be placed in a precise category according to its dentition status.

Tables 1 and 2 show that there is a wide variance in times that teeth are cut. Those times are influenced not only by age but by nutrition, breed, sex, locality and even individual trait.

The scope for error in trying to attribute an exact age to a carcass by its teeth is therefore quite broad.

There should be no increase in the breadth of that scope by mistakes in allocation of categories.

# The Baueras of South-eastern Queensland

*by Beryl A. Lebler, formerly of Botany Branch*

IN 1793, Sir Joseph Banks gave the generic name *Bauera* to a new plant he had discovered in New South Wales.

In doing this, he honoured Francis and Ferdinand Bauer, two excellent botanical artists of that period.

Only three species of Bauera are known and all are shrubs with thin, wiry branches and opposite leaves. Since the leaves are sessile and each is divided almost to the base into three leaflets, at first glance the leaves appear to be in whorls of six. The flowers are either sessile, or on long, slender pedicels.

Individual flowers have four to six sepals, as many petals as sepals, and usually twice as many stamens. These surround the ovary which contains two cells. The fruit is a capsule which splits into two valves. Because the flowers are open and shallow with white to deep pink petals and yellow centres, they resemble the dog rose which was so common in the lanes of England. The common name dog rose is sometimes applied to these plants. The genus is found only in Australia and two species grow in South-eastern Queensland. These are: *Bauera capitata* and *B. rubioides.*


*Bauera capitata*

## *Bauera capitata*

The specific epithet is a Latin word meaning growing in a dense head. It describes the terminal inflorescence.

DESCRIPTION: This is a small subshrub which can reach a height of 1·5 m. Usually, it has a woody stock which produces numerous, wiry stems. These are often crowded together into clumps. Some are unbranched but often there is a cluster of lateral branches towards the top of the stem.

Magnification shows a sprinkling of spreading, short, white hairs on the stems. The leaves spread widely from the stems. They are sessile, about 0·7 cm long and are deeply divided into three lobes. The outer lobes are 0·2 cm wide, with a prominent blunt tooth about half-way up the outer edge. On some leaves, a similar tooth is also found on both margins of the central lobe. On the lower parts of the stem, the leaves are about 1 cm apart but towards the ends of the branches they are much closer together.

The flowers are purple-pink and are sessile or almost so in the axils of the terminal leaves. They are so close together that the crowded flowers appear to be in little leafy heads of up to four flowers. Four to six pale green sepals form the calyx and they are united at the base. Like some of the leaves, each sepal has a tooth about half-way along the margin. The sepals are about 0·5 cm long and 0·3 cm wide.

There are as many petals as there are sepals. They are rounded at the tip and narrowed to the base, about 0.7 cm long and 0.3 cm wide and are widely separated from each other. A ring of erect stamens with filaments the same colour as the petals and small, yellow anthers surround the ovary. There are usually twice as many stamens as petals. Two free styles curve out through the anthers, one to either side of the flower.

FLOWERING TIME: This plant flowers spasmodically throughout the year with the main flush in spring time.

HABITAT: This dog rose grows on the coastal sand plains in peaty sand, in open forest and in wallum swamps and heaths.

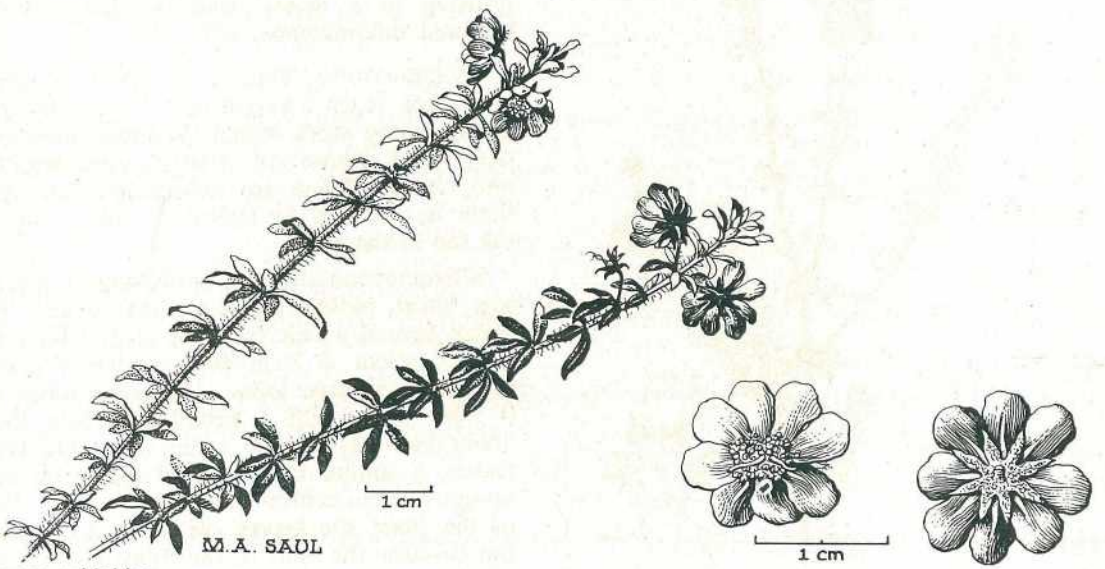
DISTRIBUTION: It is found only in New South Wales and Queensland, from as far south as Port Jackson to as far north as Fraser Island offshore and at Tuan, south of Maryborough on the mainland.

GENERAL REMARKS: This is a very attractive small shrub but has not been brought into general cultivation.

## Wiry dog rose (*Bauera rubioides*)

This was the plant which Sir Joseph Banks named *Rubia tinctorum*. Madder is a European plant whose long, fleshy roots were used to produce a pigment. This native plant, particularly in the young stages of growth, resembles Madder and the specific epithet alludes to this resemblance.

DESCRIPTION: This is a dense, spreading shrub which has many ascending lateral branches and can reach a height of 1.5 m. Long, brown, spreading hairs cover the stems and are sprinkled over both surfaces of the leaves. Old stems are tough and wiry and on these, the leaves can be up to 2 cm long. Usually the leaves are much shorter. They are almost sessile and are divided to the base into three lanceolate leaflets with entire margins.




*Bauera rubioides*

Ascending twigs are arranged along the stems and from the axils of the leaves near the ends of the twigs the flowers develop. They are on slender, red pedicels which are usually much longer than the leaves. The flowers are held out well away from the stem and face downwards.

A variable number of narrow-pointed green sepals (usually seven or eight) spread out beneath the lavender-pink petals. These are rounded at the tip and much narrowed to the base. Many stamens with slender, white filaments and rounded yellow anthers surround the ovary. This is green and glabrous with two slender white styles curving upwards above the anthers.

FLOWERING TIME: Odd flowers can be found on this plant at most times of the year but the main flush of flowers occurs in spring to early summer.

HABITAT: In South-eastern Queensland, this plant can be found only on high rocky slopes growing among the dense shrubby understorey of open forests, in crevices or pockets of soil on exposed rocks. In other parts of Australia, it grows in damp coastal forests and in swampy heaths.

DISTRIBUTION: It has been found in South Australia on Kangaroo Island, in Tasmania and in all the eastern mainland states to as far north as the McPherson Range. In Queensland, it has been found only on Mt. Lindsay and Mt. Barney.

GENERAL REMARKS: This is a very attractive shrub which has been cultivated for many years. The plants begin to bloom when quite small and benefit from tip pruning.

### Field Key to the Baueras of South-Eastern Queensland

1. Flowers sessile. Leaflet margins with a few blunt teeth . . . . . *Bauera capitata*
2. Flowers on long, slender pedicils. Leaflet margins entire . . . . . *Bauera rubioides*

---

# Corrections

In the May–June 1980 issue (Vol. 106 No. 3) of the *Queensland Agricultural Journal*, the following sections were incorrect:

On page 236 under 'Picloram + MCPA' and 'CROP TOLERANCE' Linseed reads '840 note 10'.

This should read '840 note 12'.

On page 275 the section under 'Kite' reads 'PH grain quality classification only'.

This should read '1H grain quality classification only'.

# Pastures for the

The Mackay wet coast holds great potential for increasing cattle production (beef and dairy) by the use of improved pastures. Of the 400 000 ha potentially suitable for improvement, 60 000 has already been developed. When fully developed, this area could support 500 000 cattle.

THE Mackay wet coast is that area receiving greater than 1 150 mm annual rainfall and exceeds 1 000 000 ha. It stretches from Proserpine (20° 20'S) to Carmila (22°S) and inland to the coastal ranges. It includes the city of Mackay, the Shires of Proserpine, Pioneer, Mirani and Sarina, and portion of the Nebo and Broadsound Shires (see map 1).

The region is best known for its sugar and tourist industries, and provides support facilities for coal mining in the hinterland.

The region is also important for beef, dairying and pasture seed production. It currently carries 200 000 beef cattle, is self-sufficient in milk production, and produces around 15 000 kg of tropical pasture seed each year.

Of the total area of 1 000 000 ha, 100 000 ha are assigned to the growing of sugar-cane and 400 000 ha are considered suitable for tropical pasture development. The remaining land is unsuitable for development because it is too steep, is subject to flooding, or has been set aside as National Parks or timber and forestry reserves. When the potential pasture area is fully developed, it should carry in excess of 500 000 cattle.

The carrying capacity of the unimproved native pastures is low, ranging from one beast to 10 to 20 ha. Liveweight gains are also low due to the low quality of the pasture in all but the early wet season.

Following initial experimental work from 1960 to 1966 the area planted to tropical pasture species has increased to an estimated 60 000 ha in 1979, reaching a yearly peak of around 5 000 ha in 1974/75. Almost half of this development is by sugar-cane farmers with land surplus to cane requirements.

## Climate

The climate is monsoonal with a marked seasonal distribution. At Mackay, 80% of the mean annual rainfall (M.A.R.) of 1 672 mm occurs in the five summer months December to April (figure 1). There is a 90% probability of Mackay's annual rainfall exceeding 1 000 mm. The highest rainfall occurs at Dalrymple Heights with M.A.R. of 2 262 mm. M.A.R. for some other centres are Proserpine 1 803, Carmila 1 582 and Mirani 1 672.

# Mackay wet coast

*by H. G. Bishop and B. Walker, Agriculture Branch*

*Photographs above. Beef cattle grazing sown pastures on (above left) flat coastal plain country and (above) undulating hills.*

Mean monthly maximum temperature in Mackay exceeds 30°C in November, December and January. June, July and August are the coldest months at 11·5°C, 9·7°C and 12·0°C mean minimum temperatures respectively (figure 1). Temperatures on the tableland areas are generally 2°C cooler in November, December, January and February; 3°C cooler in September, October, March and April, and 4°C cooler in May, June, July and August.

Light to moderate frosts occur near the coast, becoming more frequent and severe further inland. Dalrymple Heights, with an elevation of around 1 000 m, receives more than 30 frosts in most years.

## Topography, soils and vegetation

The region can be basically divided into three classes of country. The highland area of the Clarke and Connors Ranges forms the western boundary, while the coastal plains between the highlands and the sea are interspersed with areas of undulating hills. The distribution of the various soil types is shown in map 2.

### Coastal plains

The areas of flat to gently undulating coastal plains occur predominantly to the south and west of Proserpine and to the south and west of Mackay. The altitude is generally less than 30 m with a few hills rising to 150 m. Mangrove swamps, tidal flats, large marine plains and sand dunes occur along parts of the coastline.

Duplex (texture contrast) soils are most common, occupying some 360 000 ha. Profile classes Dy3.41 and 3.42 (of the Northcote classification) dominate. They include podzolic and solodic soils with hard-setting sandy to loamy surfaces overlying mottled yellow clay sub-soils. They show mainly an acid reaction trend with depth although neutral and alkaline forms can be present.

Chemically, these soils are infertile—being low in phosphorus, potassium, sulphur and molybdenum. Physically, they also present problems for pasture development as surface and internal drainage is poor and much of the area is periodically waterlogged during the wet season. Other soils present in this zone include deep sands, heavy clays, and saline clays of tidal flats along the coastal fringe.

