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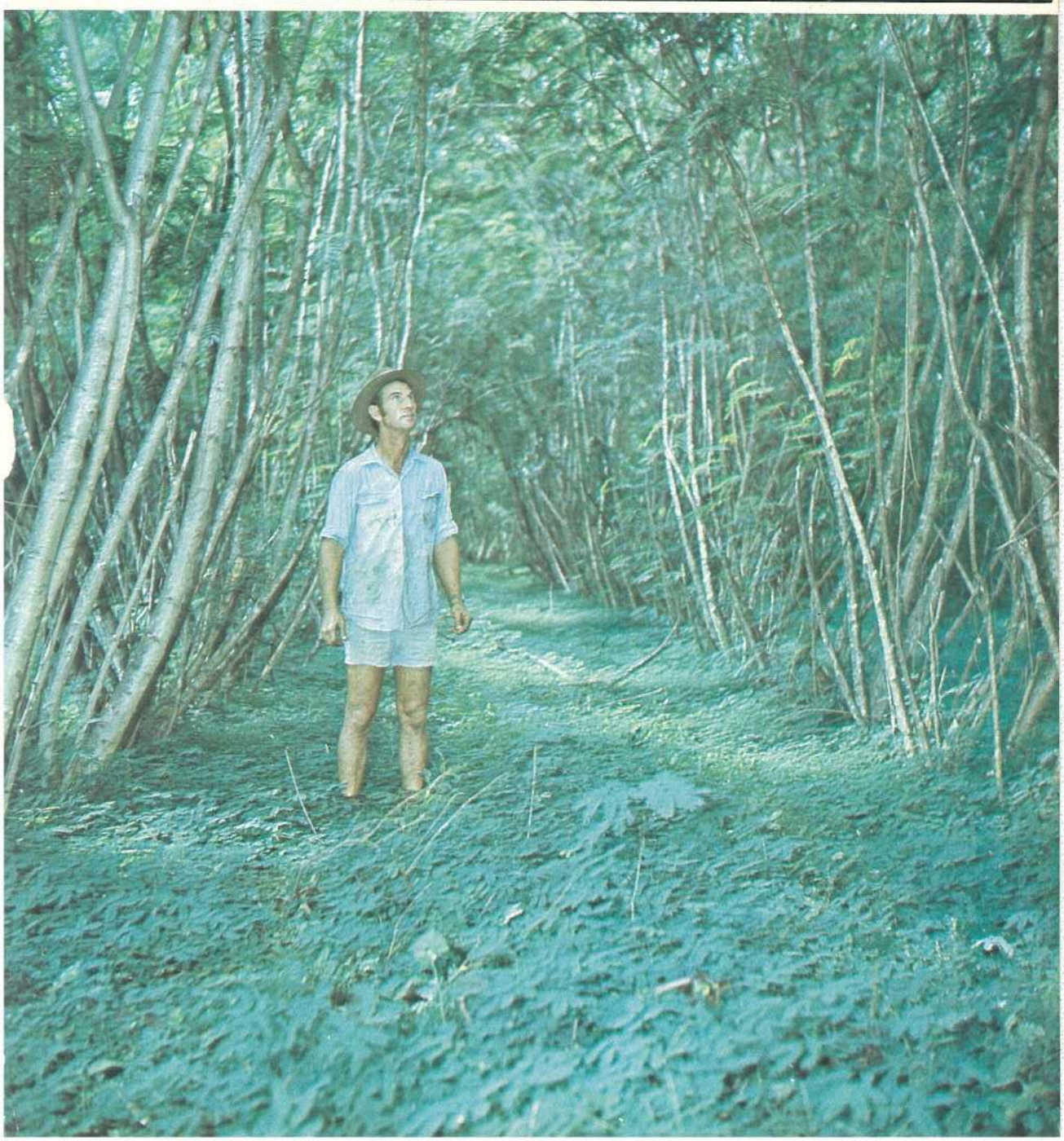

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COVER: Tree leucaena for fattening cattle is being examined by Gordon Wyland at 'Mona Vale' in Central Queensland. See 'A management system for leucaena' in this issue.

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Contents

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85473—7

Tree leucaena nearly 6 m tall at 'Mona Vale' in central Queensland. Rows are 4 m apart with about four trees per m of row. Forage is available from seedlings and lateral shoots along the row.

A management system for leucaena

LEUCAENA, a tree legume, is a commercial success on a central Queensland beef property.

It is used as a high protein supplement to fatten cattle grazing spear grass (*Heteropogon contortus*) during autumn, winter and spring.

The secret of success for Gordon and Helen Wyland of 'Mona Vale', north of Rockhampton, has been to allow the leucaena to reach tree height so that a permanent canopy of leaves is out of reach of the grazing cattle. Only the dense sward of leucaena seedlings and the accessible lateral branches are grazed.

The 24 ha block of leucaena (*Leucaena leucocephala* cultivar Peru) has become an important part of the feed programme at

by J. H. Wildin, Agriculture Branch

Mona Vale. Mean annual rainfall is about 780 mm, of which 70 % falls in the hotter months (October to March). During autumn and winter, when the native grass pastures are mature and low in feed quality, cattle growth is restricted by protein shortage in their diet. Leucaena provides the protein supplement. Commencing in autumn, bullocks in the adjacent paddock are given continuous access to the forest of leucaena, allowing 0.4 ha of leucaena per beast.

By continually turning off fat cattle from autumn onwards, the stocking pressure is progressively reduced with time. This ensures that remaining stock have a fattening diet. The simple system of allowing cattle access to the leucaena paddock for 9 months of the year has not adversely affected the leucaena trees and cattle continue to gain weight.

At Mona Vale, cattle grazing has not affected the leucaena seed crop which is harvested mechanically from the canopy each year in early autumn. Although leucaena is primarily used for fattening, the high protein feed can be very useful for growing weaners.

The amount of edible leucaena out of reach of cattle at Mona Vale is always more than the accessible material. This top growth

Gordon Wyland examines the succulent 2-month-old regrowth of seedlings between two rows of leucaena trees in early February.

Bullocks at 'Mona Vale' graze leucaena seedlings and lateral shoots as a protein supplement to the low quality grass in an adjacent paddock, commencing in March.

represents a very valuable drought reserve. In a drought, a few trees could be lopped each day for feeding on the site.

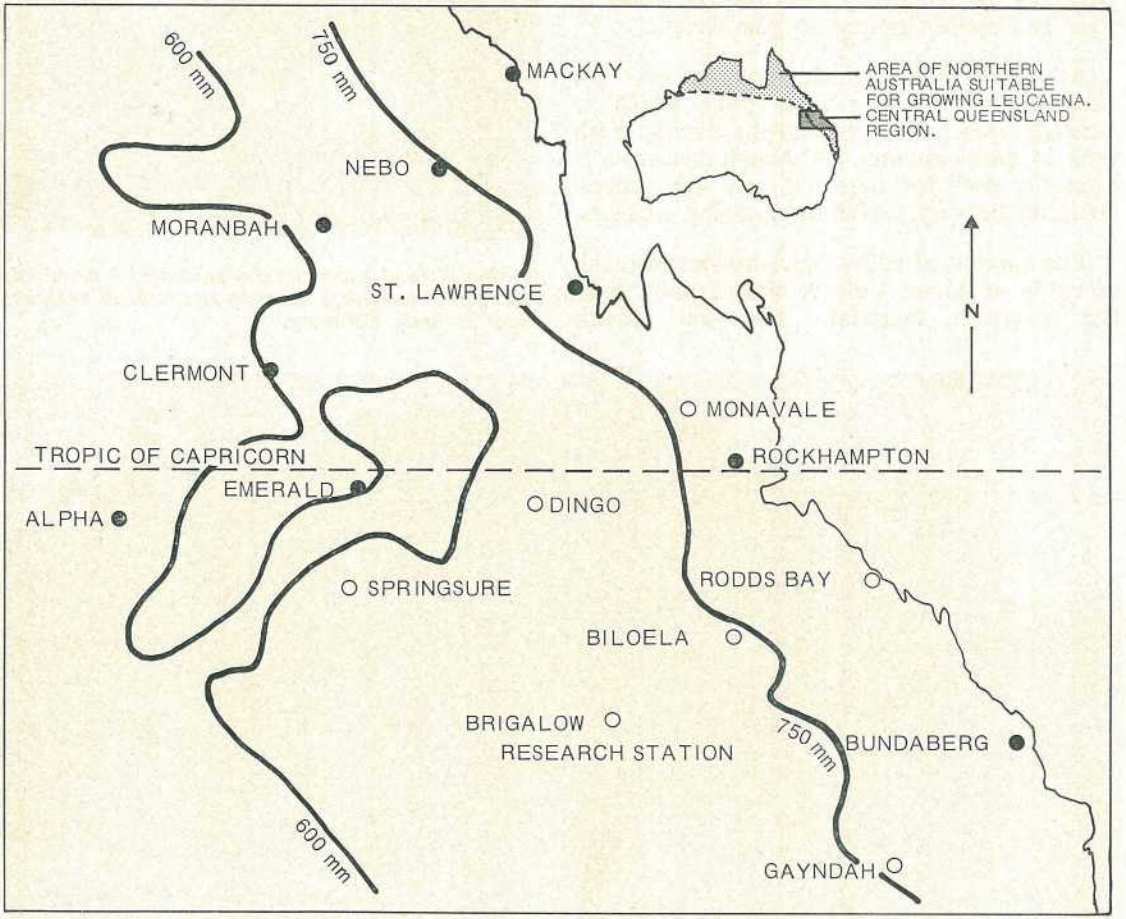
Protein need

Cattle on most beef properties in central Queensland can benefit from added protein in their diet during the cool season. Leucaena offers a cheap source of protein for supplementary grazing, making it a special purpose pasture.

From experience, it is estimated that with conservative but sensible stocking policies on both native and sown pastures in central Queensland, up to 5 % of the area of a cattle property could be fenced off and planted to leucaena without seriously reducing production (and income) during the leucaena establishment years. Once established, leucaena becomes a permanent protein source for cattle fattening.

Suitable areas

Leucaena can be grown on most well-drained soils in tropical and sub tropical regions receiving more than 600 mm annual rainfall. Successful small plantings of leucaena have already been made in central Queensland. (See map 1.)



Map 1. Central Queensland showing the 600 mm and 750 mm isohyets and centres (O) where leucaena is growing successfully. The inset map shows the area of northern Australia climatically suited to leucaena.

Planting

The aim is to establish at least three mature trees per metre of row. Drill scarified and inoculated seed into a moist, clean seed-bed during the period December to early February at a spacing of about 5 cm. Planting depth must be 2 to 4 cm; deeper plantings have been failures.

Row width must be adjusted for different rainfall regimes and soil types to allow the plants to reach tree size rapidly. As a general rule, row spacing can be as close as 3 m in 1000 mm rainfall districts, but it should be about 7 m in drier sub coastal districts receiving 600 mm. Where rows are greater than 5 m apart, plant green panic (*Panicum maximum* var. *trichoglume*) or another suitable grass in the interrow space. To minimize grass competition, do not plant grass within 1 m of the leucaena row.

Phosphorous fertilizer boosts early growth. Apply superphosphate (about 25 kg per ha) at planting along the leucaena row.

Simple management

Leucaena growth is adversely affected by continuously grazing off all leaves. If the canopy is accessible to cattle, rotational grazing is essential to maintain healthy leucaena plants.

The success of tree leucaena for supplementary grazing lies in the permanent high canopy of leaves which ensures:

- A deep root system to exploit moisture and nutrients at depth.
- A continuous supply of photosynthate (plant food from green leaves) to enable regrowth from lower lateral branches. This provides 1 000 to 1 500 kg (dry matter) of edible leucaena per ha each year and may be continuously grazed.
- Frost protection of green material under the canopy.
- An assured annual seed crop which can be mechanically harvested.
- A high population of seedlings (between the rows of trees) which supplies a high proportion of the edible leucaena (1500 to 2500 kg dry matter per ha each year).

When used as a supplement to grass pastures of adequate bulk, leucaena has no mimosine toxicity problems. In central Queensland, there are no harmful effects on cattle grazing leucaena under the system outlined above.

Simulation Society of Australia Fourth Biennial Conference

The Simulation Society of Australia is a multi-disciplinary body of professionals with a common interest in the principles and practices of simulation and modelling techniques.

A biennial conference is held to promote the interchange of ideas and experience between workers in diverse disciplines in the agricultural, biological, physical and social sciences. The organising committee has accepted 42 papers for presentation during the conference.

The Fourth Conference will be held in Brisbane on 27 to 29 August 1980 at the University of Queensland, St. Lucia.

Please contact Prof. K. J. Bullock, Department of Mechanical Engineering, University of Queensland, St. Lucia, Queensland, 4067, for the programme and registration form.

Horticulture in the Burnett Region

by K. R. Jorgensen, Horticulture Branch.

THE Burnett Region is a major producer of a wide range of horticultural crops.

The most important of these are citrus, pineapples, melons and tomatoes. The region has several advantages for the production of horticultural crops. These include: a satisfactory rainfall with a minimum of cyclones, moderate frost incidence, and good transport to Brisbane and interstate markets. Soil and water resources are in adequate supply.

The most important horticultural areas within the region centre on Gayndah and Mundubbera where citrus and rockmelons are grown; Bundaberg where vegetables (especially tomatoes), pineapples, water melons and rock melons are produced; and Maryborough around which pineapples, citrus and vegetables are produced.

Districts and local authorities

The region can be divided into four major districts. On the coast in the north-east is the Coastal Burnett district which includes the city of Bundaberg (pop. 30 500) and the Shires of Woongarra, Gooburrum, Isis, Perry, Kolan and Miriam Vale. In the south-east of the region is the Maryborough-Hervey Bay district which includes the city of Maryborough (pop. 21 500) the town of Hervey Bay, Woocoo Shire and the northern half of the Tiaro Shire.

Inland of this, in the south-west of the region, is the Central Burnett district which includes the towns of Biggenden, Gayndah and Mundubbera each with its own shire area. The northern inland area is included in the Upper Burnett district which includes the towns of Eidsvold and Monto and their shire areas.

Topography

The topography of the region may be broken into three units.

THE COASTAL LOWLANDS

This is an area of gently undulating country which extends back from the coast an average of 25 km rising as it does so to a height of around 60 m above sea-level. North of the Kolan River the lowlands narrow to a width of 8 km and are not present at all north of Baffle Creek. Along the coastal edge, this unit includes areas of sand hills, heath downs and true coastal plain. These merge into low rolling hills to the west.

Within this unit are the alluvial plains of the lower Burnett and Mary Rivers and the lower reaches of several coastal streams of which the most important are the Burrum, Isis, Gregory, Elliot and Kolan Rivers, and Baffle Creek.

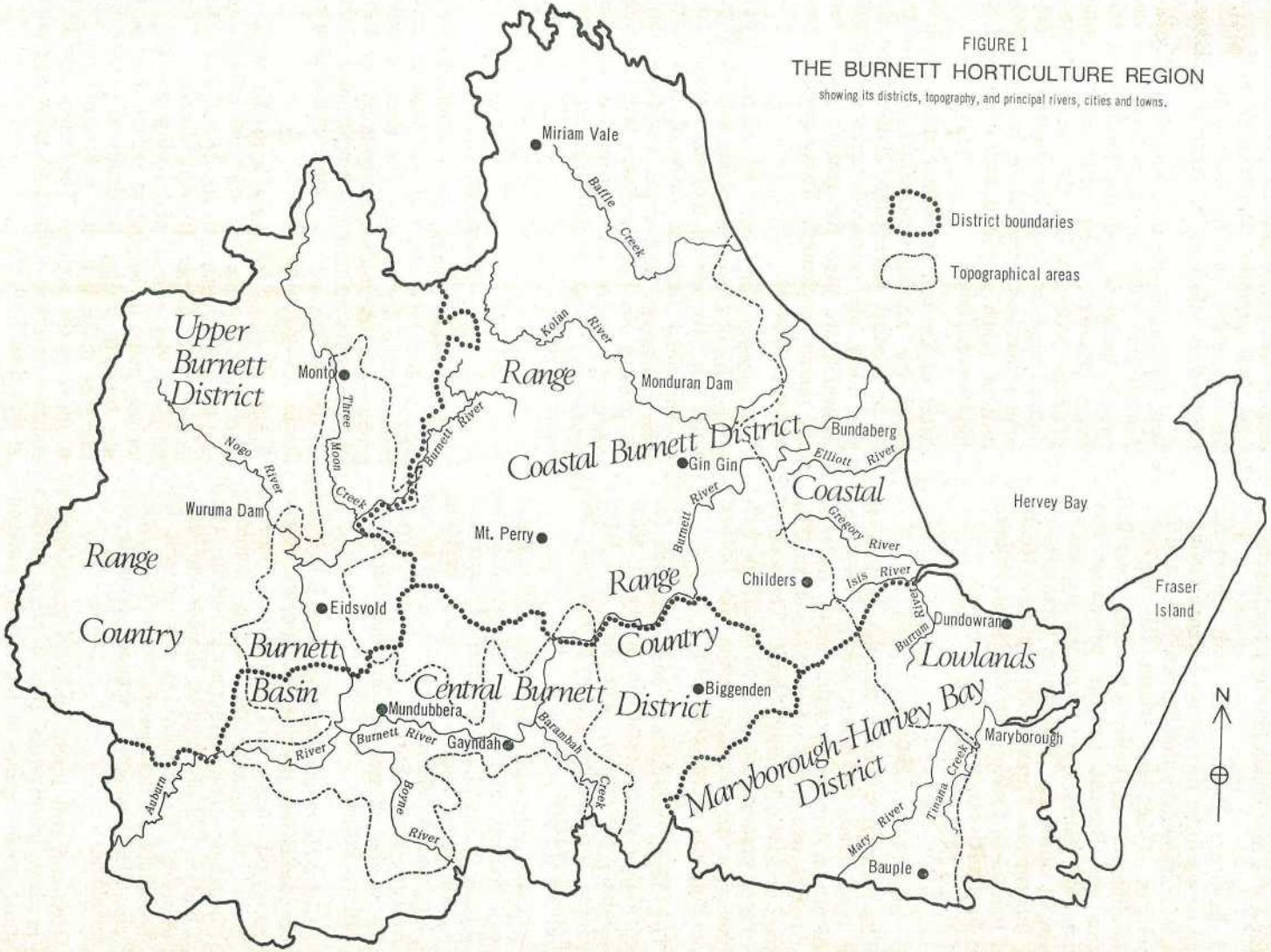
THE RANGE COUNTRY. There are two areas of dissected hilly to mountainous country. The larger of these runs in a broad band approximately north-south across the centre of the region. The major line of ranges includes in succession from south to north, the Coast, Bin Bin, Boolbunda, Burnett, Dawes and Many Peaks Ranges. There are other ranges east of these including the Urah, Woowoonga and Watalgan Ranges.

Local relief is moderate except in the vicinity of the major ranges where individual peaks rise to 670 m.