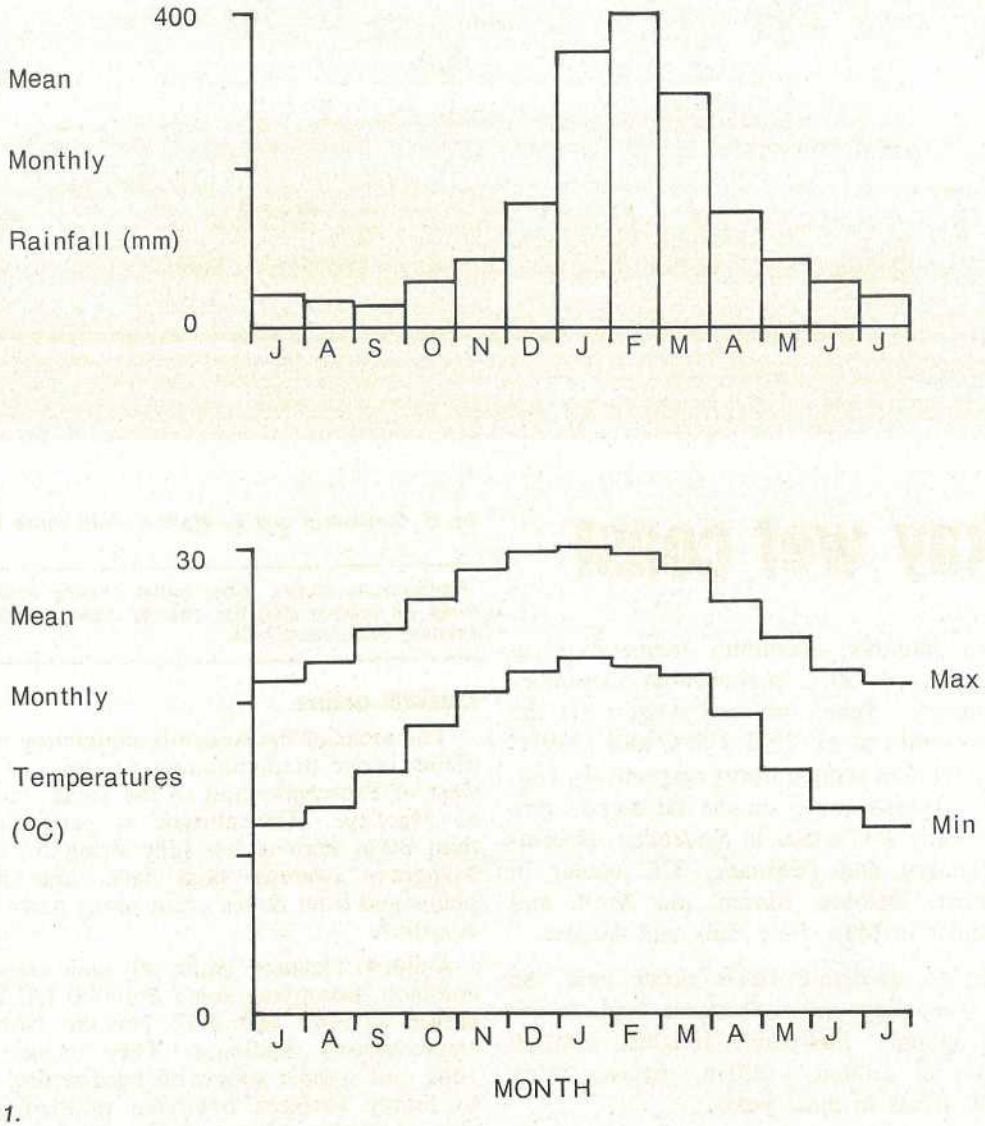



*Figure 1.*

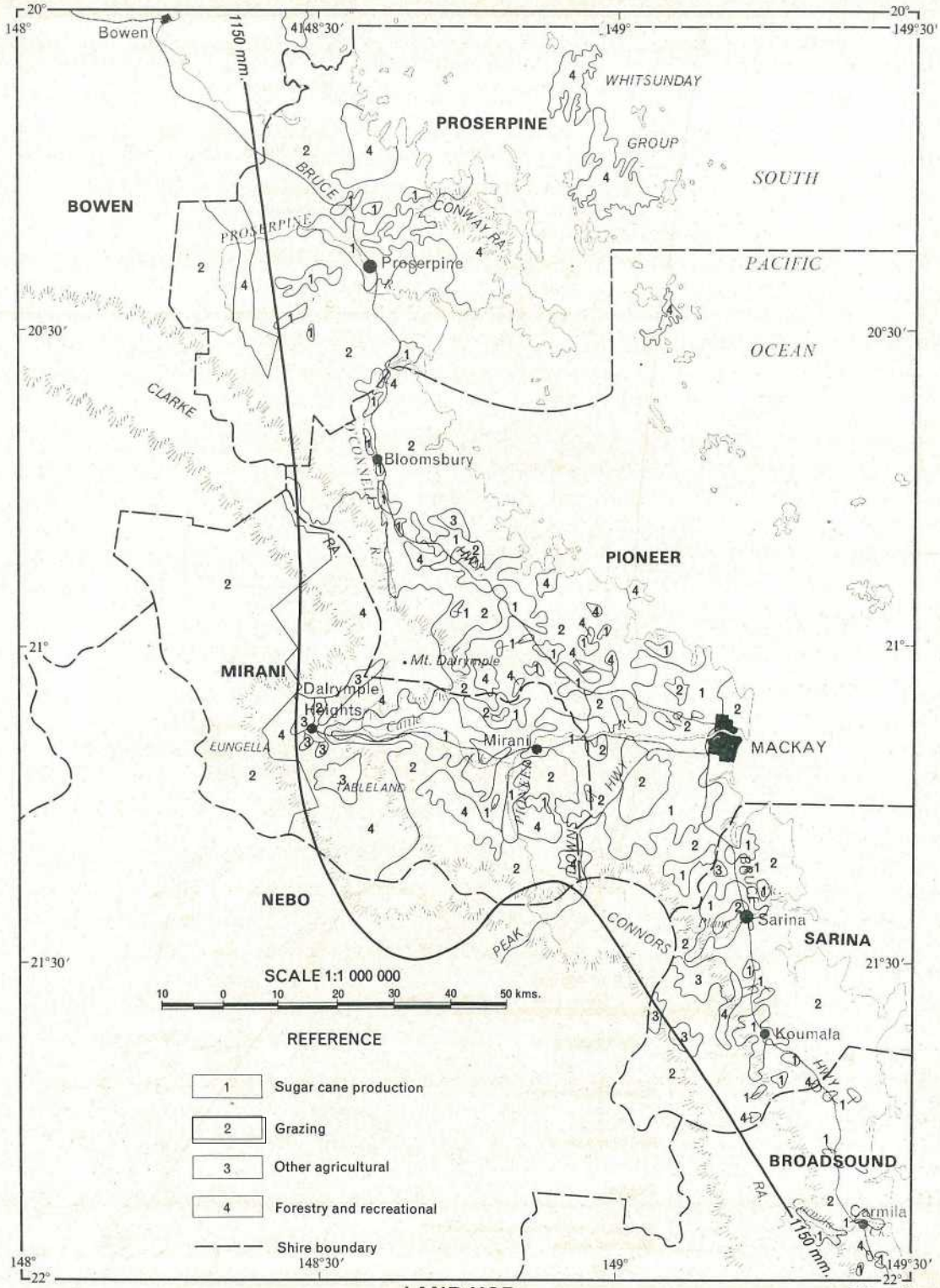
The vegetation is low woodland of paperbark tea-tree (*Melaleuca viridiflora*), pink bloodwood (*Eucalyptus intermedia*), poplar gum (*Eucalyptus alba*), swamp mahogany (*Tristainia suaveolens*) and wattle (*Acacia leptocarpa*). Grass tree (*Xanthorrhoea johnsonii*) may be prominent in localized areas.

The ground cover consists of kangaroo grass (*Themeda australis*), blady grass (*Imperata cylindrica* var. *major*), and giant spear grass (*Heteropogon triticeus*).

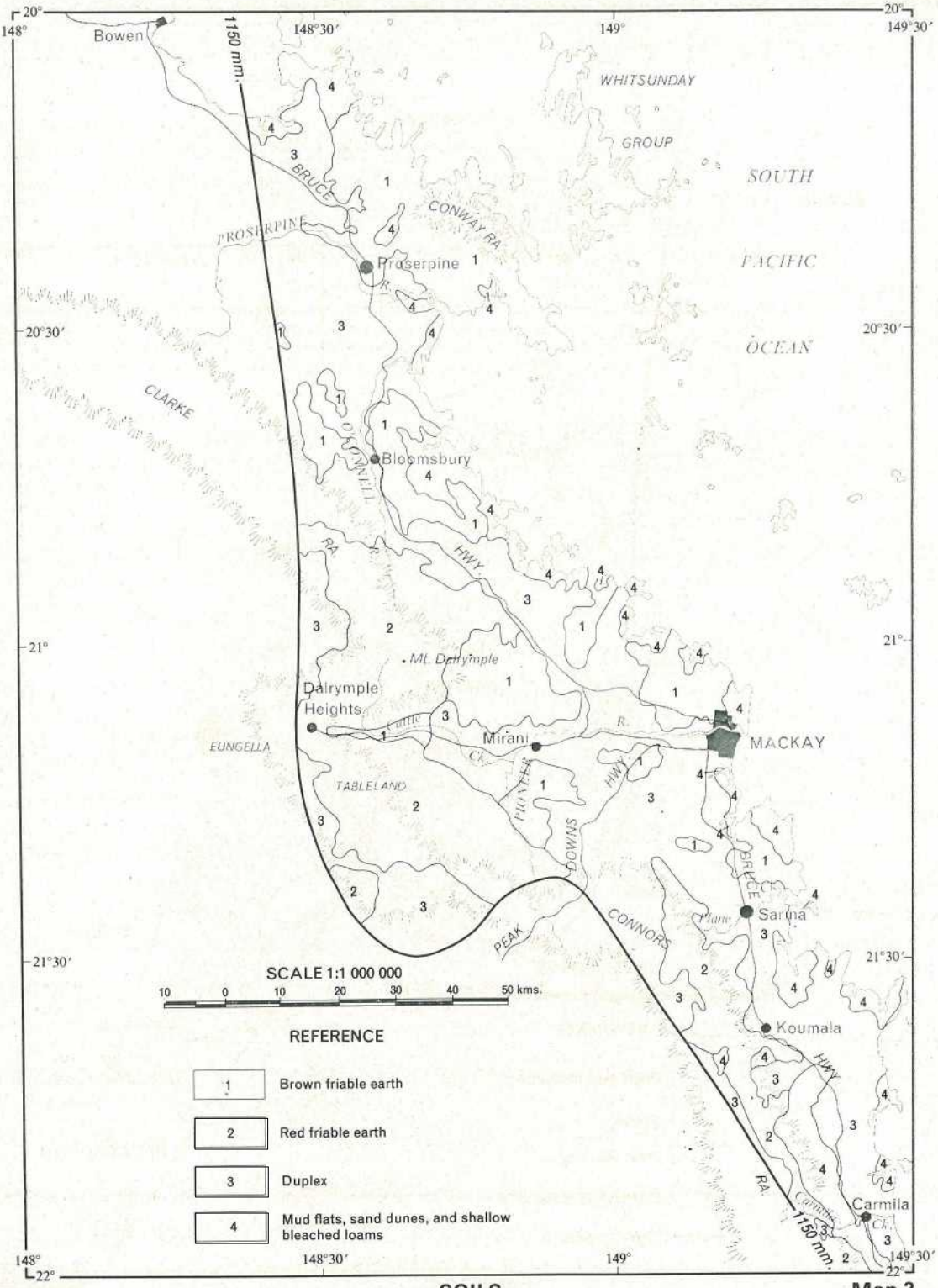
## Undulating hills

Mainly to the north of Mackay and along the eastern slopes of the ranges the land is more hilly, but quite large areas of flat to gently undulating country occur. Hills may be steep but peaks are generally less than 600 m high.

Brown or dark friable earths are the major soils and occupy about 200 000 ha. Loamy brown friable earth soils (Gn3.24) are most common but other friable earths are closely associated. In addition, approximately




**LAND USE** **Map 1**


20°
148°
Bowen
1150 mm.
148°30′
149°
149°30′
WHITSUNDAY
GROUP
SOUTH
PACIFIC
OCEAN
BRUCE
CONWAY RA.
PROSERPINE
Proserpine
20°30′
CLARKE
OVERFLOW
Bloomsbury
RA.
HWY.
21°
Mt. Dalrymple
Dalrymple Heights
Mirani
MACKAY
EUNGELLA
TABLELAND
PLATEAU
HWY.
DOWNS
BRUCE
Sarina
PEAK
CONNORS
21°30′
Koumala
HWY.
RA.
Carmila
SCALE 1:1 000 000
10 0 10 20 30 40 50 kms.
REFERENCE
1 Brown friable earth
2 Red friable earth
3 Duplex
4 Mud flats, sand dunes, and shallow bleached loams
22°

**SOILS** **Map 2**

100 000 ha of loamy duplex soils (Dy3.42) occur in the lower slopes, and minor areas of dark crackling clays (Ug5.13) occur in the bottom of valleys.

The friable earths have an acid reaction trend with depth and are chemically infertile, being low in P, S and Mo. However, physical properties are good and these soils are ideal for pasture development, although much of the less hilly area is planted to sugar-cane. On steeper slopes or hills, skeletal (stony) soils occur which are only suitable for development by aerial seeding.

The friable earths carry open-forests of Moreton Bay ash (*Eucalyptus tessellaris*), blue gum (*E. tereticornis*), poplar gum and swamp mahogany. Other species include narrow-leaved ironbark (*E. drepanophylla*), stringybark (*E. acmenoides*) and pink bloodwood. Higher hills west of Mackay carry open forests of bloodwood and stringybark.

In some areas, grass tree and zamia (*Cycas media*) may form a prominent understorey. The ground flora is dominated by blady grass and kangaroo grass. Sheltered valley sites on some of the hills and ranges close to the coast carry small areas of vine-forest.

On the shallow duplex soils, the dominant vegetation varies from open-forest to woodland of swamp mahogany, bloodwood, poplar gum, Moreton Bay ash and narrow-leaved ironbark, with ground flora similar to that of the friable earths but having areas of black spear grass (*Heteropogon contortus*).

### Highland areas

These are the headwaters of the small, swift-flowing coastal streams. Average elevation is around 600 m with peaks to over 1 200 m. Mt. Dalrymple on the Clarke range is the highest at 1 300 m.

Sandy to loamy red friable earths (Gn 3.41) with an acid reaction trend occupy 200 000 ha and occur on the Eungella Tableland and Clarke Range. They are inherently fertile and have good physical properties, but deficiencies of P, K and Mo occur. Most of the dairy farms are on this soil, but the greater part of the area is occupied by National Parks and Timber and Forestry Reserves. Associated soils include brown friable earths, sandy to loamy duplex soils and stony shallow loams.

These soils carry mainly closed vine-forest, commonly known as rain-forest. Much of the area also carries woodland of blue gum, sugar gum (*Eucalyptus grandis*), narrow-leaved ironbark and bloodwood. Cleared areas revert to mat grass (*Axonopus affinis*) if fertility is allowed to run down.

## Pasture species

A range of well-adapted legumes and grasses is available which allows a choice for different property development situations and requirements. The main characteristics, suitability and recommendations for sixteen tropical grasses, eighteen tropical legumes, one temperate grass and one temperate legume are now summarized. Of these species Kazungula setaria, Rodd's Bay plicatulum, pangola and siratro are the most widely sown, occurring in 80-90% of pasture plantings on the Mackay wet coast.

### Grasses

#### Setaria (*Setaria sphacelata* var. *sericea* (formerly *S. anceps*)) cvv. Kazungula, Nandi, Narok

Kazungula setaria is the most common grass planted in the region. It establishes readily, has good vigour, is a prolific seeder, tolerates very wet conditions and recovers readily from heavy grazing. As it tolerates cold temperatures better than most tropical grasses, it has a long growing season and in pure stands responds well to autumn and spring applications of nitrogen.

Kazungula is a tall (up to 2 m), vigorous, tufted cultivar. If ungrazed during the summer it tends to lodge after seeding in early February and a new flush of tillers grows up through the prostrate stems and seeds again in late March. If lightly stocked, large amounts of litter accumulate on the ground and in time may hinder legume seedling emergence.

For best animal performance, Kazungula needs continuous stocking to avoid rank growth and excessive litter accumulation. With correct management of stocking rate, compatibility with legumes can be achieved.

*Clearing the coastal plain of low woodland vegetation dominated by paperbark tea-tree* (Melaleuca viridiflora).

Nandi lacks vigour and persistence on the poorer sandy soils of the coastal plains but has performed satisfactorily in dairy pastures on the better soils of the Tableland areas. However, the Narok cultivar is now recommended in these areas due to its better cold tolerance and longer growing season. Low seed production in Narok can limit its spread if initial establishment is poor.

The three cultivars have high oxalate contents but no problems have been experienced in the Mackay area by grazing cattle. However, horses have been known to develop Big-Head Disease in the Mackay area on pure stands of setaria, and ground limestone should be fed regularly in these circumstances.

### Plicatulum (*Paspalum plicatulum*) cvv. Rodd's Bay and Bryan

Rodd's Bay plicatulum establishes easily and although it can thrive on wet soils of low fertility, it responds well to improved fertility. This grass combines satisfactorily with legumes and withstands heavy grazing. It is a tufted, summer-growing perennial (up to 1·2 m tall) and seeds later (in late April) than most other tropical grasses. Being a prolific seeder, seed is generally cheap compared to other tropical grasses.

Some graziers claim low acceptability to stock, but this occurs only when small areas are grazed in association with more palatable species such as guinea grass or setaria.

The more recently released cultivar Bryan is reported to be more palatable than Rodd's Bay but has not been grown to any extent in central Queensland.

### Pangola grass (*Digitaria decumbens*)

Pangola grass is planted vegetatively from cuttings as no vialable seed is set. It grows into a thick mat up to 0·5 m tall, is capable of extremely heavy stocking rates, is very

*This pangola grass area (close to cattle yards) is used as an intensive/special purpose pasture for weaners.*

palatable and responds well to nitrogen fertilizer and irrigation. However, growth is restricted by cold weather and in intensive systems in cold areas other sources of winter forage will be required.

Pangola grass is grown almost entirely in pure stands with the addition of fertilizer nitrogen. With the exception of hetero (*Desmodium heterophyllum*), legumes do not persist with it. In central Queensland, growth is not adversely affected by rust (*Puccinia oahuensis*) or aphids (*Schizaphis* sp.) which have reduced productivity on the north Queensland wet coast.

### Signal grass (*Brachiaria decumbens*) cv. Basilisk

Signal grass is a vigorous grass which, like pangola, responds well to nitrogen. It grows up to 1·5 m tall and becomes rank if ungrazed. Consequently, heavy stocking is essential to maintain a leafy pasture and best utilize applied nitrogen. It is frost sensitive and susceptible to waterlogging, and is not as popular as pangola as an intensive-use pasture on the Mackay wet coast.

With correct stocking rates, compatibility with legumes is satisfactory in the initial years of a pasture, and a considerable area of signal grass/legume pastures has been planted over the past few years. Export demand for seed of this species has also encouraged its planting. Seed for sowing should be at least 6-months-old. Fresh seed can be very dormant and has to be acid-scarified (10 to 15 minutes in concentrated sulphuric acid) to give good establishment.

### Guinea grasses (*Panicum maximum*) common and cvv. Riversdale and Hamil, and green panic (*P. maximum* var. *trichoglume*) cv. Petrie

Common guinea is naturalized on many of the better-drained soils around the Mackay district. It combines well with legumes and, of the tropical grasses, it is regarded as the best fattening grass in the area. However, it will not persist under heavy grazing. Until recently, good quality commercial seed was not available but common guinea and the cultivar Riversdale are now being used in limited plantings.

The taller-growing cultivar (2 m plus) Hamil is also used successfully in limited plantings. It is adapted to a wider range of soil types and will tolerate short term waterlogging. However, it may grow tall and rank if not heavily utilized over the summer. There is some reluctance to plant the guinea grasses in areas suitable for future cane growing as common guinea is a problem weed in cane.

Green panic lacks vigour in the wet coastal areas but can be included in seed mixtures on the Eungella Tableland. It provides quick feed in the establishment year but normally lacks persistence.