The second section of range country occurs on the western boundary of the region and it includes the Auburn Range and its foothills. This area is not so mountainous as the former and includes the Auburn Plateau.

The two sections of range country join north of Monto. The range country includes the headwaters of all the major streams in the area

FIGURE 1
THE BURNETT HORTICULTURE REGION
showing its districts, topography, and principal rivers, cities and towns.



except for the Mary and Boyne Rivers and Barambah Creek which flow up from the south.

THE BURNETT BASIN. This unit covers the basin between the two areas of Range Country which is drained by the Burnett River and its tributaries. The land within the basin is undulating with generally low relief. In most places, the Burnett and its tributaries run within deep banks up to 30 m high topped by levees of alluvium. The major tributaries of the Burnett are Three Moon, Splinter, Reid's and Barambah Creeks, and the Nogo, Auburn and Boyne Rivers.

Soils

The region contains a complex pattern of soil types many of which are not ideal for horticulture. A majority of the coastal lowlands is covered with soils which have a shallow topsoil underlain by clay subsoil. The soils of the range country are generally shallow with a moderate clay content while the Burnett basin contains deeper clay soils.

The deep, well-drained soils required for horticultural crops occur in scattered areas throughout the region. The main soil types used for horticulture can be placed into the following groups:

- Alluvial soils which are light-textured and well-drained. Suitable alluvials occur in the Burnett basin along the Burnett River and its tributaries and in the coastal lowlands along the middle and lower reaches of the Burnett, Mary, Burrum and Kolan Rivers. These alluvial soils are excellent for horticultural crops.
- Red friable loams and clay loams developed on basalts and lateritized sediments. These occur on ridges and plateaux at various points throughout the region including Bundaberg (the Hummock), Gin Gin, Childers, Bidwill, Bauple, Binjour and Mundubbera. These soils are very suitable for horticulture although in some cases (for example, Binjour) irrigation water is not available.
- Red and grey loams and clay loams with a gradual increase in clay content through their profile occur in the coastal lowlands and the foothills of the range country. The deeper and better-drained phases of these soils (for example, Bundaberg) are used for vegetables and for tree crops which have some tolerance of reduced drainage.
- Soils with sandy-textured topsoils and well-defined clay subsoils occur throughout the coastal lowlands and the foothills of the range country. These soils have internal drainage problems but the deeper, better-drained types are used for vegetables, pineapples and some tree crops provided procedures (such as raised beds) are used to improve drainage.

Most of the soil in coastal areas which is suitable for horticultural crops is currently used to produce sugar-cane. Throughout the region there are scattered areas of suitable soils which are used for grazing and a few areas remain uncleared. These require some searching to locate.

Soil erosion can occur on all soil types, and the risk of erosion increases with the slope of the soil. To prevent erosion, a grass cover is maintained between rows of tree crops while pineapples and some vegetable crops are planted on the contour. Wind erosion sometimes occurs on unprotected soils at Bundaberg. Most of the soils are acid and require liming.

Climate

The Burnett region has a subtropical climate with a long, hot and wet summer, mild winter and a dry spring. The major climatic problems are occasional droughts on one hand and the heavy rainfall resulting from cyclonic activity on the other. Some meteorological details are given in table 1.

Rainfall along the coast is in the range of 1 100 to 1 200 mm per year and it decreases rapidly moving inland to 700 to 800 mm in the Central and Upper Burnett districts. The relatively dry winter and spring periods are an advantage in helping to reduce diseases at the time of major horticultural production but they make irrigation a necessity for horticulture in the region. The heavy rainfall in summer makes it difficult to grow vegetables at that time.

TABLE 1
METEOROLOGICAL DATA

——	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Rainfall (mm)													
Bundaberg	221	183	141	84	66	69	54	32	37	60	79	133	1159
Maryborough	178	181	166	92	75	73	55	41	45	75	85	134	1200
Gayndah	121	111	80	36	40	44	39	29	37	64	76	109	786
Monto	116	124	80	40	43	40	38	25	23	54	80	92	755
Max. Temperature (°C)													
Bundaberg	29·8	29·7	29·0	27·4	24·5	22·4	21·6	23·2	25·0	27·0	28·4	29·3	26·4
Maryborough	29·8	29·4	28·6	26·9	24·1	22·0	21·2	23·0	25·1	27·3	28·5	29·3	26·3
Gayndah	32·0	31·6	30·5	28·7	25·1	22·5	21·7	23·6	26·5	29·3	31·3	32·0	27·9
Monto	31·7	31·1	29·8	27·7	24·1	21·1	20·4	22·8	25·9	29·0	31·3	31·3	..
Min. Temperature (°C)													
Bundaberg	21·4	21·3	20·0	17·7	14·2	11·9	10·1	11·4	13·8	17·0	19·3	20·5	16·6
Maryborough	20·3	20·4	19·0	16·6	12·6	9·9	7·8	8·8	11·6	15·3	17·4	18·9	14·9
Gayndah	20·1	19·9	18·1	14·7	10·3	7·9	5·8	7·3	10·3	14·3	17·2	19·0	13·7
Monto	19·0	18·4	16·8	12·9	9·3	6·5	4·8	6·7	9·2	13·0	15·7	17·6	12·5
Evaporation (mm)													
Bundaberg	200	180	160	160	120	90	80	80	130	200	200	200	1800
Gayndah	220	220	190	150	120	70	80	90	150	190	200	220	1900

Temperatures are at their highest in January with a mean maximum of around 29·8°C on the coast rising to 32°C in the Central Burnett. July is the coldest month with a mean minimum of 10·1°C at Bundaberg and 7·8°C at Maryborough. Moving inland, temperatures fall to a mean July minimum of 5·8°C at Gayndah and 4·8°C at Monto. The highest summer temperatures and the lowest winter temperatures can interfere with fruit setting of some crops, such as tomatoes.

Light frosts occur throughout the region mainly in June, July and August, and heavy frosts occur in the north-west and south-west. Frost incidence increases moving north to south along the coast, from coast to inland throughout the region and from south to north within the Burnett basin. Frost incidence on individual properties is determined, however, by local topography as much as by district temperatures. Citrus is grown in the Central Burnett district with only occasional frost damage while tomatoes can be grown on selected sites in the Bundaberg district throughout winter.

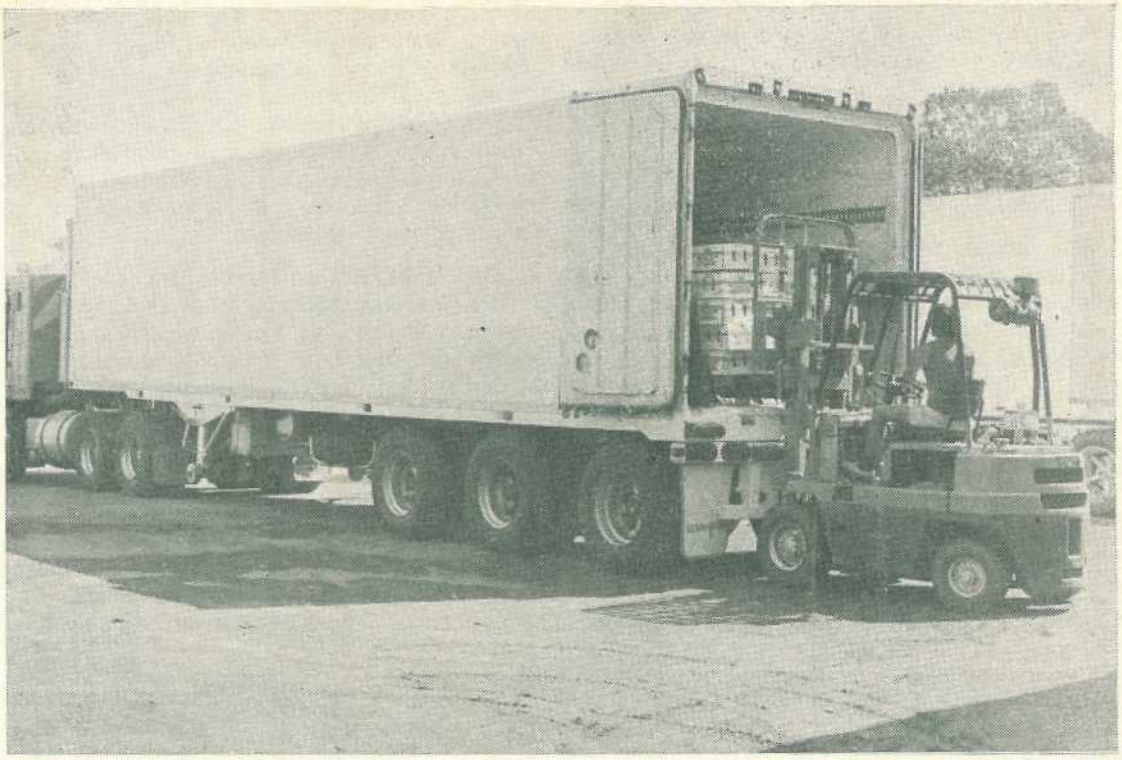
Humidities overnight average 70% R.H. throughout the region. During the day, humidities fall to 60% or less on the coast and 50% or less inland. In the morning along the coast, peak relative humidities are usually found in February or March while inland the peak months are in June.

Evaporation rates are highest in the summer months and lowest in winter. Evaporation is slightly greater inland (Gayndah 1 900 mm per year) than on the coast (Bundaberg 1 800 mm).

Winds throughout the region are generally north-east to south-east throughout the day, with a westerly tendency overnight. An average of 1·5 tropical cyclones occur along the coast each year. However only 20% of these cross the coast so cyclonic wind damage is not common. Thunderstorms occur throughout the region with an average frequency of 20 to 30 per year at any one site. Some of these produce hail which causes crop damage.

Major flooding occurs in the Burnett and Mary Rivers, often as the result of a cyclonic influence, but does not have a serious effect on horticultural crops. Permanent tree crops are grown on high levee banks while short-term crops are not in the ground during summer when the floods occur. Flash flooding in small streams from storms and cyclones may cause damage. The prolonged heavy rain produced by cyclonic influences causes

The Burnett River at Gayndah flows between high levee banks.



Refrigerated trucks are used to transport cooled produce to interstate markets.

waterlogging of soils which may lead to problems with crops such as avocado which require good soil drainage.

Droughts occur throughout the region from time to time and ten such periods of 2 or more years have occurred since 1880.

Irrigation

Irrigation is essential for horticutural production throughout the region because of the normal hot dry weather in spring when most crops are being grown.

The Burnett River and its tributaries provide a good water supply to farmers along their banks except during drought periods. Supplies from the Burnett River have been improved considerably by the construction of the Wuruma Dam near Eidsvold which maintains river flow during dry periods. The Mundubbera Weir holds water for local use only. The water of the Burnett River and its tributaries contains salt levels and these can cause problems in dry seasons.

In the Bundaberg district, some areas have good supplies of underground water. Other areas are supplied with water via the channels of the Bundaberg Irrigation Scheme which distributes water stored in the Monduran Dam and Kolan Barrage on the Kolan River and the Bundaberg Barrage on the Burnett River. Water from this Scheme is, however, only available to farms which were in production in 1970 and most of these are cane farms.

The Mary River has good water supplies available upstream of the tidal influence at Tiaro, below that the water may become salty during droughts. Other coastal streams also provide water for irrigation but many are unreliable. Exceptions occur where there are large water holes or storages such as the Burrum River Weir.

Only limited underground water is available throughout the region with the exception of the major aquifer at Bundaberg. The minor

aquifers that do exist are often discontinuous and unpredictable in their occurrence. Where no water is available from other sources, gully dams are constructed to store run-off water on the farm.

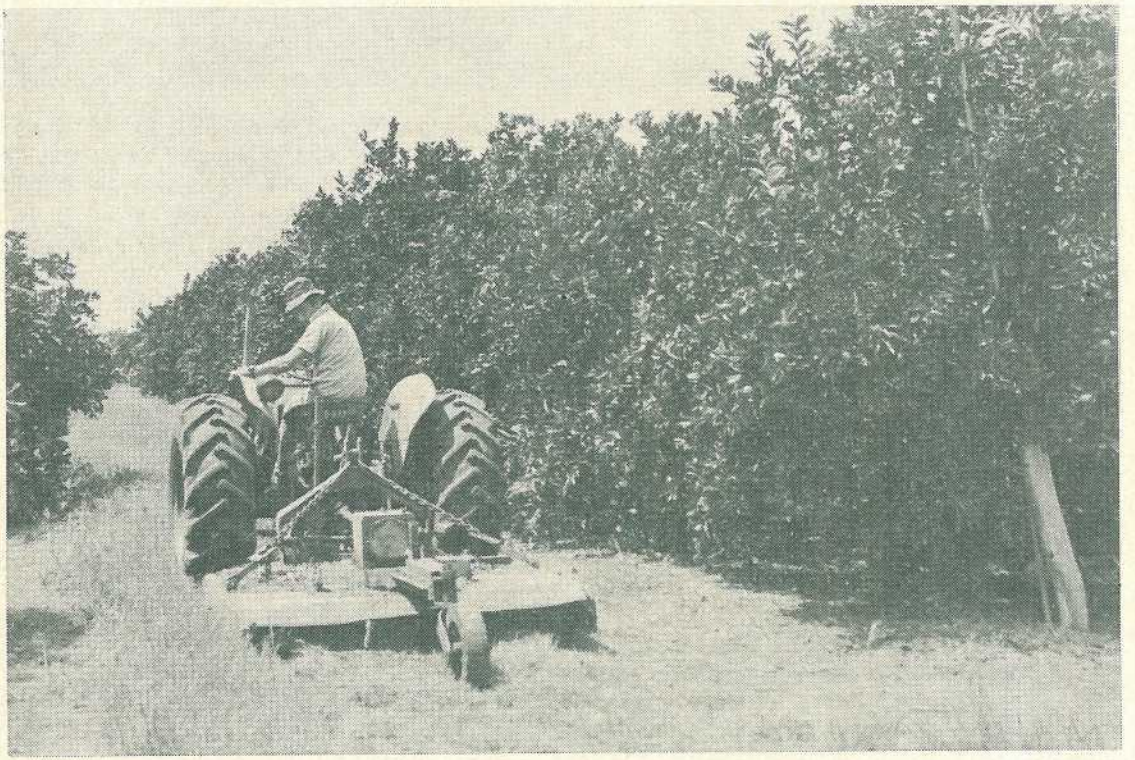
Marketing and transport

The major markets for the horticultural products of the Burnett region are in the capital cities of Sydney, Brisbane and Melbourne. These require high quality produce which has been carefully graded and packed and has a good shelf life. Refrigeration is being used to an increasing extent to cool perishable vegetables prior to their transport and it is an essential treatment for citrus being shipped overseas.

Citrus fruits, particularly mandarins from the Central Burnett, are exported through the port of Brisbane to Europe, Canada, New Zealand and South-east Asia. These fruits are specially treated to maintain their quality and prevent breakdown before being packed in overseas shipping containers and sent by rail to Brisbane. Citrus fruit for New Zealand and Victoria has to be fumigated with ethylene di-bromide to control Queensland fruit fly and this is done at Gayndah and Mundubbera. A fumigation chamber is also available at Bundaberg for vegetables.

Citrus fruit and pineapples are sent by rail to Brisbane for processing at the Northgate cannery. Processing crops which are more perishable such as beans, zucchini and cucumbers are taken to Brisbane by road.

The major horticultural districts of the region are well served by rail transport but its use is declining. Road transport is being used to an increasing extent because of the speed and cost of the transport and the reduced handling involved. The large centres of production (Bundaberg, Gayndah and Mundubbera) have a regular and reliable road



Most citrus trees are grown with a herbicide-treated strip along the tree row and a mown sod between the rows.

Macadamia nuts are grown in the coastal districts of the Burnett Region.

transport system during the harvest periods and refrigerated transport is available from Bundaberg to the southern capital cities.

Some produce is sold locally through the market agents at Bundaberg and Maryborough and an increasing amount is sold from roadside stalls.

Horticultural crops

Citrus

The Central Burnett district around the towns of Gayndah and Mundubbera is the major citrus district in Queensland, producing 60% of the state's crop. Its advantages for citrus production include the warm, dry climate which produces attractive, blemish-free fruit which mature earlier than those in other Australian States; the availability of irrigation water; the well-drained soils along the Burnett, and the low frost hazard.

The district is well suited to mandarin production and the main variety grown is the Ellendale which is sold on all Australian markets and also exported overseas. Mandarins comprise 41% of production while oranges (mainly Navels and Valencias) make up 43% of the crop. There are small areas of lemons and grapefruit. The majority of the fruit is sold fresh and only 15% is sold for processing.

All of the orchards are irrigated and each pumps its own supplies from the Burnett River or a tributary. The water is applied by fixed overhead sprays, under-tree sprays or travelling irrigators. A permanent sod is maintained between the tree rows to protect the soil from erosion and compaction. Each orchard had its own equipment including a large pesticide sprayer and most have their own packing shed complete with post-harvest treatment equipment. At Gayndah, 15 growers operate a large co-operative packing shed.

Small areas of minor tropical and subtropical tree fruits such as mango are being established throughout the region. This mango tree was photographed at Mundubbera.

TABLE 2

HORTICULTURAL PRODUCTION (1978–79 A.B.S.)

Crop	Not Bearing	Bearing	Production (tonnes)
Fruit			
Citrus	62 820 trees	261 980 trees	31 564
Avocados	9 640 trees	1 330 trees	12
Macadamia	3 760 trees	47 260 trees	587
Bananas	24 ha	19 ha	94
Pineapples	194 ha	334 ha	6 466
Total fruit (bearing and not bearing)	..	2 506 ha	..
Vegetables			
Tomatoes	..	200 ha	3 295
Beans	..	472 ha	1 989
Capsicums	..	42 ha	242
Zucchini and squashes	..	69 ha	497
Rock melons	..	241 ha	2 786
Water melons	..	590 ha	5 847
Total vegetables excluding potatoes ..	..	2 068 ha	..

Source—Australian Bureau of Statistics

There is also a small citrus industry of 150 ha in the Burrum district near Howard. Fruit from this coastal district are more suitable for processing and many Valencia and Joppa oranges are grown for this purpose. Most of the orchards are on the alluvial soils of the Burrum River and draw water for irrigation from the Burrum Weir. Orchards below the weir or on soils away from the river use farm dams or bores for water supplies.

Macadamia nuts

The macadamia is native to the coastal ranges in the south-east of the Burnett Region and it is now becoming an important crop throughout the coastal areas. The largest orchard owned by the C.S.R. Company is near the mouth of Baffle Creek north of Bundaberg and this company has another orchard south of Maryborough. Privately-owned orchards range from a few trees to 20 ha.

All the orchards are in coastal areas and many are on soils with only moderate internal drainage which the macadamia can utilize quite well. All of the large orchards are irrigated.