### Kikuyu (*Pennisetum clandestinum*) cv. Whittet

Kikuyu is a low growing (to 0·5 m) prostrate grass, best suited to the more fertile scrub soils of the Tableland. Naturalized common kikuyu is an important grass on dairy farms. It often occurs in run-down mat grass pastures and its dominance can be quickly achieved by applications of nitrogen fertilizer. Kikuyu will also combine well with white and Safari clovers, once nutritional deficiencies are corrected.

More recently, the planting of seed of the Whittet cultivar has become popular, giving quicker establishment than runners. Although susceptible to heavy frosts, the use of nitrogen in autumn and spring extends the growing season of kikuyu, thus reducing the winter feed gap evident with most tropical grasses.

### Para grass (*Brachiaria mutica*)

Para grass is a vigorous stoloniferous species suited to swampy or excessively waterlogged areas. Although seed is sometimes available, runners are commonly planted, either by pressing into the soil around the edges of swamps or by spreading over the ground and covering with a disc plough. It responds well to nitrogen fertilizer and a bulk of nutritious feed is produced during the summer which can be stood over for winter grazing.

### Urochloa (*Urochloa mosambicensis*) cv. Nixon

Nixon is a perennial summer-growing grass which has naturalized in areas of north Queensland and the Northern Territory where it was sown extensively as a companion species with Townsville stylo. An erect, branching grass, it grows to 1 m tall, is quite palatable to stock, withstands close grazing but will not tolerate waterlogging.

Limited plantings on the wet coast with Townsville stylo in low-input development have been successful. However, because of its prolific seeding habit and response to improved fertility it could become a weed of cane headlands.

### Elephant grass (*Pennisetum purpureum*) cv. Capricorn

Capricorn elephant grass is a vigorous cane-like grass capable of very high yields of palatable and nutritious forage over the summer months when planted as a special use pasture. It is best utilized by cutting and feeding in yards or, if grazed, by using a rotation system. Deep, fertile, well-drained soils are most suitable and large responses to nitrogen application can be obtained.

Common elephant grass has naturalized in areas of the wet coast. Unfortunately, it is often this material which is used for planting material rather than the leafier and more vigorous Capricorn cultivar.

### Angleton grass (*Dichanthium aristatum*)

Angleton grass is a summer-growing perennial which has become naturalized in many areas of coastal Queensland. It is best suited to heavy-textured soils and will spread by rooting from the nodes of tillers touching the ground. It grows less vigorously on lighter soils and in lower rainfall areas. Seed cannot be purchased commercially, but a property owner in the Bloomsbury area sells seed when it is available. This species probably has more potential on heavy soils in lower rainfall areas.

### Rhodes grass (*Chloris gayana*) cv. Callide

Callide Rhodes grass is a vigorous, erect-growing perennial grass which spreads by means of stolons. It is coarse in appearance but has good palatability. It flowers in April and remains green and leafy well into the autumn. Although susceptible to continued waterlogging, its ability to colonize and spread makes it a suitable grass for minimal cultivation situations on a range of soils.

### Ryegrass (*Lolium multiflorum*) cv. Grasslands Tama and (*L. (perenne x multiflorum) x perenne*) cv. Grasslands Ariki

The ryegrasses are annual or perennial cool season species valuable for producing winter and spring feed under very intensive systems with irrigation and high fertilizer inputs. Their main role is in filling this feed gap in dairy farms and thus maintaining milk quotas, but they can also be used for intensive beef and vealer production. By using the combination of a quick-growing annual (Tama) and a longer season perennial (Ariki) feed is provided over a much longer period than from grazing oats. However, high irrigation and fertilizer inputs (in particular nitrogen) have to be maintained.

## Legumes

### *Siratro* (*Macroptilium atropurpureum*) cv. Siratro

Siratro is a perennial twining legume which establishes readily, grows vigorously and is palatable to stock. It develops a large, woody tap-root and roots readily at the nodes, forming new individual plants. Siratro has the ability to contribute large amounts of nitrogen to the pasture. It grows best on well-drained soils and, although very adaptable to soils and conditions, it is sensitive to waterlogging. Where annual rainfall is above 1 500 mm, leaf drop from the fungal disease rhizoctonia (*Rhizoctonia solani*) is common during the wet season.

Siratro is frost sensitive but responds well in early summer when moisture becomes available. Siratro is very sensitive to overgrazing. Persistence of siratro pastures beyond 3 to 4 years is doubtful on the coastal plains but regeneration from seed, particularly after soil disturbance and resting, is good. On the better-drained soils siratro persistence is not a major problem.

### Stylo (*Stylosanthes guianensis*) cvv. Schofield, Endeavour, Cook and Graham

Schofield stylo was used extensively as a pioneer legume in pasture mixtures on the Mackay wet coast. In the 1978 summer, its growth was severely restricted by a new race (type B) of the fungal disease anthracnose (*Colletotrichum gloeosporioides*). Consequently, Schofield is no longer recommended for planting. Endeavour has never been sown widely but its use is now precluded by type B anthracnose. Cook was never as productive as Schofield in the Mackay area but it has a high tolerance to type B anthracnose. Graham was released in 1979 and due to its tolerance to type B anthracnose and superior growth and persistence to Cook, it is now recommended for planting on the Mackay wet coast.

Graham is an early-maturing, heavy-seeding perennial with a semi-prostrate growth habit reaching a height of up to 0·75 m. It is adaptable to a wide range of soils and will grow at lower soil phosphorus levels than most of the twining legumes. It shows better seedling regeneration and therefore persistence in pastures than the other cultivars. Top growth is sensitive to moderate frosts.

### Townsville stylo (*Stylosanthes humilis*)

Townsville stylo has played an important role in low input pasture development on the Mackay wet coast. As a low growing, heavy-seeding annual its role was over-seeding into native pasture with minimum seed-bed preparation. Type A anthracnose severely reduced its growth in the 1975 season and it is no longer recommended for planting. Some old Townsville stylo pastures showed a resurgence of growth in the 1979 and 1980 seasons. However, better species of stylo are now available for planting.

### Caribbean stylo (*S. hamata*) cv. Verano

Verano is an early-maturing, short-lived perennial stylo which can be planted wherever Townsville stylo previously grew. It acts as an annual in heavy frost areas and if allowed to grow to maturity without grazing.

Verano has a semi-erect branching habit and will grow to 0·75 m tall. Although it was released as suitable for areas with an annual rainfall of 500 to 1 270 mm, it grows well on the wet coast in areas receiving up to 1 700 mm, and under continuous grazing it has combined successfully in mixtures with sown grasses. A prolific seeder, Verano is an ideal pioneer legume for sowing with minimal cultivation, and will quickly improve its density after establishment.

### Shrubby stylo (*S. scabra*) cv. Seca

Seca is a tall (up to 2 m) shrubby perennial stylo, resistant to anthracnose, tolerant of low fertility soils and is very persistent. It is suitable for sowing with Verano stylo and should become a valuable species in low-input pasture development on the wet coast.

### Glycine (*Neonotonia* (formerly *Glycine*) *wightii*) cv. Tinaroo

Tinaroo grows well on the well-drained, fertile soils of the Mackay wet coast. It is a perennial climbing legume best suited to the low hills and areas of moderate relief. It lacks the seedling vigour of siratro but will tolerate colder conditions—growing into the winter and starting earlier in the spring.

### Centro (*Centrosema pubescens*) common and cv. Belalto

Centro is a perennial twining legume which was used extensively in early pasture mixtures on the Mackay wet coast but subsequently lost favour to siratro. However, some of these early plantings on the better-drained undulating country receiving in excess of 1 600 mm M.A.R. are still persisting where other legumes have failed. In these areas, centro persistence has been extremely good even under heavy grazing. Its cold tolerance is intermediate between Tinaroo glycine and siratro and spring growth commences earlier than siratro.

The cultivar Belalto has a higher cool season yield and persistence than common centro on the northern wet tropics. However, because of seed shortage, it has not been grown extensively on the Mackay wet coast.

### Desmodiums (*Desmodium intortum* cv. Greenleaf and *D. uncinatum* cv. Silverleaf)

Both Greenleaf and Silverleaf are summer-growing perennial twining legumes. They are used in dairy pastures on the Tableland where better-drained soils and cooler temperatures occur. They are slow in establishing but, if grazed leniently during the first season, runners will root down and produce a good cover. Persistence is quickly reduced by heavy grazing. Although sensitive to frosts, cold tolerance is better than most tropical legumes. Both cultivars have shown poor persistence on the coastal plains.

### Hetero (*Desmodium heterophyllum*) cv. Johnstone

Hetero is a perennial, prostrate and strongly stoloniferous legume which has only been recently tried on the Mackay wet coast, but has been very successful on the north Queensland wet coast. It is the only legume to combine successfully with pangola grass over a period of years.

Seed harvesting is very difficult and no commercial seed is available, all plantings to date being from vegetative material. Establishment and spread from planted runners is rapid, and early grazing aids establishment. Although quite specific in its rhizobium requirements, runners with a few roots usually carry the required rhizobium. It will tolerate cool temperatures but top growth is killed by moderate frosts.

### Phasey bean (*Macroptilium lathyroides*) cv. Murray

Phasey bean is an erect annual or short-lived perennial which has naturalized in very wet areas of the coastal lowlands where protected from grazing. It has a place in poorly-drained situations as a pioneer species, but seed is often unavailable.

### Kenya white clover (*Trifolium semipilosum*) cv. Safari

Safari grows over the summer period and plantings are doing well in the high altitude areas of the Mackay wet coast, such as the Eungella Tableland. A 30-hectare area on the Tableland planted with Nandi setaria and grazed by dairy cattle is now three-years-old and is very productive. It is slow to establish and is very susceptible to rugose leaf curl disease soon after establishment.

Although often not very productive over the first year, it develops resistance to the disease and then grows vigorously and spreads well under grazing. It combines with kikuyu grass and can also be grown with more vigorous grasses such as Nandi setaria if the latter are not allowed to grow tall and rank. It has a good cold tolerance but is susceptible to heavy frosts. Safari has failed to persist in plantings on the coastal lowlands and is not recommended for these areas.

### White clover (*Trifolium repens*) cv. Ladino

This temperate legume has naturalized in some areas of the Eungella Tableland. Its contribution to pasture production is small, due mainly to low fertilizer usage and is limited to a short late winter and spring period. Safari clover is now recommended for the Tableland.

Current research is evaluating white clover and also subterranean clovers under irrigation as a nitrogen source and high protein grazing supplement in association with intensive ryegrass systems.

## Pasture mixtures

Simple mixtures of one legume and one grass are preferred for ease of management. However, mixtures of up to two grasses and three legumes are often desirable to fit the variations in soil type and topography occurring in a paddock.

The most common pasture cultivars recommended for planting on the Mackay wet coast are given in table 1. A general purpose grass-legume mixture recommended for most coastal plain and undulating hill areas is Kazungula setaria 1 kg, siratro 1 kg and Graham stylo 1 kg. This mixture can be modified when local experience and knowledge indicate additional or alternative species to be beneficial.

## Fertilizers

Adequate fertilizer application is essential for good establishment and maintenance of a legume/grass pasture. Experiments on a wide range of soils in the Mackay area have shown that the major nutrient deficiencies (in addition to nitrogen) are phosphorus, molybdenum, sulphur and occasionally potassium. The amounts required of these nutrients were shown to vary with soil type. Minimum recommended rates are summarized in table 1.

As a general rule, maintenance fertilizer levels for phosphorus are one-third the establishment rate. Molybdenum is recommended every 5 years and, where potassium is needed, the recommended rate is 50 kg muriate of potash per year.

For low input development, primarily with Verano, Graham and Seca stylos half the above rates are recommended. For grass-nitrogen pastures, the rates of phosphorus and potassium will depend on the level of nitrogen used and this is shown in table 1.

Maintenance phosphorus levels should continue until soil levels (bicarbonate extraction method) reach 20 p.p.m.P in the top 10 cm of soil. Thereafter, further applications should be made when the levels fall below this value.

Where finance is limiting, young pastures should receive priority. The initial fertilizer input represents between 20 to 25% of the total pasture development costs. If fertilizer input is reduced, the money spent on other development costs of land preparation and seeding may be wasted.

Although some lowering of the above rates will still allow pastures to be developed, care is necessary not to harm future production potential. For example, pastures which lack vigour due to low fertilizer usage may allow weeds to invade and reduce production.

Animal health often benefits from nutrients applied in fertilizers. If superphosphate applications are reduced, it may be necessary to feed phosphorus supplements directly to the animal. To date, animal responses to trace elements have not been recorded on the Mackay wet coast although responses in dairy cattle to sodium (common salt) and injections of copper are currently being substantiated.

## Pasture development methods

The choice of method of pasture development largely depends on economic considerations. However, future potential use of the land, size of enterprise, stage of property development and the type of country are other important considerations.

### Low input or partial development

The use of the herbicide 'Tordon' or ring-barking to kill the timber will increase native pasture yield but nutrient starvation of cattle during the winter months will occur due to

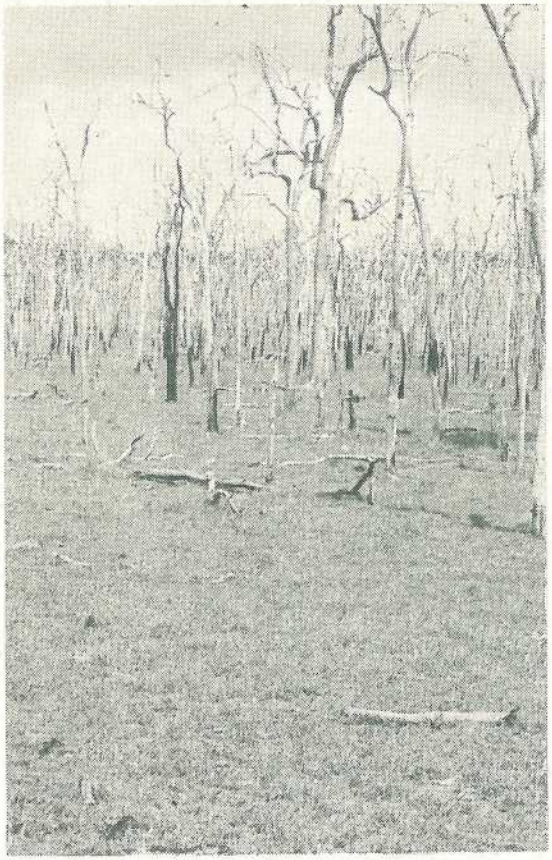
TABLE 1

SPECIES, SEEDING RATES AND FERTILIZER RECOMMENDATIONS FOR MACKAY WET COAST

| Soil/Vegetation Type | Grasses | Rate†† (kg/ha) | Legumes | Rate†† (kg/ha) | Fertilizer |
|---|---|---|---|---|---|
| FULL DEVELOPMENT | | | | | |
| Duplex soils | | | | | |
| (Legume-grass mixtures) | *Kazungula setaria | 0·5 – 1 | *Siratro | 1 – 2 | Establishment—Mo super**—400 kg/ha. |
| | †Rodd's Bay plicatulum | 1 – 2 | *Graham stylo | 2 – 3 | Maintenance—½ of establishment rate |
| | †Bryan plicatulum | 1 – 2 | †Verano stylo | 3 – 5 | (Mo super each 5th year). |
| | †Hamil grass§ | 2 – 3 | †Hetero§ | cuttings | Potash—50 kg/ha muriate each year.§ |
| | ‡Signal grass | 2 – 3 | †Centro (common)§ | 2 – 3 | |
| | | | ‡Cook stylo | 2 – 3 | |
| | | | ‡Seca stylo | 2 – 3 | |
| (Pure grass) | §Pangola grass | cuttings¶ | | | Super—200–400 kg/ha each year. |
| | †Signal grass | 3 | | | N—80–400 kg/ha each year.‖ |
| | †Para grass | cuttings¶ | | | |
| Brown friable earths | | | | | |
| (Legume-grass mixtures) | *Kazungula setaria | 0·5 – 1 | *Siratro | 1 – 2 | Establishment—200 kg/ha Mo super. |
| | *Hamil guinea | 2 – 3 | *Tinaroo glycine | 2 – 4 | Maintenance—½ of establishment rate |
| | *Riversdale guinea | 2 – 3 | *Centro | 2 – 3 | (Mo super each 5th year). |
| | †Narok setaria§ | 1 | *Graham stylo | 1 – 2 | |
| | ‡Signal grass | 2 – 3 | ‡Cook stylo | 2 – 3 | |
| | ‡Rodd's Bay plicatulum | 1 – 2 | ‡Verano stylo | 3 – 5 | |
| | ‡Bryan plicatulum | 1 – 2 | ‡Hetero§ | cuttings¶ | |
| (Pure grass) | *Pangola grass | cuttings¶ | | | Super—100–200 kg/ha each year. |
| | †Signal grass | 2 – 3 | | | N—80–400 kg/ha each year. |
| Red friable earths | | | | | |
| (Legume-grass mixtures) | *Whittet kikuyu | 2 – 3 | *Tinaroo glycine | 2 – 4 | Establishment—200–600 kg/ha Mo super. |
| | *Common kikuyu | cuttings¶ | *Greenleaf desmodium | 1 – 2 | Maintenance—½ of establishment rate and |
| | †Nandi setaria | 1 | *Silverleaf desmodium | 1 – 2 | Mo every 3–4 years. |
| | †Narok setaria | 1 | *Safari clover | 2 – 3 | 50 kg/ha muriate each year.§ |
| | †Kazungula setaria | 1 | †White clover | 2 – 3 | |
| | ‡Green panic | 2 – 3 | | | |
| (Pure grass) | *Whittet kikuyu | 2 – 3 | | | Super—200–400 kg/ha each year. |
| | *Common kikuyu | cuttings¶ | | | N—80–400 kg/ha each year. |
| | †Narok setaria | 1 | | | |