Other tree and vine fruits

Small areas of avocado are scattered throughout the region wherever suitable areas of very well-drained soils are available. The trees in the inland areas are least affected by root rot although they are subject to salt problems. Only a few mangoes and custard apples are currently grown.

Small areas of grapes are grown mainly in the inland areas along the Burnett River. There are some problems with diseases and birds but the crop matures at Christmas when prices are good. The new Cardinal variety ripens earlier than the standard Muscat and obtains high prices.

Pineapples

Pineapples are an important crop in frost-free areas of the coastal district. The main producing areas are around Bundaberg and in the Dundowran and Bauple areas near Maryborough. The larger farms are fully mechanized for fertilizing and harvesting while all operations are done by hand on the smaller farms. Most of the production goes to the Northgate Cannery for processing but increasing quantities are sold fresh.

Other plantation fruits

Bananas are a minor crop with the main area of production in the coastal area north of Bundaberg. The whole region is free from

Bunchy Top disease. Papaws and passionfruit are grown in a few scattered areas mainly in the Maryborough district.

Melons

Rockmelons are an important crop throughout the region and they are grown mainly in the warm dry spring months. The largest areas are in the Central Burnett district where they are grown as a side-line by citrus growers and graziers. Production of rockmelons is increasing in the Bundaberg district.

The Bundaberg district concentrates more on the production of watermelons which are often grown as a side-line by cane farmers for the early summer market. Watermelons are a convenient crop to grow because they can utilize the irrigation facilities that these farmers have available yet they require a minimum of post-harvest handling.

Tomatoes

Tomatoes are an important crop in the Bundaberg district which has established a reputation for high quality in all the major east coast markets. Some of the growers are vegetable specialists but many grow vegetables as a side-line to sugar-cane. This combination allows the vegetable areas to be rotated around the farm from year to year.

Production methods are becoming mechanized to an increasing extent. Almost all blocks are now established using container propagation techniques or field seeding and there is an increasing sophistication in post-harvest handling including fungicide treatments and cooling. Most of the crop is sold on interstate markets so there is a need for careful post-harvest handling procedures to ensure that the tomatoes arrive in good condition.

Spring and autumn are the main production times but it is possible to grow the crop through the winter on good frost-free land. Midsummer is too hot and wet for efficient production.

Small areas of tomatoes are also grown in the Maryborough and Central Burnett districts for sale locally or in Brisbane.

Other vegetables

Almost all vegetables are grown in the region except for those requiring cool conditions such as celery. Most are sold on Brisbane and interstate markets.

Beans are grown in the coastal districts for fresh market sales and large areas are also grown in Bundaberg for processing in Brisbane. Many of the processing beans are grown by cane farmers and the beans are mechanically harvested.

Capsicums are grown in coastal districts especially at Bundaberg where there are several specialist growers. Zucchinis are grown throughout the coastal districts for fresh fruit markets. Some zucchinis and cucumbers are grown at Bundaberg for processing. Small areas of cucumbers and moderate areas of pumpkins are grown throughout the region.

Cabbage, cauliflower and lettuce are grown in small quantities, mainly for local sale.

Future prospects

The Burnett Horticulture Region has some land and water resources available for further horticulture production and a steady expansion of the industry is anticipated.

The availability of markets will have a strong influence on this expansion. The overall market for produce in Australia is expanding only as fast as the Australian population, although sales of certain specialty fruits are expanding more rapidly as production techniques improve.

Export markets are currently available for citrus especially mandarins, but these markets are never secure because of changing competition, freight costs and chemical treatment restrictions.

Some expansion of horticulture in the region will occur as a result of the shift of production from other regions. The movement of growers to the region from southern regions and other States is expected to continue because of the lower prices of land and the suitable climate. In other cases, restricted production in other regions due to urban pressure will provide production opportunities for Burnett growers.

One of the important factors affecting the expansion of horticulture in the coastal districts of the region is the relative profitability of sugar-cane production. As cane prices rise, cane growers in the Bundaberg district have less need to supplement their income with vegetable production.

When prices rise sufficiently to produce an expansion in assigned cane areas, former horticultural areas are used to grow cane and horticultural production is forced further from the mill areas which are the centres of population. Although sugar-cane will grow satisfactorily on poorly-drained soils, it is usually grown on the best soils with available water close to the mill.

Water supplies

Several new water storage structures are being planned which may assist in the production of horticultural crops in the Region. These include the Boondooma Dam on the Boyne River, barrages on the Mary River and Tinana Creek near Maryborough, the Cania Dam on Three Moon Creek, the Gayndah Weir on the Burnett River and the Bucca Weir on the Kolan River.

Crops

Citrus production is expected to undergo moderate expansion in the Central Burnett, provided export markets continue to be available. Citrus growers in that district could also expand into other tree and vine fruits such as early grapes, avocados, early peaches, mangoes, litchis and kiwi fruit which are under-supplied on Australian markets.

Several of these crops need further investigation and development before large plantings can be recommended. Large, undeveloped areas of well-drained soils are scarce along the Burnett and its tributaries but land is available on ridges a short distance from the streams.

Macadamia plantings are expected to increase particularly in coastal districts. Markets are available for this crop and it can be grown on soils with less than perfect internal drainage. The production of macadamias and other tree crops will expand on good soils in coastal districts which are too steep for cane, providing that irrigation water is available.

Pineapple production will remain stable, limited by available markets. There is also a likelihood that some southern growers will move their pineapple production to this region in coming years. Papaw and banana production will undergo moderate expansion.

Vegetable production will increase mainly in the Bundaberg district which has the best soils in the coastal parts of the region. Expanding sugar production will force horticulture to move north and west of Bundaberg. Increasing freight costs are expected to improve the region's competitive advantage compared with more northerly regions.

CHANGING YOUR ADDRESS?

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Trap yards for feral goats

by D. R. NIVEN, Sheep and Wool Branch.

SEMI-ARID Australia is home to a large but unknown number of feral goats.

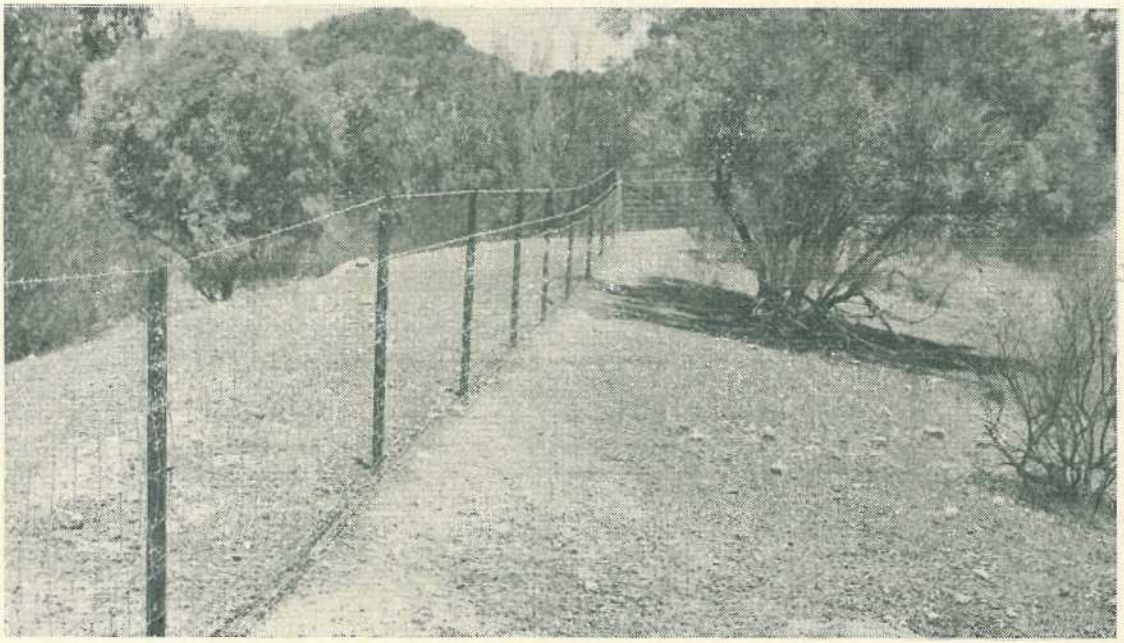
100 000 have been taken from the Charleville area alone over the past year. This gives some idea of the vast numbers in Australia's interior.

Most of the goats taken are sent to meatworks but some are used by Angora breeders in up-grading programmes.

Feral goats prefer the scrubby and rocky areas of a property and are therefore difficult to muster. In order to overcome this problem, Mr Les Landsberg of 'Nimboy', Cooladdi constructed a goat trap on his property. He did this by fencing off an earth tank in a paddock where numbers of feral goats had been observed. The fence is an eight wire hinge joint run as close to the ground as possible and topped with two barbed wires.

Entry to the trap is via a gate or an adjacent jump down. When trapping commences and the gate is closed, entry can still be made via the jump. The jump is an excavation railed to a height of 1·4 m and with wings along each side so that goats are unable to jump out once they have entered the trap. A force pen and loading ramp are situated at a convenient point in the trap. The ramp is constructed so that the goats run uphill to make loading easier.

Mr Landsberg's yard has proved an effective and simple goat trap. Apart from the labour that was required for construction, it enables him to capitalize on his feral goat population with a minimum of effort.



A section of fence line showing the eight wire hinge joint topped by two barbed wires.