| Soil/Vegetation Type | Grasses | Rate†† (kg/ha) | Legumes | Rate†† (kg/ha) | Fertilizer |
|---|---|---|---|---|---|
| PARTIALLY CLEARED AREAS (Minimum inputs) All soil types | †Urochloa (Nixon) | 2 | *Verano stylo | 3 – 5 | Establishment—Mo super at ½ rate for full development. |
| | †Rodd's Bay plicatulum | 2 | *Graham stylo | 2 – 3 | |
| | †Bryan plicatulum | 2 | *Seca stylo | 2 – 3 | Maintenance—⅓ of establishment rate each year. |
| | †Callide Rhodes | 1 – 2 | †Siratro | 1 – 2 | |
| IRRIGATED AREAS | *Pangola grass | cuttings¶ | †Hetero | cuttings¶ | 500 kg/ha super each year (Mo if legumes are present). |
| | *Tama ryegrass | 30 | ‡Tinaroo glycine | 3 – 5 | |
| | *Ariki ryegrass | 30 | ‡Safari clover | 3 | 100 kg/ha muriate of potash each year. |
| | †Narok setaria | 2 – 3 | ‡Ladino white clover | 3 | 300–600 kg/ha N each year (for pure grass.)‖ |
| | ‡Kazungula setaria | 1 – 2 | | | |
| | ‡Capricorn elephant grass | cuttings | | | |

* Highly recommended
† Recommended
‡ Least recommended
§ For local situations
¶ Planted on a 1 m x 1 m grid
‖ See text.
** Mo super = single superphosphate with 1 kg molybdenum trioxide per tonne, marketed as ' Super Mo 300 (Mo ·03)'.
†† Adjust seeding rates if mixtures of more than one grass and one legume are planted.



*An area of low input or partial development on the coastal plain showing standing dead timber which has been killed by Tordon poisoning.*

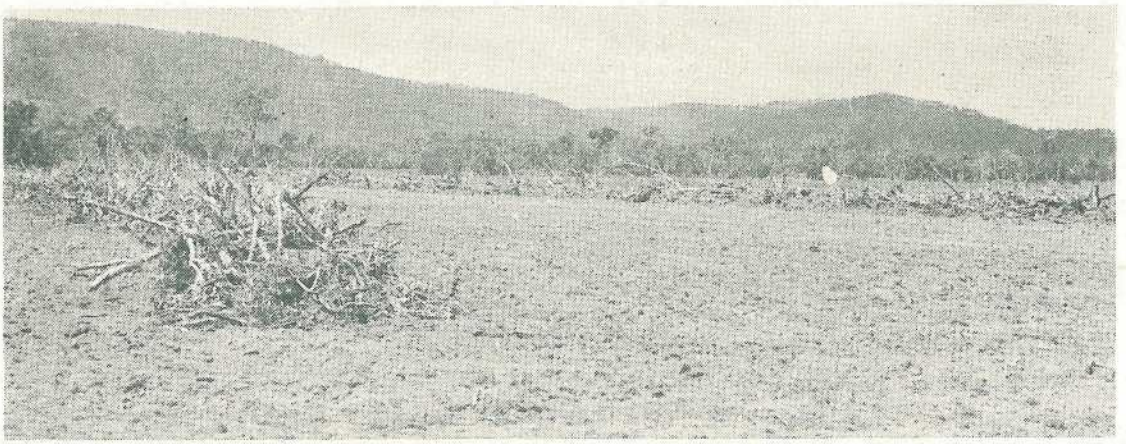
the low quality of herbage. Feeding a nitrogen supplement such as urea will partially overcome this problem and allow increased carrying capacity and reduce liveweight losses. Carrying capacities of 4 to 8 ha per steer are possible with this method.

The native pasture may be improved further by oversowing improved legumes such as Verano, Graham and Seca stylos and/or siratro and applying Mo superphosphate. The native pasture is burnt early in the wet season and the pasture seed and fertilizer flown on soon afterwards. The carrying capacity of this form of development is 1·2 to 1·6 ha per steer.

This method has been used extensively for Townsville stylo establishment on areas of coastal tea-tree country. Present species and fertilizer recommendations are presented in table 1. A tree seedling problem occurs after about 6 years and this has to be treated by further Tordon poisoning or by pushing and stacking the dead timber and ploughing out the tea-tree seedlings.

### High input or full development

The timber is mechanically cleared after the wet season (April to June), stick-raked and burnt in windrows. Two disc ploughings to 10 to 15 cm are required, the first in late autumn or after spring storms, and the second 8 weeks later. Perennial pastures are sown using species listed in table 1.



*For full development, timber is pushed into windrows and the area ploughed to prepare a seedbed for planting pastures.*

Recommended fertilizer applications are twice that for low input development and carrying capacities vary from 0·6 to 0·8 ha per steer depending on soil type.

### Intensive or special purpose systems

Land preparation is similar to the full development system but either pangola grass, signal grass, para grass, kikuyu grass or ryegrass is planted.

The amount of fertilizer to be applied and the carrying capacity achieved will depend on the amount of nitrogen fertilizer applied and is set out in table 1.

With irrigation, the nitrogen rate can be increased even further. This system has been successfully used by dairy farmers with ryegrass for winter-spring feed. It is also employed by some beef stud operators to carry large numbers of stock on small areas.

### Which system to use

No single plan or integrated system of development is suitable for all properties. The choice depends mainly on economic considerations. On a well-established beef cattle enterprise most, if not all of the above methods of development, would be employed. The aim should be to gain maximum benefits from property resources.

Before commencing development, a property plan should be drawn and studied. Assistance for this can be obtained from the Department of Primary Industries. Most advantage is usually gained by developing the best soils first. A mixture of flat and undulating country in each developed unit or paddock will allow cattle to take advantage of wet and dry periods. However, major soil types should be fenced and developed separately.

Initially, fairly large areas of improved pastures are required to significantly affect animal production. Pasture and cattle management planning is made easier where 10% to 20% of a property is intensively (grass + N) developed. Such pastures can be heavily stocked allowing greater flexibility of stock movement on legume-based pastures. Where irrigation is available, even greater flexibility is possible.

## Pasture establishment

The best time to plant is in late November or December when the probability of 4 or 5 consecutive days of rain is highest but with the ground still not too wet to cultivate. Heat waves are the greatest hazard to successful establishment at this time of the year. January plantings on coastal plains country can have problems with waterlogging, to which young legume seedlings are very susceptible.

Some success has been achieved with autumn plantings of legume/grass pastures, particularly on undulating hill country. Planting time for pangola grass is not so critical and in some cases autumn plantings are favoured. Circumstances favouring autumn plantings could be: an early onset of the wet season (before land could be prepared), on land where grader grass (*Themeda quadrivalvis*) or other weeds are known to be a problem, or when other property commitments have priority in early summer (for example, cane farming). Autumn planting is risky for areas where heavy frosts occur.

With summer planting, successful establishment is possible from sowing seed on the seed-bed surface. Autumn plantings, however, should be lightly covered by dragging a chain or bush or by light rolling. Covering and rolling of summer plantings may cause the soil surface to seal and hinder seedling emergence.

More even distribution of seed and fertilizer is obtained by ground implements than by aerial application. This is important for establishment into areas requiring a complete cover of vigorous pasture to control weeds and timber regrowth.

### Seed quality

The use of clean seed of known germination percentage is very important. It is poor economics to skimp on seed rates and quality as seed costs only represent about 10% of the total establishment costs.

### Seed treatment

All legume seed should be inoculated with the appropriate inoculum prior to sowing. Many of the common legumes (for example, siratro and the stylos) will nodulate with the common rhizobium (CP 756) which is also present in most soils. However, all legumes

should be inoculated as a safeguard and for some (for example, hetero and Safari clover) it is essential that their specific rhizobium be used.

Fresh seed of some pasture species, especially Seca stylo and signal grass, can have high levels of hard seed, and germination can be greatly improved by scarification prior to sowing. However, the presence of a proportion of hard seed is an insurance against false germinations from small falls of rain.

## Pasture management

### Establishment year

Management in the first year of a legume/grass pasture should aim to encourage and develop the legume content. This will ensure that a high level of nitrogen is added to the system to encourage and develop grass growth. The pasture should be allowed to seed before grazing commences to ensure a good reservoir of legume seed in the soil for subsequent survival.

### Grazing management

Continuous grazing is the most productive method of management with beef cattle. Cattle numbers should be raised or lowered in line with pasture growth or the amount of pasture available. Spelling of grass/legume pastures during the wet season leads to rank growth of grasses, much of which is trampled on to the ground when grazing is resumed. This trampled material forms a surface mulch which, when excessive, can retard seedling regeneration of legumes.

However, during very wet periods when free water is on the ground (this happens on parts of the coastal plains) or on soils which become boggy, removal of cattle from the pasture may be necessary to protect the legume. Areas of native pasture or sown grass fertilized with nitrogen are useful in allowing strategic resting of legume-grass pastures.

Stylo-based pastures generally require heavier stocking than pastures containing climbing legumes, particularly in the December to March period. Although the perennial stylos can compete with grasses better than Townsville stylo, the pasture needs to be kept moderately short for best animal production.

### Stocking rates

Most tropical legume-grass pastures are very sensitive to stocking rates and it is important to maintain a 'proper' stocking rate for good liveweight gain and legume-grass stability. If pastures are continually overgrazed, legume yield declines, nitrogen input is reduced, grass yield is consequently lowered, and grazing pressure on the legume increases even further. The result is a low (poor) producing pasture, usually with a large weed component.

Such pastures cannot be quickly improved by spelling, and other means of legume rejuvenation have to be considered.

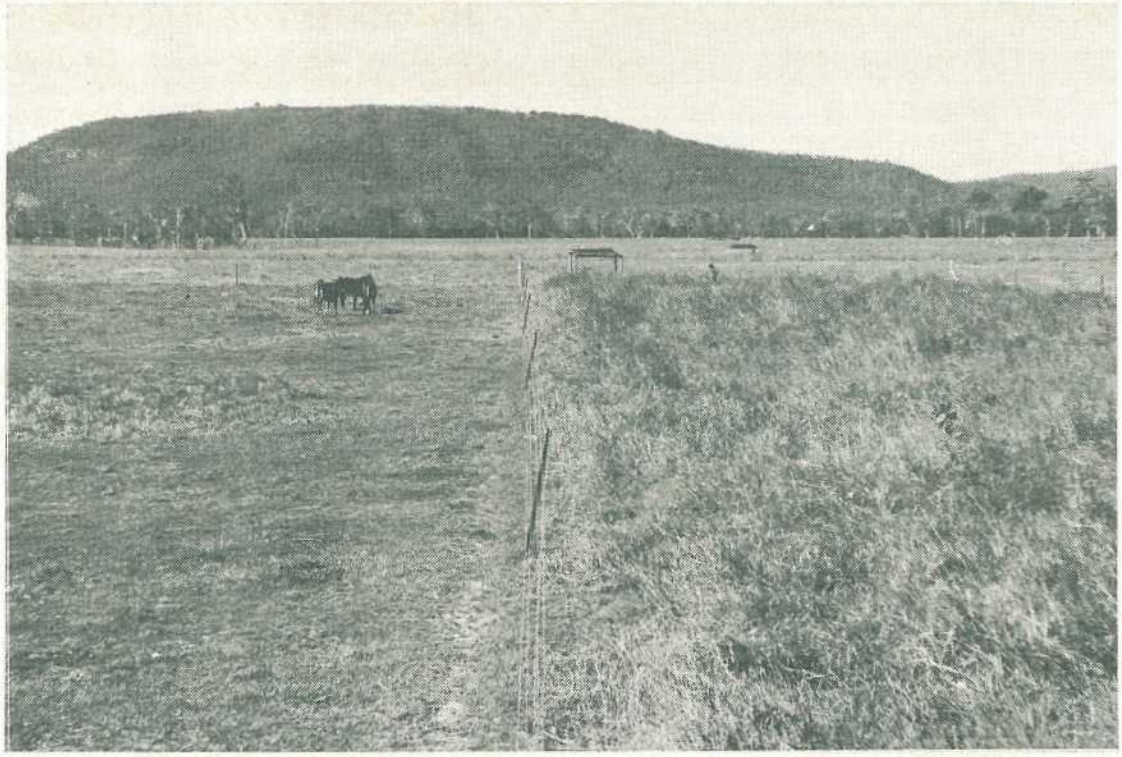
### Pasture renovation

Persistence of siratro is not a problem on the better-drained friable earth soils, provided the pastures are not continually overgrazed and are adequately fertilized. However, on the duplex soils, siratro yield can decline and the legume may almost completely disappear from well-fertilized pastures. This siratro decline is associated with either overgrazing or excessive grass competition. Waterlogging of the soil for a few weeks to several months during the wet season is another likely factor.

Where siratro-based pastures have been allowed to seed in the establishment year, soil seed reserves should be adequate for legume regeneration.

Spelling overgrazed pastures or burning-and-spelling pastures where excessive litter has accumulated is a slow means of legume recovery. Two wet seasons are required before substantial yields of legume occur. However, siratro yields of up to 1 000 kg per ha have been obtained in 3 months by renovating the pasture with a tined implement before the wet season.

The renovation process of breaking up the top 10 cm of the soil surface produces a new establishment of siratro seedlings. Better soil aeration, water infiltration and release of nutrients (particularly nitrogen) occur as a result of this soil disturbance and when protected from stock, new siratro plants quickly produce a bulk of herbage. It may be necessary to rejuvenate pastures by carrying out this renovation process every 3 to 5 years.



*The low-producing pasture on the left is stocked at one beast per 0·4 ha. The more productive pasture on the right is stocked at one beast to 0·8 ha.*

### Animal production

The maximum liveweight gain for improved pastures can range from 140 to 200 kg per year, depending on seasonal conditions, soils, species and grass/legume ratio. Generally, grass/legume pastures lightly stocked give higher liveweight gains per animal than grass/nitrogen pastures. However, the effect of increasing the stocking rate on liveweight gain for grass/legume pastures can be dramatic, with a decline of 50 to 60 kg occurring for each additional animal per ha.

The main differences between the pasture types are the different carrying capacities, which result in considerably different liveweight gains per hectare. A generalized example is given in table 2.