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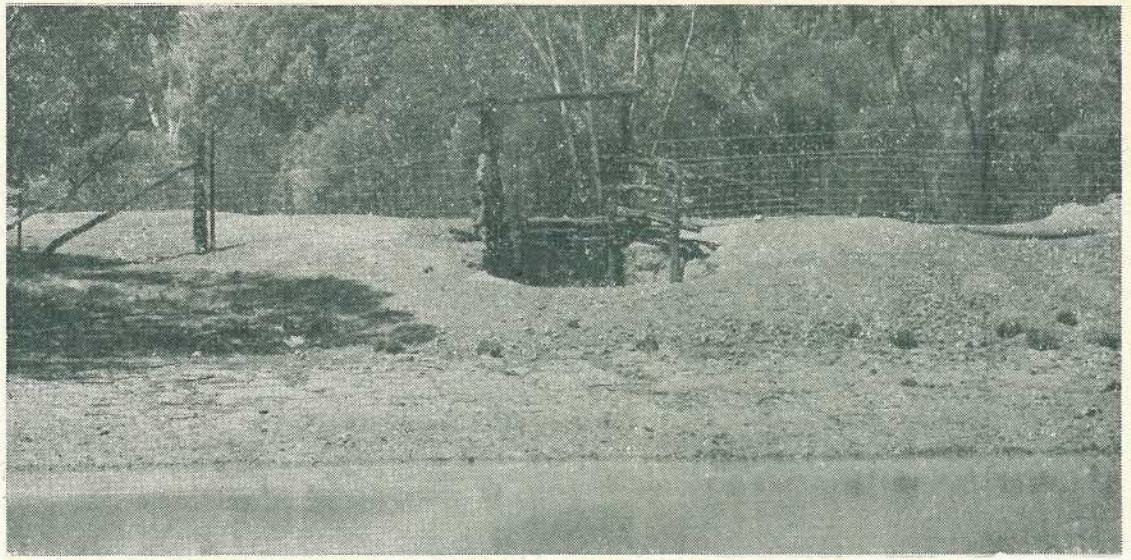


The gate and jump-down section. The 1·4 m jump with wings on each side prevents goats from jumping out once they have entered the trap.

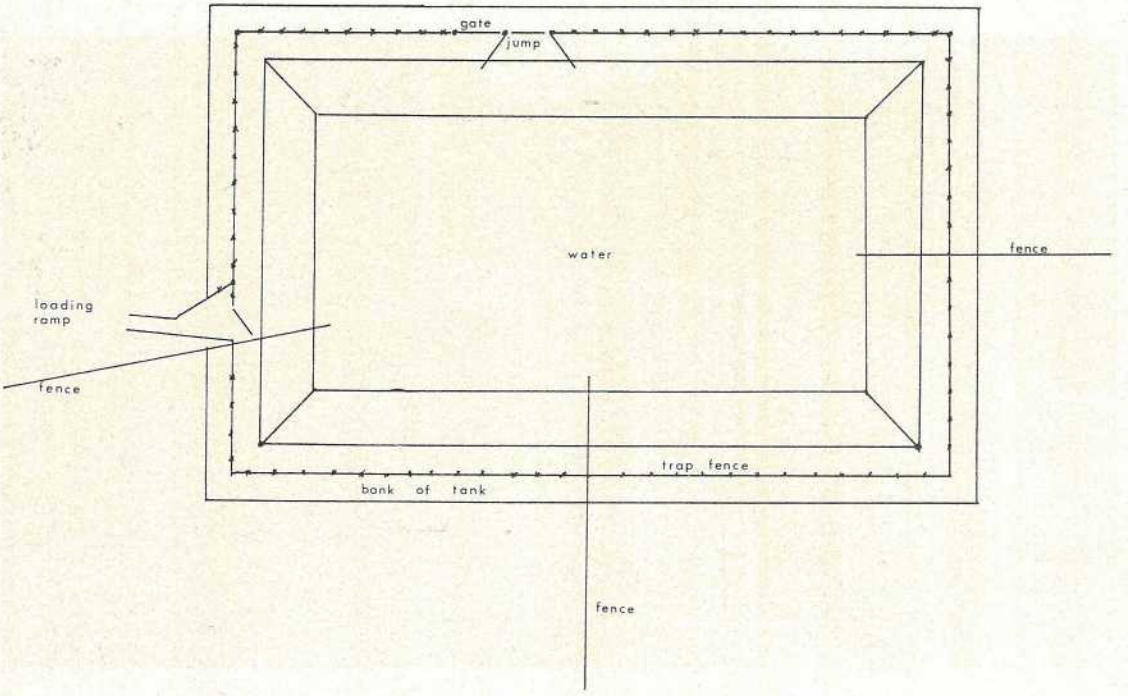


Figure 1. Plan of the goat trap.

Steel mesh silos for on-farm grain storage

PROBABLY the most common form of temporary on-farm storage is the mesh silo. Many of these structures have become semi-permanent as they are a cheap, effective method of storing grain.

by N. A. Hamilton, Agriculture Branch

Siting the structure

The site should be well drained with no likelihood of run-off water accumulating at the base of the silo. The centre of the formed base is humped to allow the drainage of any water which may have penetrated the dump.

Mesh silos erected under a shed must be protected on all sides from the weather. This is especially important if the bin floor is sealed.

Photograph above. Double diameter single height steel mesh silos each with a capacity of 160 t. As the silos are under cover, polypropylene liners have been used.

TABLE 1

STEEL MESH SIZES

Size	Dimensions	Cost ($)*
GSM 46 G55A ..	100 mm x 150 mm; 14·25 m long x 2·3 m high	84.80
GSM 44 G5A ..	100 mm x 100 mm; 14·25 m long x 2·3 m high	103.55

* Costs are ex Brisbane as at March, 1980.

TABLE 2

LINERS FOR STEEL MESH SILOS

Size	Material	Cost ($)*
15·24 m x 4·16 m	GSA hessian (double sheet)	62.60
	GSA polypropylene (two sheets)	53.19
15·24 m x 2·438 m	GSA hessian (single sheet)	33.60
	GSA polypropylene (single sheet)	23.20

* Costs are ex Brisbane as at March, 1980.

TABLE 3

OPTIONAL EXTRAS

Item	Dimension	Cost ($)*
ground sheets	..	12.53
black polypropylene top cover	6 m x 6 m x 200 m	30.80
yellow outdoor vinyl cover	5·5 m x 5·5 m x 200 mm	34.93

* Costs are ex Brisbane as at March, 1980.

Hessian may be used as ground cover for mesh silos erected in the open to minimize unloading losses. Polypropylene or bitumenized paper are impermeable to water and should not be used as ground cover unless a top cover is also used.

Materials required

Two sizes of steel mesh are available (table 1).

Liners are also available in two sizes and are either of hessian or polypropylene (table 2).

The optional extras for steel mesh silos are outlined in table 3.

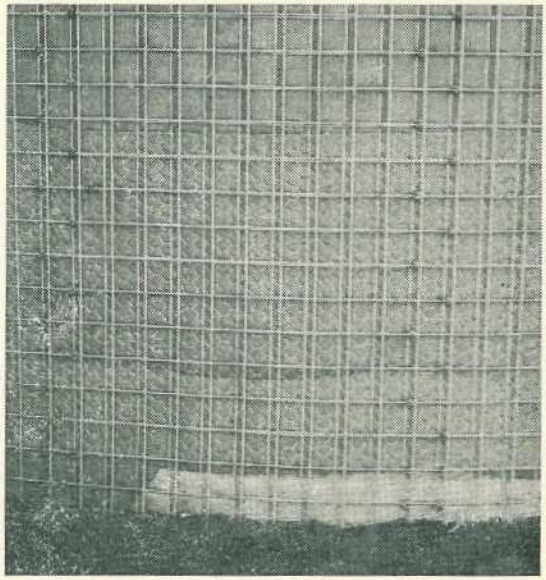
If top covers are used with mesh silos, the material can be protected against ripping by cutting longitudinally a length of 12 mm garden hose, equivalent in length to the circumference of the silo, and fitting this over the top of the mesh and tying into place.

Moisture and air can flow through hessian and provide some aeration of the grain mass. However, hessian has a relatively short life as it rots and is susceptible to insect and termite damage.

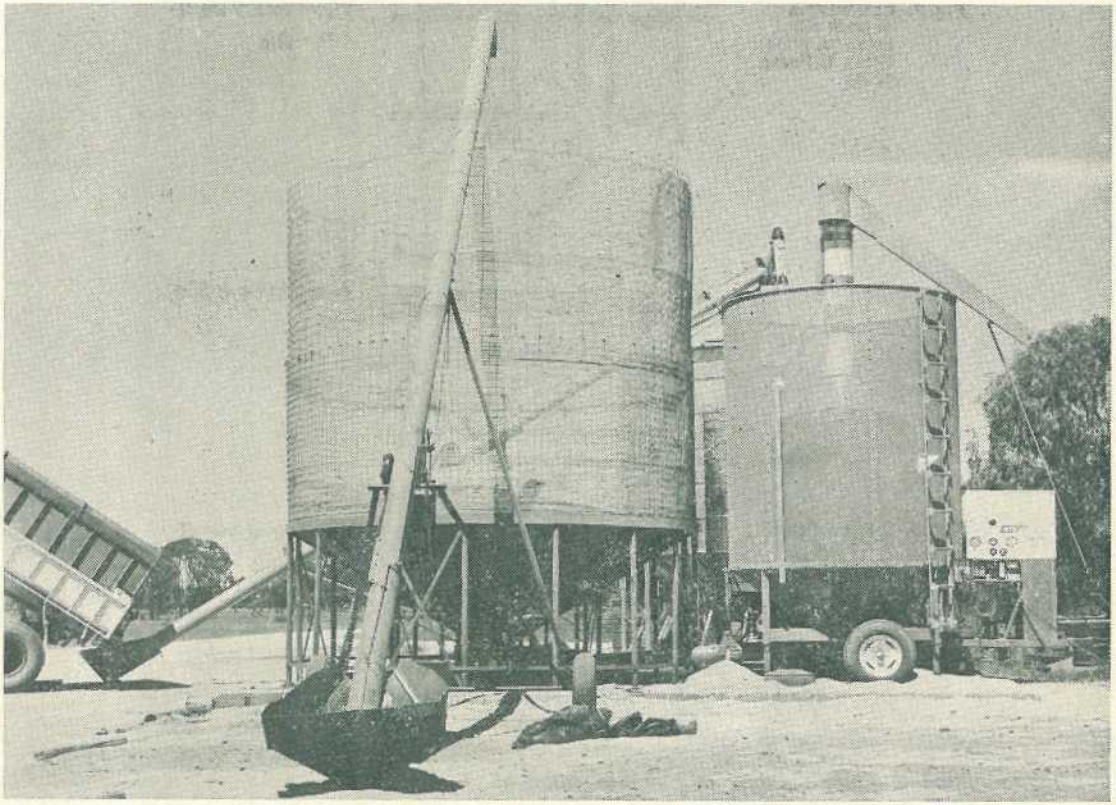
Polypropylene is cleaner to use, stronger and less susceptible to ripping or weather damage. The polypropylene normally used is a fibrous, woven material. The weave is

tighter than that of hessian and only forced aeration is possible through the material. In outdoor storages, the material diverts water running off the peaked grain surface down the inside of the mesh silo and large quantities of grain may be lost. Polypropylene is a better conductor of heat and accelerates moisture migration which leads to deterioration of grain quality.

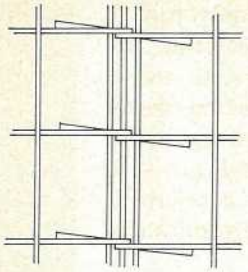
Because of these characteristics, it is desirable to use hessian in outdoor, uncovered mesh silos and to use polypropylene in undercover mesh silos.



Mesh silo correctly joined using U clips. The overlap used here is in excess of standard requirements. Note the staggered position of the clips.



Single diameter double height steel mesh silo on a conical base to allow easy, even unloading. This silo has a capacity of 60 t.



View from outside of Silo

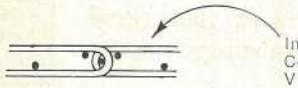
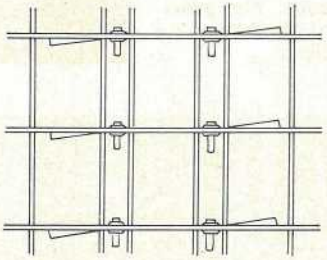
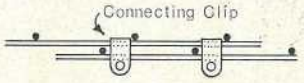


Fig. 1. Construction of mesh silo using a connecting rod. (From T. Fusae 1978)

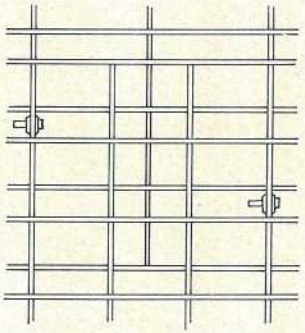


View from outside of Silo

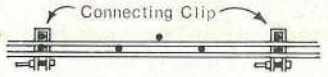


View from top of Silo

Fig. 2. Construction of mesh silo using 'U' clips (From T. Fusae 1978)



View from outside of Silo



View from top of Silo

Fig. 3. Construction of double height mesh silo using 'U' clips (From T. Fusae 1978)

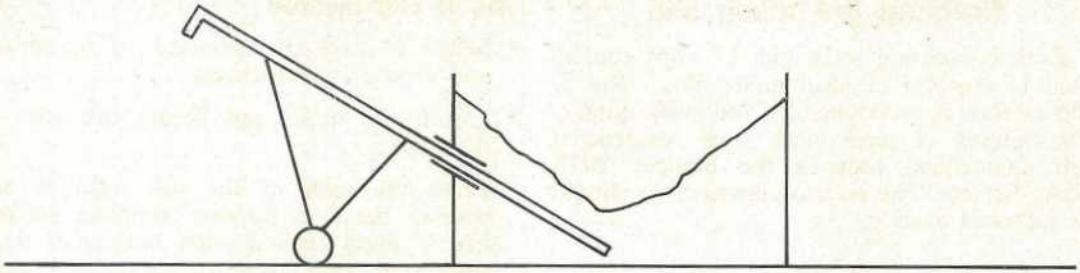


Fig. 5. Unloading a mesh silo through auger port cut into side of mesh.

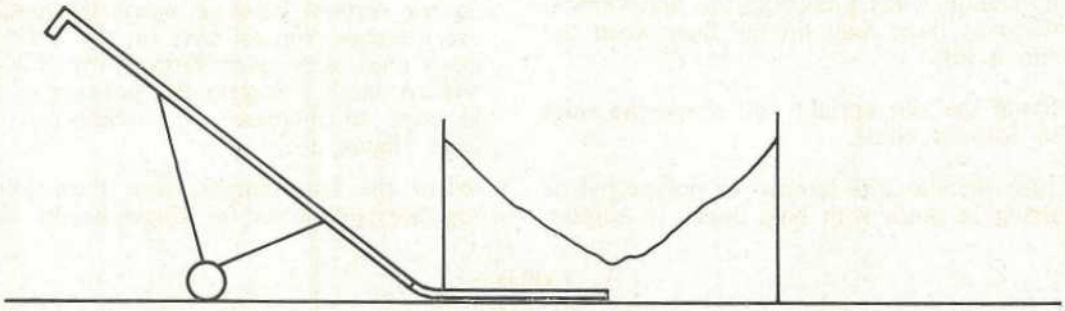


Fig. 6. Unloading a mesh silo through tunnel with auger extension. This is used when auger cannot reach centre of silo

Erecting the mesh silo

Both connecting rods and 'U' clips can be used in erection of steel mesh silos. The U clip method is recommended following numerous failures of steel mesh silos constructed with connecting rods in the bumper 1978 wheat harvest. The erection instructions should be followed exactly.

The connecting rod method

- Select a level site adjacent to operations and clear of obstructions.
- Unroll the mesh and flatten the ends of the roll.
- Place a piece of pipe across the mesh between the first and second vertical wires in from the end of the roll. Bend the mesh around the pipe ensuring that the bend is parallel to the vertical wire for the full width of the roll. Repeat the procedure at the other end of the roll.
- Bring the ends of the roll together with the folded ends facing towards the centre of the silo. Interlock the ends and insert the connecting rod to form a permanent joint (figure 1). Trim off any protruding horizontal wires preceding the first vertical wires as these may rip the liner when the silo is full.
- Stand the silo upright and shape the sides to form a circle.
- Line the silo with hessian or polypropylene fixing in place with bale hooks or similar.

The U clip method

- Select a level site adjacent to operations and clear of obstructions.
- Unroll the mesh and flatten the ends of the roll.
- Bring the ends of the roll together and overlap the ends by two complete meshes. Fix U clips around each horizontal wire, staggering their position over the full width of the mesh (figure 2). Under no circumstances, are the U clips to be placed around the vertical wires in the erected silo, as such a joint has very little strength.
- Stand the silo upright and shape the sides to form a circle.
- Line the silo with hessian or polypropylene —fixing in place with bale hooks or similar.

Double height silos

Double height silos can be constructed using 46G55A for the top tier and 44G5A for the base. U clips should be used for all joints.

- Unroll both rolls of mesh and overlap three full meshes for the complete length of the rolls.
- Join the two lengths of mesh with U clips on the vertical wires at every 300 mm, at every second vertical wire on the 46G55A mesh and every third vertical wire on the 44G5A mesh. Stagger the position of the U clips to increase the stability of the joint (figure 3).
- When the two lengths have been joined together, follow as for single height silos.

TABLE 4

CAPACITIES OF MESH SILOS

—	Single steel mesh ring—heaped grain	Double height steel mesh—heaped grain	Two lengths of single height steel mesh—heaped grain
Volume m^3	43·5	80	201
Approx. tonnes of wheat ..	30	55	140
Cost*	$126.75	$253.50	$260.29
Cost*/tonne	$4.23	$4.61	$1.86

* Ex Brisbane March, 1980—polypropylene liner and 44G5A steel mesh.

Loading and unloading mesh silos

Loading and unloading must be done evenly from the centre to maintain the stability of the mesh silo. In double diameter mesh silos, the auger may have to be altered to reach the middle of the silo. Chutes on the end of the auger can increase the reach.

When unloading, push the auger right into the centre of the silo. One method of unloading the mesh silo is to have a hole cut into the side of the bin. This should be reinforced with another layer of mesh around the hole. A short tube is inserted into this roll, a 20 L drum opened at both ends pointing down into the silo will suffice. The auger is then inserted into the silo through the hole (figure 4).

Where it is not possible to get the auger to the middle of the silo, more than one port may have to be opened to ensure even unloading.

Where no ports were made during silo erection, the silo can be unloaded by cutting the liner and allowing the grain to spill out of the silo to be augered from a hole dug beside the silo. It is very important to have several exits in this case to ensure even unloading.

Another method of ensuring even unloading is to erect a tunnel across the floor of the silo. This can be made of ducting or mesh covered with bags. To unload, an auger extension is pushed into this tunnel (figure 5).

Conical steel bases are available for single diameter silos. These are self emptying and ensure even and complete unloading.

Breakthrough in brucellosis eradication campaign

The Brucellosis disease eradication campaign in Queensland has reached a milestone with the declaration of the North Queensland brucellosis provisionally free area—the first in the State.