## Seed production

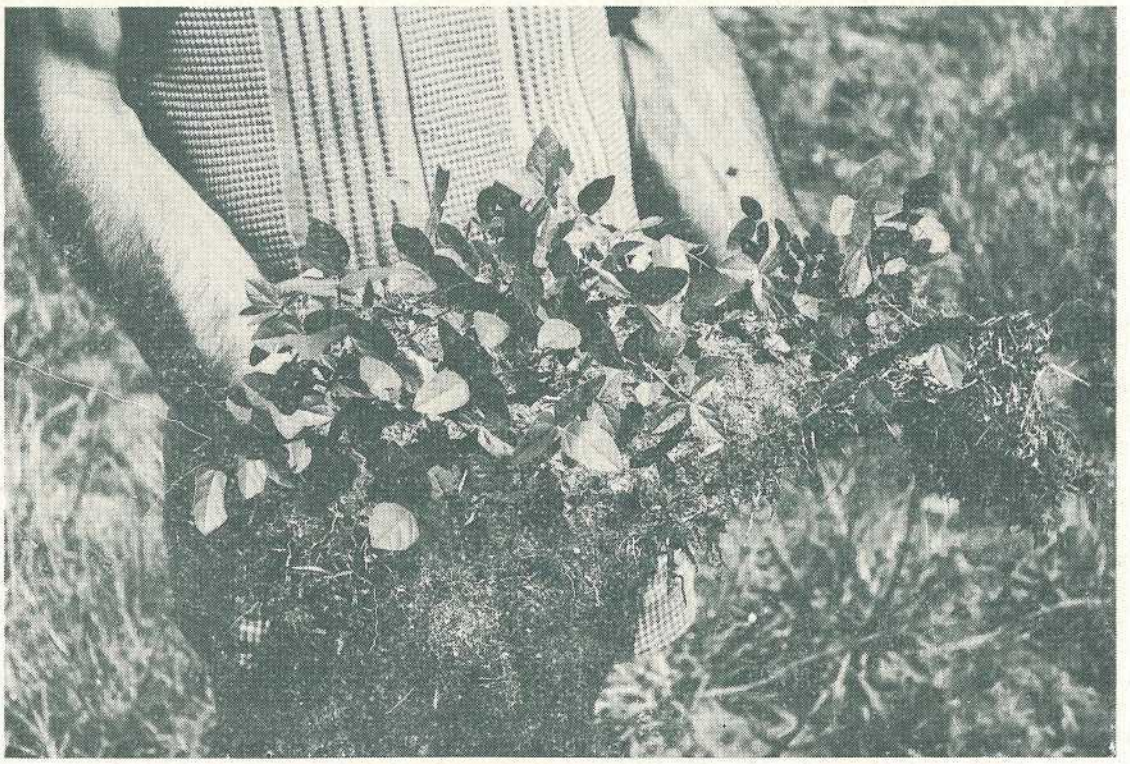
Seed of Kazungula setaria, Rodd's Bay plicatulum, signal grass, common guinea grass, angleton grass, Verano stylo, Seca stylo, Graham stylo and siratro is harvested locally. Much of the grass seed is contract harvested, where the operator arranges with property owners to destock pastures on a share arrangement of the seed harvested. Although this can seem a profitable arrangement for the property owner, pastures destocked for seed become rank and are of less value for grazing in the year of harvest. Regular use of a pasture for seed production can reduce the legume content.

*Renovating an old setaria/siratro pasture using a springtine implement.*

## Diseases of pasture species

Anthracnose (*Colletotrichum gloeosporioides*) is the most serious pasture disease on the Mackay wet coast. This fungus causes leaf spotting and attacks the tillers just below the inflorescence, which subsequently breaks off and dies. The disease is most severe during prolonged wet periods and its effects are reduced as rainfall declines. There are two forms of anthracnose:

Type A anthracnose first appeared in 1975 on Townsville stylo and has been most severe in the Proserpine and Bloomsbury areas. No Townsville stylo seed crops have been harvested on the Mackay wet coast since 1974, but herbage is still available for grazing in most years.



*Prolific growth of siratro seedlings in the pasture following renovation.*

TABLE 2

ANIMAL PRODUCTION FROM DIFFERENT PASTURE TYPES WITH A LIVEWEIGHT GAIN OF 150 KG PER HEAD

| Pasture Type | Stocking Rate (ha/head) | Liveweight Gain/ha (kg) |
|---|---|---|
| Annual legume e.g., Verano stylo .. | 1·4 | 110 |
| Perennial legume + grass .. .. | 0·8 | 200 |
| Grass + nitrogen (300 kg/ha) .. | 0·25 | 600 |

Type B anthracnose appeared in 1977 and has almost completely killed out Schofield stylo.

Verano, Graham and Cook stylos are much less affected by anthracnose and Seca stylo is completely resistant.

In wet years, and particularly on the coastal lowlands, siratro plants may be affected by rhizoctonia leaf spot (*Rhizoctonia solani*), a fungal disease which causes the leaves to turn brown and drop off. It occurs mainly in areas of dense, matted growth. This disease can considerably reduce the amount of siratro available for grazing and may cause the death of young plants.

Rust (*Uromyces appendictulatus*) on siratro first appeared on the Mackay wet coast in 1978. It occurs mainly on old leaves during dormant periods (winter) and does not seem to affect the yield of vigorously growing plants.

Rust (*Puccinia oahuensis*) on pangola grass was first noticed on the Mackay wet coast in 1971. Light to moderate infections are to be found during the winter and spring months, but the disease does not appear to greatly affect the growth of the grass or its acceptability to stock.

## Pest problems

Migratory locusts (*Locusta migratoria*) can severely reduce siratro seedling establishment if outbreaks occur while most seedlings are in the two-leaf stage.

A few outbreaks of amnemus weevil (*Amnemus quadrituberculatus*) have been reported on glycine pastures and occasionally army worm (*Pseudaletia convecta*) is a serious local pest.

In 1975, rats destroyed a 160 ha siratro seed crop by eating through the main stems at ground level.

## Weed problems

Grader grass (*Themeda quadrivalvis*), also known as Habana oat grass, is an annual weed of disturbed areas and of burnt or overgrazed pastures. It first spread along roadsides (hence the name 'grader grass') and now is a weed of cultivated areas, such as cane headlands, pasture seed-beds and Townsville stylo pastures which do not have a sown perennial grass. Cattle will eat grader grass up to flowering stage. Good control is obtained from vigorous perennial pastures and by avoiding burning or overgrazing.

Devil's fig (*Solanum torvum*) can be troublesome on newly-established pastures on friable earths, particularly on hillsides. Hand slashing and swabbing with a 4% solution of Tordon 105 is the best means of control. Overall spot spraying with a 0·2% solution of 2,4,5-T butyl ester is effective on young plants.

Sensitive weed (*Mimosa pudica*) is a prickly semi-prostrate legume bush which appears in overgrazed pastures. Although partially eaten by stock, it can cause problems with dairy cattle by cutting the udder and teats.

Poisonous plants such as zamia (*Macrozamia miquelii*), grass tree (*Xanthorrhoea* spp.), poison peach (*Trema aspera*) and lantana (*Lantana camara*) can be a problem in some situations.

In recent years, *Sporobolus diander* (Paramatta or rats tail grass) and *Eriachne triseta* have completely dominated old Townsville stylo pastures in the Proserpine and Bloomsbury areas. It appears that the lack of a

sown perennial grass in these pastures has left the way open for invasion by these perennial weed grasses. Experimental work aimed at the introduction of an improved perennial grass and a perennial legume into these pastures has commenced.

A new pasture weed (*Cassia obtusifolia*) was identified in the region in 1977. This is an introduced annual which forms thickets up to 2 m high. Herbicide spraying trials indicate the weed can be controlled with 2,4,5-T ester or Tordon 50-D.

## Tea-tree regrowth

Tea-tree seedlings and suckers are a major problem in Townsville stylo pastures where initial development did not include ploughing. The problem is more severe in the Proserpine and Bloomsbury areas, but will occur wherever cleared or timber-treated tea-tree country has not been ploughed. This regrowth requires treatment 6 to 8 years after initial development. Two ploughings several months apart and sowing perennial pasture will prevent regrowth problems.

## Summary

The increase in beef cattle numbers on the Mackay wet coast during the years 1967 to 1980 (80 000 to 200 000) can largely be attributed to the expansion of tropical pasture development (together with improved breeds and cattle management). Tropical pastures have provided improved nutrition and continuity of feed supply necessary for quick turn-off of marketable animals.

*Tea-tree regrowth on an area of coastal plain which was not ploughed. Two ploughings 6 to 8 weeks apart will prevent this regrowth.*

The potential for further development is immense. To date, only 60 000 ha of a possible 400 000 ha has been developed to sown pastures. Much of this land is owned by cane farming interests with the capital, machinery and technology for large scale pasture development. The high and reliable rainfall of this region makes pasture development a safe investment.

Our present technology in pasture development is good. However, problems such as the long-term persistence of legumes, maintenance fertilizer requirements and species for special situations (waterlogged areas, heavy grazing situations and low input development) are under continuing investigation.

In the dairying industry, the use of improved technology on sown pastures is allowing fewer farmers (and cows) to produce more milk.

With beef, the full range of enterprises is being practised: breeding and fattening, breeding and sale of stores, and buying and fattening. Each takes its turn in being the most profitable enterprise, depending on the changing market situation. However, when the high cost of development, the high productivity and carrying capacity of the pastures and the reliability of the rainfall are considered, a greater proportion of the fattening enterprise is likely to develop. Future increases in the price of grazing land are likely to be accompanied by the development of the more intensive systems of production.

## Further reading


Australia—Department of Minerals and Energy. Burdekin–Townsville Regional Research Series. Separate maps and booklets published between 1970 and 1973. Govt. Printer, Canberra.

Australia—Department of National Development, Fitzroy Region Resource Series. Separate maps and booklets published between 1965 and 1969. Govt. Printer, Canberra.

Beasley, R. (1979)—The Central Wet Coast Region. Department of Primary Industries, Beef Cattle Husbandry Branch Technical Bulletin No. 18.

Kerridge, P. C. and Everett, M. L. (1973)—Nutrient studies on some soils from Eungella and East Funnel Creek, Mackay hinterland. Tropical Grasslands, Vol. 9, No. 3, page 219.

Rankine and Hill (Consulting Engineers) (1971)—Mackay Regional Study, Land Use and Demography Forecasts, Vol. 1. Prepared for Co-ordinator-General's Dept. Queensland.

Walker, B., Kerridge, P. C. and Webb, A. A. (1979)—Soil fertility studies for pastures in the Mackay wet tropical coast of Queensland. Tropical Grasslands, Vol. 13, No. 2, page 110.

Walthall, J. C. (1977)—'Big head' disease in horses at pasture. Queensland Agricultural Journal Volume 103, page 331.

# Selecting bulls on weight for age

A trial at the Emerald Pastoral College demonstrated the value of selecting bulls on their weight for age.

Bulls that had high growth rates (13·5% above average) produced steers that were 28 kg or 5% heavier at sale than bulls with moderate growth rates (7% below average).

When steers are worth 80c per kg liveweight and heifers 70c per kg liveweight, the advantage to the high growth rate bulls could be $1 200 to $1 500 over their breeding life.

*by B. G. Mayer, Emerald Pastoral College and R. A. Barnett, W. J. Hall and W. J. Taylor, Beef Cattle Husbandry Branch.*

A trial designed to compare the breeding value of two high growth rate Brahman bulls with two moderate growth rate Brahman bulls was conducted on the Emerald Pastoral College's 'Berringurra' property at Blackwater.

The bulls were selected from a group of 48 bulls bred by Mr. W. McKenzie of 'Rhudanna', Comet, which is approximately 40 km south-west from 'Berringurra'.

The 48 bulls were ranked on their weight for age at an average age of 587 days (approx. 19 months). Two bulls that had higher than average weight for age, and two bulls that had lower than average weight for age were selected. Performance details of these bulls are shown in table 1.

The two groups of bulls were joined with two groups of 60 Hereford breeders. The breeders were allocated to their groups at random to ensure there was no difference between the two groups of breeders. All the progeny were run together until weaning, when the heifers and steers were segregated.

## Expected differences in progeny

The expected differences in weight for age at approximately 19 months between the progeny of two groups of bulls selected in the way shown in table 1 can be calculated by the following method:

Expected difference = Average selection differential of the parents × heritability of weight for age.

In this example, the selection differential of the parents is 89 kg (482 kg—393 kg) for the bulls and zero for the cows because they were selected at random. Therefore, the selection differential of the parents is $\frac{89 + 0}{2}$ = 44·5 kg.

Previous trials have shown that the heritability of weight for age at approximately 18 to 20 months is in the order of 0·5, or 50% of the parental selection differential. Therefore, the expected difference in the progeny of these two groups of bulls is 44·5 × 0·5 = 22·25 kg.

## Results

The results of this trial are expressed as liveweight of the two groups and are shown in table 2.

**TABLE 1**

PERFORMANCE DETAILS OF TRIAL BULLS

| Bull No. | Weight at 587 days (kg) | Ratio | Place in Group |
|---|---|---|---|
| 183 | 497 | 117 | 2 |
| 193 | 467 (Average 482) | 110 (Average 113·5) | 6 |
| 203 | 394 | 93 | 38 |
| 236 | 392 (Average 393) | 93 (Average 93) | 38 |
| Average 48 Bulls .. | 423 | 100 | .. |

**TABLE 2**

EFFECT OF SIRE SELECTION ON WEIGHT OF PROGENY

| Progeny group \ Average age | 262 days (Wean) | 347 days | 738 days | 915 days |
|---|---|---|---|---|
| **Steers** | | | | |
| High growth bulls .. .. .. | 191 (24) | 230 (24) | 491 (23) | 577 (23) |
| Moderate growth bulls .. .. | 183 (16) | 216 (16) | 460 (16) | 549 (16) |
| Difference .. .. .. .. | 8 | 14 | 31 | 28 |
| **Heifers** | | | | |
| High growth bulls .. .. .. | 170 (18) | 205 (18) | | |
| Moderate growth bulls .. .. | 162 (32) | 195 (32) | Heifers used for breeding. | |
| Difference .. .. .. .. | 8 | 10 | | |

Note: Number in brackets represent the number of progeny at each observation.

The differences at the 347 day weight were statistically significant ($p<\cdot05$) while differences at the other three ages were significant at $p<\cdot10$.

These results support the genetic theory outlined previously. The theoretical difference at 18 to 20 months was calculated at 22·25 kg per head. Actual differences were 14 kg at 347 days and 31 kg at 738 days. On a *pro rata* basis this would represent 24 kg at 587 days, the age the sires were selected.

The final difference at 915 d in the steers represents a 5% advantage.

## Industry application

The information derived from this trial provides a base to estimate the value of selection on weight for age to the commercial producer.

Steers by the high growth bulls averaged 577 kg liveweight versus 549 kg for the steers by the moderate growth rate bulls. At 80c per kg liveweight this represents an advantage of $22.40 per head. It is feasible to expect a similar 5% advantage in the liveweight of cull heifers. If heifers are sold at 450 kg liveweight, comparable weights for high growth rate and moderate growth rate progeny would be 461 kg and 439 kg respectively. At 70c per kg liveweight this represents $15.40 per head extra.

Under reasonable conditions one would expect about 80 to 100 calves per bull during his breeding life. Selling steers at comparable weights as in the trial and half the heifers at the weights suggested would represent an advantage to a high growth rate bull of $1 204 to $1 505 when compared with a moderate growth bull.

When performance records are available, they are usually in the form of a ratio. In this case, the ratios averaged 113·5 for the high growth bulls and 93 for the moderate growth bulls. Using this as an example, the advantage per percentage point in the ratio is $58.70 to $73.40. In other words, a bull with a ratio of 110 would be worth up to $587 to $734 more than one with a ratio of 100.

An additional benefit is that heifers (by high performance bulls) retained in the herd would pass a proportion of their liveweight advantage to their progeny. Therefore, continued use of high performance bulls makes a permanent and continuing contribution to herd productivity.

**Acknowledgement**

Thanks are due to Mr. Wally McKenzie for supplying half the bulls for the trial free-of-charge. Support of this nature is appreciated by all concerned with the trial.

# Metrics — 'over in a year'

CONVERSION to the metric system of weights and measures in Australia will be virtually complete in about 12 months.

The Minister for Science and the Environment Mr David Thomson said this when announcing the re-appointment of the Metric Conversion Board for a further term to 30 June next year.

Mr Thomson said Mr John Norgard, who had headed the Metric Conversion Board since its inception in 1970 had been re-appointed as Chairman.

Other Board members re-appointed were the Deputy Chairman, Mr G. M. Hastie, O.B.E., the full-time Executive members, Mr A. F. A. Harper, A.O., Mrs M. M. Fitz-Gerald, Mr P. B. Free, Mr W. I. Stewart, A.M., and Commissioner R. G. Sweeney.

Amendments to weights and measures, packaging and import regulations, traffic laws, building and other local government ordinances and similar legislation meant that the measurement standards of Australia were now metric.

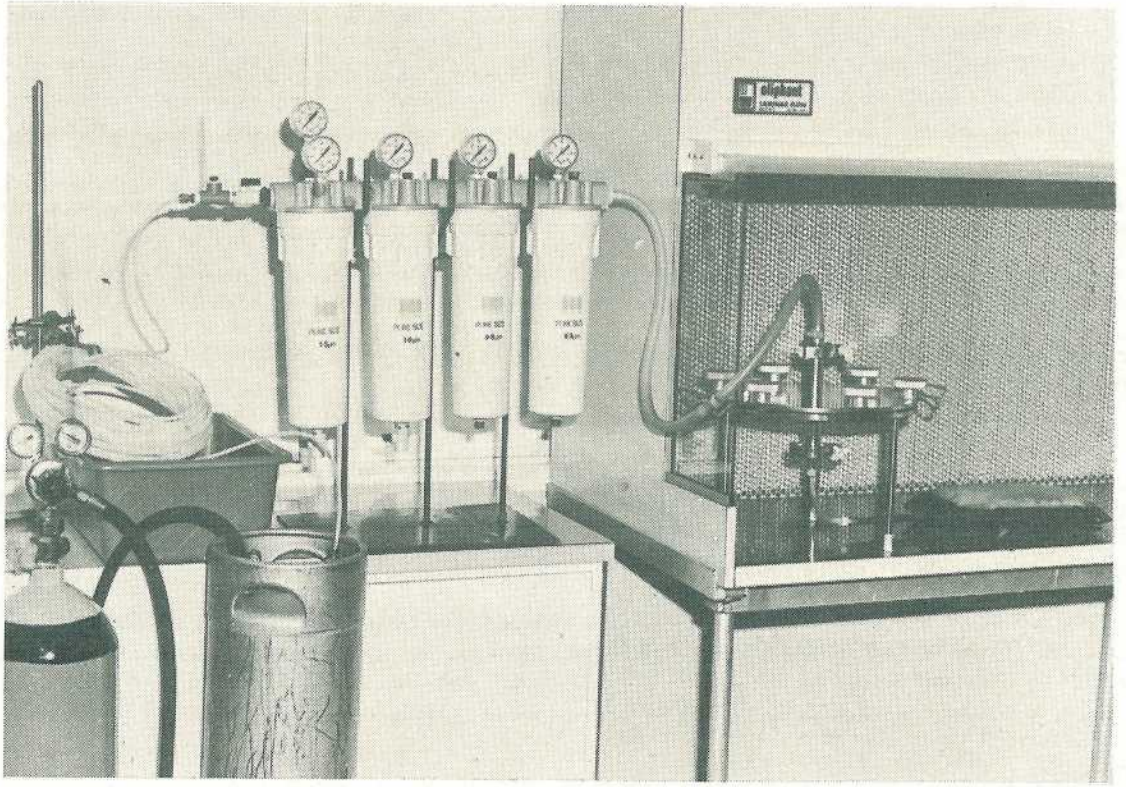
Education has been solely metric since 1974 and the overwhelming proportion of manufacturing and servicing industries has converted or is well advanced with conversion plans.

Individual citizens, traders and manufacturers should consider now whether they are equipped to live and operate in a metric society.

Assistance is available from the Metric Conversion Board. It is planned that the Board will be disbanded at the end of June 1981 and any on-going metrication activities will be handled by the National Standards Commission with the assistance of a Metric Advisory Committee.

The Board will move from its present accommodation in St. Leonards, Sydney, at the end of June to the National Standards Commission, 12 Lyonpart Road, North Ryde, N.S.W., 2113 (phone: 02–888 3922).

# Tick and tick fever control



## A progress report from the Tick Fever Research Centre, Wacol

*by R. J. Dalgliesh, Tick Fever Research Centre*

Above. Plate 1. *Filtration system for sterilization of cattle serum used as diluent in tick fever vaccine. Serum is forced by nitrogen gas from the cylinder at left through the filtration system into the plastic bag on the bench at the right.*

A formidible armoury of chemical and management weapons has been assembled to fight against ticks and tick fever.

Acaricides, pasture spelling, tick resistant breeds of cattle and vaccines against tick fever are the front-line weapons.

Continuing research is in progress on the habits and physiological make-up of ticks and the disease agents they transmit. This provides an 'intelligence service' for refining and effectively applying our defences against the cattle tick and its transmitted diseases.

Workers at the Tick Fever Research Centre have concentrated on producing high quality vaccines to control tick fever. They are also

attempting to increase our understanding of how, when and why ticks transmit the blood parasites that cause tick fever.

This article discusses progress in these and other studies on the cattle tick and tick fevers.

## Tick fever vaccines

Since it was first performed in Australia more than 80 years ago, vaccination against tick fever has had a long and interesting history. The vaccine has undergone many changes over the years, and improvements during the last 14 years have resulted in a relatively sophisticated, effective vaccine.

The most revolutionary change was to increase the number of living parasites in the vaccine many times without increasing the severity of the reaction produced by vaccination.

About 700 000 doses are at present used each year by stockowners in Queensland.

The most recent change in the vaccine was to replace bovine blood plasma with bovine serum in the vaccine's suspending medium, or diluent, as it is called. This might seem a small modification but it was the culmination of several years of intensive effort to produce a vaccine diluent that can be quickly and properly sterilized.

Serum, unlike plasma, can be sterilized without making it unsuitable as a diluent, but there were many problems to overcome in producing the large quantities of serum required. Sterilization is achieved by a similar filtration procedure to that used in making beer. Now the Tick Fever Research Centre can prepare batches of 100 L of sterile serum which is sufficient for 1 000 L of vaccine diluent. The method has been submitted for publication and will undoubtedly find application in other fields of science.

Continuing quality control is essential in producing the vaccine. This was emphasised by the finding that some batches of commercial plastic bags reduced the effectiveness of vaccination by killing the live parasites needed in the vaccine.

Cattle are not immunized unless they develop tick fever in a mild form, and it is essential that the vaccine parasites are viable and will multiply when injected.

Apart from its detrimental effect on tick fever vaccine, the detection of toxicity in a widely-used plastic material is disturbing. Alternative containers for the vaccine are now being tested. The likely replacement is a blow-moulded container of a different plastic material, which is currently used for other veterinary vaccines.

The success of vaccination against tick fever in Queensland has prompted other countries to import our vaccines, and several countries in South-east Asia have become regular customers. Supply to more remote countries is a problem because of difficulties with transport and the perishable nature of the vaccine. To overcome this problem, a method has been developed to preserve vaccine by freezing. Unless special precautions are taken, freezing kills the tick fever parasites and the vaccine is useless.

The recent supply of vaccine preserved in liquid nitrogen to Trinidad and Tobago fulfilled several years' experimentation. High production costs and the relatively complex procedures needed to prepare frozen vaccine make it uneconomic for routine use in Australia.

## Tick fever parasites and the cattle tick

Studies on the complex life cycle of tick fever parasites (called *Babesia*) during the last 3 years have revealed some intriguing findings.

We found that changes in temperature cause *Babesia* parasites in ticks to change from one form to another. An increase in temperature produces the form of the parasite that infects cattle, and a decrease produces the form that infects the tick.

Conveniently for the *Babesia,* these temperature changes are built in to the life cycle of the tick. The temperature increase occurs when larval ticks carrying *Babesia* attach to cattle—*Babesia* in the tick are warmed by the cow's body heat and so become infective (see plate 2).

The temperature decrease occurs when the engorged adult tick, with its gut full of blood and *Babesia* from the cow, drops to the ground. *Babesia* parasites in the tick's gut are then cooled and change to forms that can invade the gut cells and other tissues, including the ovary and developing eggs. These forms

continue to multiply in the tick eggs. When the larvae hatch out they are infected and, on being warmed, become capable of infecting cattle and so completing the full cycle.

Another effect of temperature occurs when infected larvae are held at cool temperatures for several weeks. Cooling the larvae for this period somehow helps the *Babesia* within them to mature, and be more capable of infecting cattle when the larvae eventually infest them.

Larvae exposed to a month of cool weather before locating and infesting cattle are probably more likely to transmit *Babesia* than larvae which find their host within 1 or 2 days of hatching.

These effects of temperature on tick fever parasites may partly explain field observations that cattle infested with ticks do not always develop tick fever at the expected time.

## Immunity studies

Wider use of tick and tick fever resistant breeds of cattle offers the best chance for complete control of the cattle tick. The comparative resistance of Zebu-type cattle to tick fever was recently confirmed. Of 35 Sahiwal cattle deliberately infected with virulent *Babesia* parasites, only two needed treatment to control the infection, but seven out of eight British breed cattle required treatment after being infected with the same number of parasites.

An age difference in resistance of the Sahiwal cattle was also seen, with calves 3 to 7-months-old more resistant than younger calves, heifers and old cows. This shows that the safest age for cattle to be either immunized naturally by tick infection or vaccinated is 3 to 7 months of age.

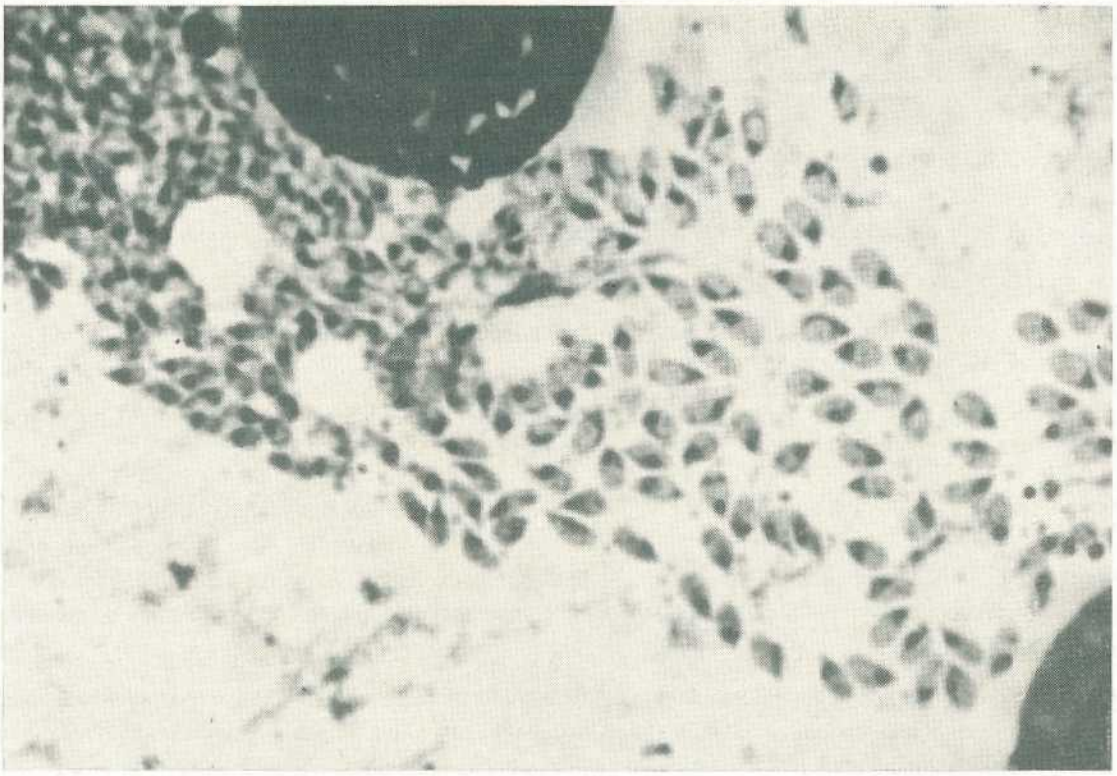


Plate 2. *The pear-shaped organisms are tick fever parasites in a larval tick. Warmth from the cow causes these parasite forms to develop in the tick which then injects them into the cow along with feeding fluids.*

Studies on immunity against ticks produced intriguing and disconcerting results. In one study, it was found that *Babesia* parasites somehow interfere with the immunity of cattle to ticks causing a greater tick burden to develop on infected animals. This occurred whether the cattle were infected with a strain of virulent *Babesia* or the weakened *Babesia* used in our vaccines.

In another experiment, we found that a certain tick-fever drug also suppressed the immunity of cattle to ticks. So far, our observations have been under laboratory conditions, and field trials being undertaken to study these effects are not completed. We do not expect vaccination or drug treatment to cause serious increases in tick numbers on cattle.

### Measurements of success

One yardstick of the success of research is the number of publications deriving from the results of the work. During the last 3 years, 18 papers dealing with the studies performed at the Tick Fever Research Centre have been published in scientific journals in Australia and abroad.

The benefits of efforts to develop and maintain the production of effective tick fever vaccines are reflected in our export trade. The availability of a reliable vaccine for Australian cattle being exported to heavily tick-infested countries of South-east Asia has been an important factor in the success of the recently increased cattle trade with this region.

Vaccination against tick fever is becoming an accepted part of cattle management in Queensland and other tick-infested areas of the world. Reliable, economical vaccines are in great demand. The successful use of 700 000 doses of vaccine a year in Australia and an increasing demand for the vaccine in overseas countries is encouraging evidence that cattle industry funds for research have been wisely invested.

---

# New tomato variety released

A new tomato variety named 'Scorpio' was released in July.

This fruit has an excellent flavour, is reasonably firm and has a satisfactory shelf life.

It was the first variety combining resistance to bacterial wilt with commercially acceptable yield and fruit quality.

Scorpio was suited especially for trellised culture during the warmer months of the year when bacterial wilt was likely to be a major problem.

However, the new variety did not have resistance to verticillium wilt, or to fusarium wilt race 2.

But, since this race of fusarium wilt had not been found in South-east Queensland and verticillium wilt was a problem mainly during cooler months, Scorpio should have a place in the tomato industry.

The new variety is the result of a Departmental team effort. Plant pathologists from Nambour concentrated on breeding bacterial wilt resistance and horticulturists from the Redlands Horticultural Research Station developed the agronomic and quality characteristics.

Small quantities of seed are available to interested seed merchants.

# Chemical weed control guide summer crops–1980

THE following tables are a guide to the chemical control of weeds in summer crops.

The successful use of herbicides requires careful attention to the following points:

- Correct identification of the present or anticipated weed problem.
- In very weedy areas, selection of a crop such as maize in which chemical control is relatively simple rather than a crop such as sunflowers for which few herbicides are available.
- Selection of a herbicide which is going to give satisfactory results for an acceptable cost without harmful residual effects on the proposed following crop. If a highly residual herbicide must be used, the future cropping programmes may have to be modified.
- Careful study of the product label, paying particular attention to the method of application (including incorporation procedures where appropriate), rate of application and timing.
- Awareness of any harmful effects on the treated crop, neighbouring crops, following crops, operators and the environment.
- Application of the herbicide strictly in accordance with the directions on the label.

In this guide, there is a list of common weeds showing their susceptibility to the herbicides used in summer crops. This should be used in conjunction with the tables for individual crops.

The information contained in this guide is based on product labels, results from Departmental trials and observations made in growers' crops. Since herbicide performance may be strongly influenced by soil and wheather conditions there is always a chance that results may not be as good as was expected and growers may need to modify future treatments to suit their own particular situations. Small, unsprayed areas should always be left to allow accurate assessment of results.

Further advice applicable to growers' special needs is available from Agriculture Branch extension officers.

*by J. E. Rawson, J. M. T. Marley and S. R. Walsh, Agriculture Branch*

## Chemical Weed Control Guide—Sorghum

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| atrazine .. .. | Several products (wettable powder 800 g/kg, flowable 500 g/L) | Refer to product labels for rates and methods of application for different soil types | Post-planting pre-emergence or split application (pre and post-emergence) | Most annual broad-leaved weeds and some annual grasses. Certain common grasses including urochloa and summer grass may not be adequately controlled | Crops other than maize, sweet corn, sorghum and broom millet may be damaged by atrazine residue if they are planted within 18 months of application. Refer to product labels |
| propachlor .. .. | Ramrod 65 .. | 6·7 kg | Post-planting pre-emergence | Most annual grasses and some broad-leaved weeds | No risk of damage to following crops |
| **Post-emergence** | | | | | |
| 2, 4-D amine .. | Several products (500 g/L) | 1·1 L | When crop is 10 to 25 cm high and secondary roots have developed | Most broad-leaved weeds | Spray drift may damage sensitive crops such as cotton, sunflowers and vegetables. Do not apply from misting machines and boomless jet nozzles as uneven spray application and consequent crop damage may result. Drift hazard is also accentuated. Some varieties are more susceptible to 2, 4-D than others<br>**2, 4-D is not recommended for sorghum in Central Queensland** |
| picloram + 2, 4-D .. | Tordon 50D .. | 1·4 L | As for 2, 4-D .. | Full season control of thornapples. Most other broad-leaved weeds including annual ground cherry, wild gooseberry and mintweed are controlled | For uniformity of application and reduction of drift hazard, ground-operated boom sprays are preferred.<br>Crops other than winter cereals may be damaged by picloram residue if they are grown following a treated sorghum crop. Refer to product label for details<br>**Tordon 50D is not recommended for sorghum in Central Queensland** |

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Post-emergence** | | | | | |
| atrazine .. .. | Several products (wettable powder 800 g/kg, flowable 500 g/L) | 2·8 kg or 4·5 L (sandy soil) to 4·2 kg or 6·7 L (heavy soil) | When weeds are in the 3 leaf stage or less | Most annual broad-leaved weeds and some annual grasses | Add wetting agent at the rate of one part of 50% to 60% product to 500 parts of spray mixture |
| | | | The sorghum plants must have at least 3 leaves | Certain common grasses including urochloa and summer grass may not be adequately controlled<br>Mintweed and black pigweed may be controlled at lower rates. Refer to product labels | Crops other than maize, sweet corn, sorghum and broom millet may be damaged by atrazine residue if they are planted within 18 months of application. Refer to product labels |
| dicamba .. .. | Several products (200 g/L) | 7·0 L–1·4 L | 10 to 25 days after emergence (crop 10 to 30 cm high) | Amaranths, blackberry nightshade, caltrop, thornapples and mintweed | Spray drift may damage sensitive crops such as cotton and vegetables. Refer to product label |

## Chemical Weed Control Guide—Maize

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| atrazine .. .. | Several products (wettable powder 800 g/kg, flowable 500 g/L) | 2·8 kg–4·2 kg or 4·5 L–6·7 L | Post-planting, pre-emergence | Most annual broad-leaved weeds and some annual grasses. Certain common grasses including urochloa and summer grass may not be adequately controlled | Crops other than maize, sweet corn, sorghum and broom millet may be damaged by atrazine residue if they are planted within 18 months of application. Refer to label for details<br>On the Atherton Tableland, best results are obtained from a split application of 1·4 kg pre-emergence followed by 1·4 kg post-emergence using wettable powder 800 g/kg. (2·2 L using flowable 500 g/L) |
| metolachlor .. | Dual .. .. | 2 L–4 L | Post-planting, pre-emergence | Annual grasses, including species resistant to atrazine | Use the higher rate of Dual on heavy soils or where a heavy grass population is expected |
| metolachlor + atrazine (tank mix) | Dual + Gesaprim 80 (800 g/kg) or Flowable Gesaprim (500 g/L) | 2 L–4 L of Dual + 1·7 kg of Gesaprim 80 or 2·5 L of Flowable Gesaprim | Post-planting, pre-emergence | Annual grasses and broad-leaved weeds | Rain or irrigation within 10 days after application of Dual improves results<br>Do not plant crops other than maize or sweet corn within 6 months of application of Dual |
| pendimethalin .. | Stomp 330E .. | 4·5 L | Post-planting, pre-emergence | Annual grasses, including species resistant to atrazine and some broad-leaved weeds | Stomp should be used on maize on the Darling Downs only<br>Rain or irrigation within 7–10 days after application of Stomp improves results<br>Do not plant sensitive summer crops such as sorghum or millets within 12 months of application of Stomp<br>If maize or sweet corn is replanted during the same season seeding depth must be below the depth of retilling |

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| pendimethalin + atrazine (tank mix) | Stomp 330E + atrazine as wettable powder 800 g/kg or flowable 500 g/L | 3 L of Stomp + 1·25 kg or 2 L of atrazine | Post-planting, pre-emergence | Annual grasses and broad-leaved weeds | The tank mix treatment should not lead to residue problems with atrazine as the application rate is low |
| propachlor .. .. | Ramrod 65 .. | 6·7 kg | Post-planting, pre-emergence | Most annual grasses and some broad-leaved weeds | No risk of damage to following crops |
| **Post-emergence** | | | | | |
| 2, 4-D amine .. | Several products (500 g/L) | 1·1 L | When weeds are small and maize is 10 to 30 cm high and secondary roots have developed | Most broad-leaved weeds | Spray drift may damage sensitive crops such as cotton, sunflowers and vegetables |
| picloram + 2, 4-D .. | Tordon 50D .. | 1·4 L | As for 2, 4-D .. | Full season control of thornapples. Most other broad-leaved weeds including annual ground cherry, wild gooseberry and mintweed are controlled | For uniformity of application and reduction of drift hazard, ground-operated boom sprays are preferred<br>Crops other than winter cereals may be damaged by picloram residue if they are grown following a treated maize crop. Refer to product label for details |
| atrazine .. .. | Several products (wettable powder 800 g/kg, flowable 500 g/L) | 2·8 kg–4·2 kg or 4·5 L–6·7 L | When weeds are in the 3 leaf stage or less | Most annual broad-leaved weeds and some annual grasses<br>Certain common grasses including urochloa and summer grass may not be adequately controlled | Add wetting agent at the rate of one part of 50% to 60% product to 500 parts of spray mixture<br>Crops other than maize, sweet corn, sorghum and broom millet may be damaged by atrazine residue if they are planted within 18 months of application. Refer to label for details |

## Chemical Weed Control Guide—Millets and Panicums

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | No pre-emergence herbicides available | | | | |
| **Post-emergence** | | | | | |
| 2, 4-D amine .. | Several products (500 g/L) | 1·1 L | When crop is stooling and secondary roots have developed | Most broad-leaved weeds | Spray drift may damage sensitive crops such as cotton, sunflowers and vegetables |

## Chemical Weed Control Guide—Sunflowers

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| pendimethalin .. | Stomp 330F .. | 2·5 L | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 24 hours of application with implements set to a depth of 5–10 cm. See label for details |
| pendimethalin .. | Stomp 330E .. | 4·5 L | Post-planting, pre-emergence (not incorporated) | Annual grasses and some broad-leaved weeds. (Pre-planting incorporated application is more effective for caltrop, fat-hen and blackberry nightshade) | The post-planting pre-emergence method is used where incorporation is impracticable. Rain or irrigation within 7–10 days after application improves results<br>Do not plant sensitive summer crops such as sorghum, millets or maize (except as directed for use on maize) for 12 months following application |
| trifluralin .. .. | Several products | 1·4 L (sandy soil)<br>2·1 L (loam)<br>2·8 L (clay) | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 4 hours of application. See labels for details<br>Do not plant sensitive grasses such as oats, sorghum, canary grass, rye grass or wheat for 12 months following application |
| **Post-emergence** | | None commercially available | | | |

## Chemical Weed Control Guide—Soybeans

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| trifluralin .. .. | Several products | 1·4 L (sandy soil)<br>2·1 L (loam)<br>2·8 L (clay) | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 4 hours of application. See labels for details<br>Do not plant sensitive grasses such as oats, sorghum, millet, canary grass, rye grass or wheat for 12 months following application |
| pendimethalin .. | Stomp 330E .. | 3 L | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 24 hours of application with implements set to a depth of 5–10 cm. See label for details<br>Do not plant sensitive summer crops such as sorghum, millets or maize (except as directed for use on maize) for 12 months following application |
| linuron .. .. | Linuron 50, Afalon | 2·2 kg (light soil) to 5·5 kg (heavy soil) | Post-planting, pre-emergence | Annual grasses and some broad-leaved weeds | Sow seed at least 2·5 cm deep<br>Heavy rain after application may result in crop damage<br>Do not re-plant treated area to other crops within three months of application |
| chlorthal-dimethyl/ linuron mixture | Shamrox WP .. | 8 kg (light soil) to 12 kg (heavy soil) | Post-planting, pre-emergence | Annual grasses and some broad-leaved weeds | Do not plant treated areas to sensitive crops within three months |
| sodium 5- [2-chloro-4-(trifluoromethyl) phenoxy]-2-nitro-benzoate | Blazer 2L .. | 3·0 L–4·0 L | Post-planting, pre-emergence | Some annual grassesand broad-leaved weeds | Apply 4·0 L for grass control |
| **Post-emergence** | | | | | |
| bentazone .. .. | Basagran .. .. | 2 L (1·5 L for thornapple and Noogoora burr seedlings) | From first trifolate leaf stage of crop growth and when weeds are small | Thornapples, Noogoora burr and bellvine | Apply in 220–440 L of water per hectare |
| sodium 5- [2-chloro-4-(trifluoromethyl) phenoxy]-2-nitro-benzoate | Blazer 2L .. | 1·0 L–2·0 L | Post-emergence when weeds are small | Some broad-leaved weeds | For mixed weed populations apply 2·0 L. Refer to label for rates for individual weed species |

## Chemical Weed Control Guide—Peanuts

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| verbolate .. .. | Vernam .. .. | 3·5 L | Pre-planting, soil incorporated | Annual grasses, some broad-leaved weeds and nut grass | Incorporate immediately after application. See label for details<br>Use only on red soil |
| trifluralin .. .. | Several products | 1·4 L–1·8 L (light to medium soils)<br>1·8 L–2·1 L (medium to heavy soils) | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 4 hours of application. See label for details<br>Do not plant sensitive grasses such as oats, sorghum, millet, canary grass, rye grass or wheat for 12 months following application |
| pendimethalin .. | Stomp 330E .. | 3 L | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 24 hours of application with implements set to a depth of 5–10 cm. See label for details |
| pendimethalin .. | Stomp 330E .. | 4·5 L | Post-planting, pre-emergence (not incorporated) | Annual grasses and some broad-leaved weeds. (Pre-planting incorporated application is more effective for caltrop) | Do not plant sensitive summer crops such as sorghum, millets or maize (except as directed for use on maize) within 12 months following application |
| alachlor .. .. | Lasso .. .. | 4·5 L | Apply within 2 days after planting and incorporate | Annual grasses and some broad-leaved weeds | Plant peanut seed at least 5 cm deep and incorporate up to 5 cm deep. See label for details |
| 2, 4-D amine .. | Several products (500 g/L) | 4·5 L | Apply at or immediately after planting | Annual grasses and broad-leaved weeds | Not recommended in northern Queensland<br>Heavy rain after application may result in crop damage |
| sodium 5- [2-chloro-4-(trifluoromethyl) phenoxy]-2-nitro-benzoate | Blazer 2L .. | 3·0 L–4·0 L | Post-planting, pre-emergence | Some annual grasses and broad-leaved weeds | Apply 4·0 L for grass control |

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Post-emergence** | | | | | |
| MCPB .. .. | Tropotox, Nufarm metacide | 1·4 L–2·8 L | From crop emergence to flowering stage | Annual broad-leaved weed seedlings | Do not exceed 1·4 L at flowering stage. There may be visible effects on the crop |
| 2, 4-DB .. .. | Selectone, Nufarm Buticide | 1·4 L–2·1 L | As for MCPB .. | As for MCPB .. .. | There may be visible effects on the crop |
| dinoseb .. .. | Several products (200 g/L or 400 g/L) | 5·6 L–11 L (200 g/L products) 2·8 L–5·6 L (400 g/L products) | Must be applied before weeds are 15–20 cm high | Some annual broad-leaved weeds including thornapples, bellvine and wild gooseberry | Extremely poisonous. Follow label directions on application method and operator protection |
| bentazone .. .. | Basagran .. .. | 2 L (1·5 L for thornapples and Noogoora burr seedlings) | After crop is 12 cm high and while weeds are still small | Thornapples, Noogoora burr, bellvine and star burr | Apply in 220–440 L of water per hectare |
| sodium 5- [2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoate | Blazer 2L .. | 1·0 L–2·0 L | Post-emergence when weeds are small | Some broad-leaved weeds | For mixed weed populations apply 2·0 L. Refer to label for rates for individual weed species |

## Chemical Weed Control Guide—Navy Beans

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| **Pre-emergence** | | | | | |
| trifluralin .. .. | Several products | 1·4 L–1·8 L (light to medium soils) 1·8 L–2·1 L (medium to heavy soils) | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 4 hours of application. See label for directions<br>Do not plant sensitive grasses such as oats, sorghum, millet, canary grass, rye grass or wheat for 12 months following application |
| **Post-emergence** | | | | | |
| bentazone .. .. | Basagran .. .. | 2 L (1·5 L for thornapple and Noogoora burr seedlings) | From second trifoliate leaf stage of crop growth and when weeds are small | Thornapples, Noogoora burr and bellvine | Apply in 220–440 L of water per hectare |

## Chemical Weed Control Guide—Cotton

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| diuron .. .. | Several products (wettable powder 800 g/kg or flowable 500 g/L) | 1·1 kg–2·2 kg or 1·8 L–3·5 L (The higher rates on clay soils) | a. Post-planting, pre-emergence<br>b. Post-emergence as a directed spray after the cotton is 25–30 cm high | Annual grasses and broad-broad-leaved weeds | Do not use on sandy soil. Treated areas should not be re-planted to any crop for one year after application except to cotton, maize or grain sorghum which may be planted in the spring of the following year<br>Include a wetting agent for post-emergence application. See label for details |
| fluometuron .. | Cotoran 80WP (800 g/kg) or Flowable Cotoran (500 g/L) | 1·7 kg–3·5 kg or 2·8 L–5·6 L | Pre-planting, soil incorporated | Annual grasses and broad-leaved weeds | For pre-planting and post-planting pre-emergence application use the higher rates on heavy soils<br>With post-planting pre-emergence application severe plant injury may result if there is heavy rain between planting and emergence<br>Do not make more than one post-emergence application per season<br>Include a wetting agent for post-emergence application. See label for details |
| | | 2·8 kg–4·5 kg or 4·5 L–7·2 L | Post-planting, pre-emergence | | |
| | | 1·3 L–2·8 L | As a directed spray after cotton is 15 cm high | | |
| MSMA .. .. | Daconate 8 (800 g/L) | 3 L | Apply as a directed spray after the cotton is 7·5 cm high and before the first bloom opens | Some annual grasses and broad-leaved weeds. Top kill of nut grass may be expected | Do not apply after first bloom |
| | Lane MSMA Herbicide (500 g/L) | 4·3 L | | | |
| nitralin .. .. | Planavin 75 .. | 1·5 kg–2·2 kg | Pre-planting, soil incorporated | Annual grasses and broad-leaved weeds | See label for incorporation methods and residual effect on subsequent crops |
| | | 1·5 kg–2·2 kg (The higher rate on heavy soils) | Post-planting, pre-emergence | | |

| Herbicide | Trade names | Rate of application (product/hectare) | Timing of application | Weeds controlled | Remarks |
|---|---|---|---|---|---|
| pendimethalin .. | Stomp 330E .. | 3 L | Pre-planting, soil incorporated | Many annual grasses and some broad-leaved weeds | Incorporate within 24 hours of pre-planting application. See label for method |
| | | 4·5 L | Post-planting, pre-emergence | | Do not plant sensitive summer crops such as sorghum, millets or maize (except as directed for maize) within 12 months following application |
| perfluidone .. .. | Destum .. .. | 5 L | Post-planting, pre-emergence | Some annual grasses and broad-leaved weeds. Controls nut grass | Do not plant crops other than cotton in treated soil for a period of 12 months after application |
| prometryne .. | Gesagard 50 .. | 3·3 kg (sprinkler irrigation) 4·5 kg (other situations) | Post-planting, pre-emergence | Annual grasses and broad-leaved weeds | Do not plant crops other than beans, transplanted celery and carrots within 6 months following application |
| trifluralin .. .. | Several products | 1·4 L (sandy soil)<br>2·1 L (loam)<br>2·8 L (clay) | Pre-planting, soil incorporated | Annual grasses and some broad-leaved weeds | Incorporate within 4 hours of application. See labels for details<br>Do not plant sensitive grasses such as oats, sorghum, millets, canary grass, rye grass or wheat for 12 months following application |
| Isopropyl-N-3- (N-ethyl-N-phenyl-carbamoyloxy)-phenyl carbamate | Verdinal .. .. | 3·5 L–5·0 L | Post-emergence when weeds are small | Some broad-leaved weeds | Do not apply later than 2 months after emergence of cotton |

## Susceptibility of Some Common Weeds to Herbicides Used in Summer Crops

| Weed Species | | Normal Time of Application | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-emergence | | | | | | | Pre- or post-emergence | | | | | Post-emergence (*pre-emergence in peanuts) | | | | | | |
| Botanical Name | Common Name | trifluralin nitralin pendimethalin | vernolate | alachlor | metolachlor | propachlor | chlorthal-dimethyl | perfluidone | Blazer | atrazine | prometryne | linuron | diuron fluometuron | 2,4-D (amine)* | 2,4-DB MCPB | Tordon 50D | dicamba | dinoseb | bentazone | Verdinal | MSMA |
| **BROAD-LEAVED WEEDS** | | | | | | | | | | | | | | | | | | | | |
| *Acanthospermum hispidum* | star burr | R | – | R | – | S | R | – | S | S | – | – | – | S | S | – | – | S | S | – | – |
| *Amaranthus cruentus* | redshank | S | S | S | – | S | S | – | S | S | S | S | S | S | S | S | S | – | PS | – | – |
| *Amaranthus macrocarpus* | dwarf amaranth | S | R | S | – | R | – | – | S | S | – | S | – | S | PS | S | S | S | PS | – | – |
| *Amaranthus retroflexus* | redroot amaranth | S | PS | S | – | S | – | – | S | S | – | S | – | S | PS | S | S | – | PS | – | – |
| *Amaranthus viridis* | green amaranth | S | PS | S | – | S | S | – | S | S | – | S | – | S | S | S | S | – | PS | – | – |
| *Anoda cristata* | anoda weed | R | – | R | – | – | – | – | S | PS | – | – | – | R | R | – | – | I | S | – | – |
| *Argemone mexicana* | Mexican poppy | – | – | – | – | – | R | – | – | – | – | – | – | S | I | S | – | – | – | – | – |
| *Bidens pilosa* | cobbler's pegs | R | – | S | – | S | R | – | S | S | – | R | – | I | I | S | S | S | S | – | – |
| *Chenopodium album* | fat-hen | S | S | S | – | S | S | – | S | S | S | S | S | S | I | S | – | I | S | – | – |
| *Commelina benghalensis* | hairy wandering jew | R | S | PS | – | PR | – | – | – | I | PS | PS | PR | S | I | S | – | S | S | – | – |
| *Convolvulus arvensis* | field bindweed (P) | R | R | R | – | R | R | – | – | – | R | – | – | S | – | S | S | – | – | – | – |
| *Corchorus olitorius* | jute | R | PR | – | – | – | – | – | S | PS | S | – | S | – | – | – | – | – | S | – | – |
| *Datura* spp. | thornapples | R | PR | R | – | R | R | – | S | S | – | R | S | I | I† | S | S | S | S | S | – |
| *Emex australis* | spiny emex | R | – | – | – | – | PS | – | – | PS | S | S | – | I | S† | S | S | – | S | – | – |
| *Galinsoga parviflora* | potato weed | R | R | S | – | S | R | – | S | S | S | S | S | S | I | S | – | – | S | S | – |

SUSCEPTIBILITY OF SOME COMMON WEEDS TO HERBICIDES USED IN SUMMER CROPS—*continued*

| Weed Species | | Normal Time of Application | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-emergence | | | | | | | | Pre- or post-emergence | | | | | Post-emergence (*pre-emergence in peanuts) | | | | | | |
| Botanical Name | Common Name | pendimethalin nitralin trifluralin | vernolate | alachlor | metolachlor | propachlor | chlorthal-dimethyl | perfluidone | Blazer | atrazine | prometryne | linuron | fluometuron diuron | 2,4-D (amine)* | 2,4-DB MCPB | Tordon 50D | dicamba | dinoseb | bentazone | Verdinal | MSMA |
| *Helianthus annuus* | sunflower | R | – | R | – | – | R | – | PS | S | – | – | S | S | S | S | S | – | S | – | – |
| *Hibiscus trionum* | bladder ketmia | R | – | PR | – | – | – | S | S | S | – | – | S | I | – | I | – | S | S | S | – |
| *Ipomoea plebeia* | bellvine | R | R | R | – | P | R | – | S | S | S | PS | S | S | S | S | S | S | S | S | – |
| *Ipomoea purpurea* | common morning glory | R | PR | R | – | PR | PR | – | PS | S | PS | PS | PS | PS | S | S | PS | PS | S | PS | – |
| *Medicago sativa* | lucerne (P) | R | R | R | – | R | R | – | – | R | – | – | I | I | R | S | S | – | R | – | – |
| *Nicandra physalodes* | apple of Peru | R | R | S | – | S | S | – | S | S | S | S | S | S | S | I | – | S | S | – | – |
| *Parthenium hysterophorus* | parthenium weed | R | – | PS | – | PS | PR | – | – | S | PS | PS | PS | S | – | S | S | – | – | – | – |
| *Physalis angulata* | annual ground cherry | R | – | R | – | R | PR | – | S | S | – | – | – | R | R | S | S | PS | R | – | I |
| *Physalis minima* | wild gooseberry | R | – | S | – | R | R | – | S | S | – | I | – | R | R | PS | – | S | R | – | – |
| *Polygonum aviculare* | wireweed | S | S | – | – | R | S | – | – | S | PS | I | – | S | I | – | S | – | I | – | – |
| *Polygonum convolvulus* | black bindweed | I | – | – | – | – | I | – | – | S | S | S | – | I | – | S | S | – | S | – | – |
| *Portulaca oleracea* | pigweed | S | R | S | – | S | S | – | S | S | S | S | S | I | I | S | S | S | S | S | S |
| *Raphanus raphanistrum* | wild radish | R | R | I | – | R | R | – | S | S | S | S | S | S | R | R | R | S | S | – | – |
| *Rapistrum rugosum* | turnip weed | R | – | – | – | R | R | – | S | S | – | S | S | S | S | I | R | PS | PS | – | – |
| *Salvia reflexa* | mintweed | R | PS | S | – | PS | R | – | – | S | – | – | – | I | R | S | S | S | R | – | – |
| *Sesbania cannabina* | sesbania pea | R | – | – | – | – | – | – | – | S | – | – | – | S | PR | S | – | – | R | S | I |

SUSCEPTIBILITY OF SOME COMMON WEEDS TO HERBICIDES USED IN SUMMER CROPS—*continued*

| Weed Species | | Normal Time of Application | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-emergence | | | | | | | Pre- or post-emergence | | | | | Post-emergence (*pre-emergence in peanuts) | | | | | | |
| Botanical Name | Common Name | trifluralin nitralin pendimethalin | vernolate | alachlor | metolachlor | propachlor | chlorthal-dimethyl | perfluidone | Blazer | atrazine | prometryne | linuron | fluometuron diuron | 2,4-D (amine)* | 2,4-DB MCPB | Tordon 50D | dicamba | dinoseb | bentazone | Verdinal | MSMA |
| *Sisymbrium* spp. | mustards | R | – | – | – | – | R | – | – | PS | – | S | S | S | S | – | R | S | S | – | – |
| *Solanum nigrum* | blackberry nightshade | R | – | R | – | S | S | S | S | S | S | S | S | S | – | – | S | – | S | – | – |
| *Sonchus oleraceus* | common sowthistle | – | – | S | – | S | S | – | – | S | S | S | – | S | S | – | S | – | – | S | – |
| *Tagetes minuta* | stinking Roger | R | – | S | – | S | R | – | S | S | – | S | – | S | S | S | – | – | – | – | – |
| *Tetragonia tetragonioides* | New Zealand spinach | – | – | – | – | – | – | – | – | S | – | – | – | R | R | S | S | – | – | – | – |
| *Trianthema portulacastrum* | black pigweed | S | – | R | – | R | S | – | S | S | S | – | – | I | I | I | – | – | R | – | – |
| *Tribulus terrestris* | caltrop | I | R | R | – | S | PS | S | S | I | – | R | S | I | – | I | – | S | – | S | S |
| *Xanthium* spp. | Noogoora and Bathurst Burrs | R | PR | R | – | PR | R | – | S | S | – | S | – | S | S | S | – | S | S‡ | S | S |
| **GRASSES** | | | | | | | | | | | | | | | | | | | | | |
| *Avena* spp. | wild oats | S | – | – | – | – | R | – | – | S | – | – | – | R | R | R | R | R | R | R | S |
| *Cenchrus echinatus* | Mossman River grass | S | – | S | – | S | S | – | S | I | R | – | S | R | R | R | R | R | R | R | – |
| *Cyperus rotundus* | nutgrass | R | S | R | – | R | R | S | – | – | – | – | – | I | – | – | – | – | – | R | S |
| *Digitaria* spp. | summer grass | S | S | S | S | S | S | S | – | R | R | S | S | R* | R | R | R | R | R | R | S |
| *Dinebra retroflexa* | dinebra | S | PS | PS | PS | PS | – | – | – | R | – | – | – | R* | R | R | R | R | R | R | PS |
| *Echinochloa* spp. | barnyard grass | S | S | S | S | S | S | S | S | S | – | S | S | R* | R | R | R | R | R | R | S |
| *Eleusine indica* | crowsfoot grass | S | S | S | S | S | S | – | S | S | R | R | S | R* | R | R | R | R | R | R | PS |

SUSCEPTIBILITY OF SOME COMMON WEEDS TO HERBICIDES USED IN SUMMER CROPS—*continued*

| Weed Species | | Normal Time of Application | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-emergence | | | | | | | Pre- or post-emergence | | | | | Post-emergence (*pre-emergence in peanuts) | | | | | | |
| Botanical Name | Common Name | trifluralin nitralin pendimethalin | vernolate | alachlor | metolachlor | propachlor | chlorthal-dimethyl | perfluidone | Blazer | atrazine | prometryne | linuron | fluometuron diuron | 2,4-D (amine)* | 2,4-DB MCPB | Tordon 50D | dicamba | dinoseb | bentazone | Verdinal | MSMA |
| *Eragrostis cilianensis* | stinkgrass | S | PS | PS | PS | S | S | — | — | S | R | I | S | R* | R | R | R | R | R | R | PS |
| *Sorghum halepense* | Johnson grass (P) | I | R | R | — | R | R | — | — | R | — | — | — | R | R | R | R | — | R | R | S |
| *Sorghum halepense* | (seedlings) | S | — | — | — | R | R | — | S | R | — | — | — | R | R | R | R | — | R | R | S |
| *Sorghum* spp. (from seed) | | S | — | — | — | R | — | — | — | R | — | — | S | R | R | R | R | R | R | R | S |
| *Themeda quadrivalvis* | grader grass | S | — | — | — | S | — | — | — | — | — | — | — | R | R | R | R | R | R | R | — |
| *Urochloa panicoides* | urochloa grass | S | PS | S | S | S | S | — | S | I | — | — | S | R* | R | R | R | R | R | R | PS |

* These weeds are susceptible to 2,4-D as a pre-emergence treatment only (peanuts).
† Susceptible to 2,4-DB only.
‡ *Xanthium spinosum* (Bathurst burr) resistant.
S = Susceptible; R = Resistant; I = Intermediate (moderately susceptible); — = Not known; PS = Probably susceptible; PR = Probably resistant; (P) = Perennial (established plants).

Susceptibilities are for the generally recommended rates of application and for the post-emergence herbicides weeds should be young and growing vigorously.

**The above chart was compiled from a range of published and informal sources. Since the effect of herbicides is widely influenced by environmental conditions and rate of application, there is no guarantee that any treatment will have the effect indicated in the chart.**

# Subscribe now

# *'The Queensland Agricultural Journal'*

## Concession rate available

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

---

### ORDER FORM

### QUEENSLAND AGRICULTURAL JOURNAL

Postal address: Queensland Department of Primary Industries, G.P.O. Box 46, Brisbane, Q. 4001, Australia.

**Subscription Rates—**

Ordinary —$9.00 per annum (Australian Currency)

Concession rate—$4.00 per annum

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

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

PREVIOUS ADDRESS (if applicable) .....

OCCUPATION .....

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

Signature .....

New Subscriber ☐

Renewal ☐

(Tick the one that applies)

Office Use Only



89618—S. R. Hampson, Government Printer, Queensland

# Plum varieties

PLUM growing in Queensland is limited to the Granite Belt and fringe areas of Warwick and Inglewood.

Most plums are harvested between mid November and late February. They are mainly sold as fresh fruit in Queensland. Only a small percentage is sold interstate and overseas.

Both Japanese and European types are grown on the Granite Belt. However, most plantings are Japanese plums with the most common varieties being: Wilson 55%, Doris 15%, Santa Rosa 10%, other varieties 20%.

Wilson is the first variety to mature in the district and is the most important.

### **Wilson** (plate 1)

Fruit are medium-sized and round in shape with a bright red skin and yellow flesh. The fruit are almost entirely freestone, juicy, of very good quality, and mature from late November to mid December.

The trees are very vigorous, thorny, spur freely and crop heavily. They are often slow in settling down to regular cropping and have a tendency to crop biennially if left to overcrop in one year.

### **Santa Rosa** (plate 2)

Fruit are medium to large-sized, oval-shaped with a dark red skin and red flesh. The fruit are clingstone, carry well, of good quality and mature from mid December to early January.

The trees are vigorous, very upright in growth and susceptible to bacterial spot. They are partially self-fertile and fairly heavy croppers.

### **Doris** (plate 3)

Fruit are small to medium, round-oval and have dark red skin. The flesh is orange tinged with red beneath the skin. Fruit are clingstone, very firm, of good quality and mature from early January to early February. The fruit transport well because of the tough skin.

### **Narrabeen** (plate 4)

Fruit are large and round. The skin is bright red with pronounced lenticel specking, and the flesh is yellow, juicy and of very good flavour. The fruit are freestone, firm, carry well, and mature from late January to mid February.

The trees are very vigorous and distinctly spreading in growth habit.

### **Mariposa** (plate 5)

Fruit are medium to large-sized, round and have a speckled purple skin. The flesh is dark red and of excellent flavour. The fruit are clingstone and mature from late January to mid February.

The trees are vigorous and produce regular, heavy crops.

### **Red Ace** (plate 6)

Fruit are medium to large with a mottled red skin and yellow flesh. The fruit are freestone and mature from mid to late February.

The trees are similar to Doris and very susceptible to bacterial spot.

*by G. Bulow, Horticulture Branch*

# Plum varieties

*Plate 1. Wilson—fruit are medium-sized. Mature late November to mid December.*

*Plate 2. Santa Rosa—fruit are medium to large. Mature mid December to early January.*

*Plate 3. Doris—fruit are small to medium. Mature early January to early February.*

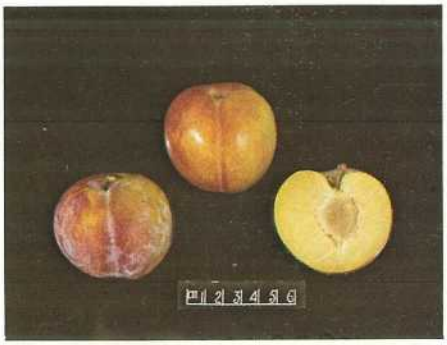


*Plate 4. Narrabeen—fruit are large. Mature late January to mid February.*

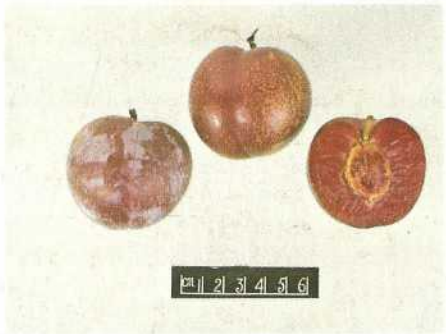


*Plate 5. Mariposa—fruit are medium to large. Mature late January to mid February.*

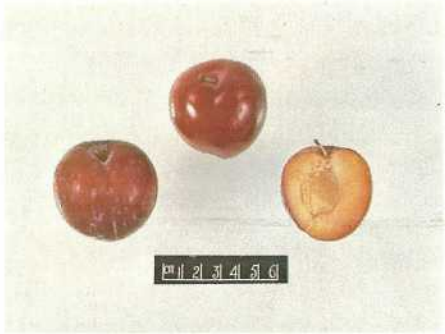


*Plate 6. Red Ace—fruit are medium to large. Mature mid to late February.*