The Minister for Primary Industries, Mr. V. B. Sullivan, said the area comprised all of the veterinary divisions based on Cairns and Townsville, plus the Croydon and Carpentaria Shires.

Cattle production there was more than 2·5 million head on 2 300 holdings.

Virtually all herds have been assessed and very few remain infected. In fact, the area prevalence is only three animals in every 100 000 head.

Mr. Sullivan said the declaration was due largely to the unqualified support given by producers in the area, who had fully realised the importance of brucellosis eradication from both the human and animal points of view.

Eradication also was necessary to ensure continued access to important overseas markets on which the livelihood of these producers largely depended.

The declaration represents a most encouraging sign to stockowners in other areas and a significant advance in plans to have the whole State declared provisionally free of both brucellosis and tuberculosis by 1984.

Growing sweet corn for processing

by G. W. Lubach, Horticulture Branch

PROCESSING companies have shown considerable interest in sweet corn production for machine harvesting in South-east Queensland.

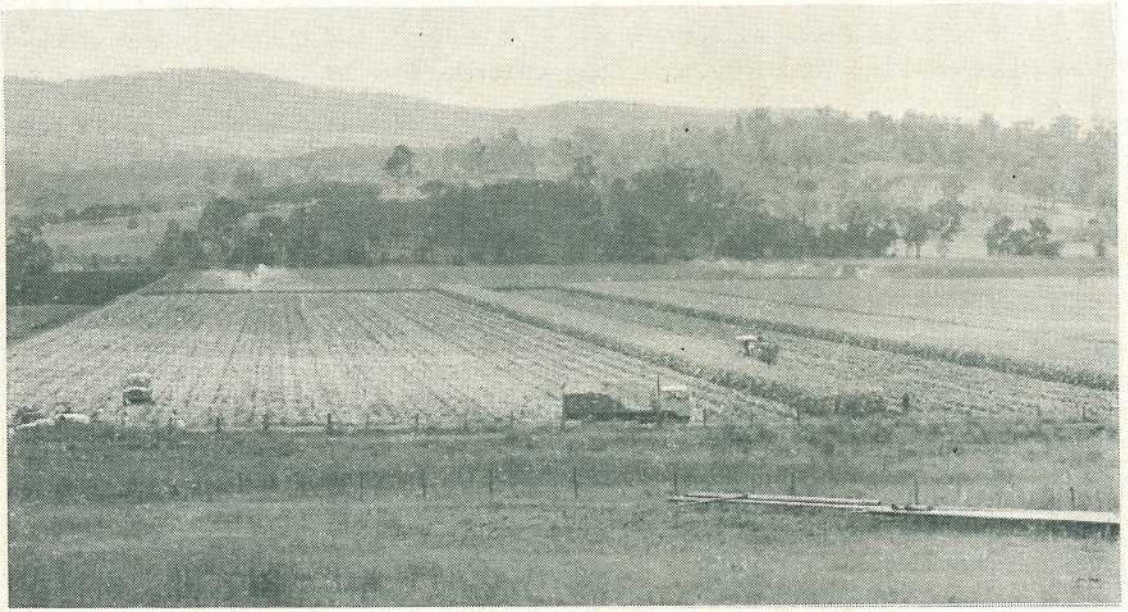
Since 1977, the annual area grown under contract for factory processing has averaged 300 ha. Sweet corn fits into many summer rotation programmes and can provide satisfactory financial returns. To obtain high yields, sweet corn requires specific management practices similar to other intensively grown vegetables.

Climatic requirements

To mature successfully, sweet corn requires a frost-free period of 65 to 110 days with day temperatures in the range of 15 to 32°C. Sweet corn plantings can commence after the risk of a late frost has passed, provided soil temperatures are above 10°C at a depth of 5 cm. This time will vary between districts but, in general, sowing can commence in early September and continue to mid February. Crops sown towards the end of the season are at greater risk from virus infection, and wet weather interfering with machine harvesting.

Production areas

The major areas of production are the Lockyer and Fassifern Valleys and the Beaudesert district. Proximity to processing factories, availability of large areas of relatively flat fertile land, ample supplies of good quality irrigation water and a long production period makes these areas suitable for sweet corn production and machine harvesting. In the long term, the eastern Darling Downs could be utilized as an additional production area.



Harvesting sweet corn in the Lockyer Valley.

A vacuum-operated precision planter produces uniform plant stands.

Sowing

Land preparation

Seedbed preparation should produce a fine tilth for a depth of 15 to 20 cm. Deep ripping may be necessary to break up heavy subsoils or hard pans. This practice promotes good drainage, increases aeration and deep root penetration.

Precision sowing

Uniform crop maturity is the objective set for any vegetable crop grown for once-over machine harvesting. Uniform maturity can be affected by irregular spacing of plants in the row and by uneven depth of seed placement.

Sweet corn seeds are rough, wrinkled and irregular in shape. They are smaller than maize seeds and do not flow easily into planter plates.

Vacuum-operated precision planters will produce the most uniform seed drop combined with accurate depth control. The belt type Stanhay (R) planters and recognised plate type corn planters including the Covington (R) can be used but plant spacing is often irregular.

Planting speeds are critical for uniform seed drop and spacing. Travelling too fast is common and causes irregularities in seed drop. An optimum speed for most planters is 4 to 6 km per hour but this will vary with the type of planter.

Planters with accurate depth control are essential for uniform seedling emergence. Planting too deep will affect plant emergence. In the loams and clay loams of the major production areas, planting depth should not be more than 2 to 3 cm. Planting any deeper may interfere with emergence if heavy rains cause the surface to crust before germination or if seed rots occur. In sandy loams, 3 cm is a good planting depth. In general, the closer the seed is to the surface, the quicker and more uniformly it will emerge provided moisture is maintained.

Plant population

Plant population and plant spacing have a marked effect on the size of cobs, yield and uniformity of the crop. It is important to think of planting rates in terms of a number of plants per ha rather than in kg of seed per ha.

The optimum plant population will vary widely depending on soil type, fertility, moisture availability, and on the varieties used. In general, a range of 37 000 to 45 000 plants per ha is satisfactory in most situations.

Very high populations, above 50 000 plants per ha, are not recommended. Cob size at these populations is too small and variable for processing requirements. Where moisture availability or soil fertility is limiting, a lower population of 32 000 plants per ha is necessary.

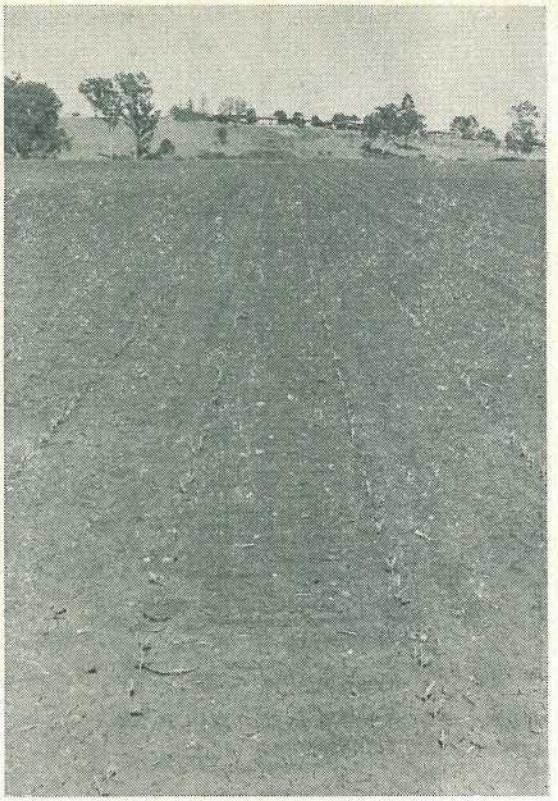
Plant spacing

Seed usage will range from 10 to 15 kg per ha varying with seed size, germination percentage and plant population required. Row spacing is governed by the harvesting machinery. Twin row harvesters generally work on 95 to 100 cm rows, while single row machines allow for closer row widths. Within the row, plant spacings range from 20 to 40 cm.

Table I can be used to determine the distance between plants within the row at varying row spacings and plant populations.

Varieties

Consistent production is often limited by the lack of suitable varieties combining satisfactory yield, quality and disease resistance. The most



Uniform plant establishment.

TABLE 1

SWEET CORN SPACING GUIDE—SEED DROP PER HECTARE

Row Width		Desired Population (no. of plants/hectare)					
		32 000	36 000	40 000	44 000	48 000	52 000
75	Distance between seeds (cm)	35	31	28	26	24	22
80		33	30	27	24	22	20
85		31	28	25	23	21	19
90		30	26	24	21	20	18
95		28	25	22	20	19	17
100		27	24	21	19	18	16

How to use this table

The figures in the body of the table show the approximate distance between SEEDS in the row at planting for each combination of desired plant population and row width.

They assume a 85% establishment of planted seeds. It should be remembered that planting too deeply or into poorly prepared soil, or at low soil temperatures may reduce establishment to a figure as low as 50%.

important diseases are maize dwarf mosaic (MDM) and leaf blight. Maize dwarf mosaic virus produces severe stunting of plants with poor cob set, particularly with heavy early infection. In autumn crops, levels of infection above 50% have commonly been recorded.

In the assessment of sweet corn varieties, desirable field characteristics are considered together with processing quality. The most important field characteristics are cob size, number of cobs per plant, time to maturity, tillering habit, plant size, heliothis resistance and disease resistance. Quality aspects from the factory viewpoint include kernel size, shape and colour, sugar content, tenderness, cob fullness (in frozen whole cobs), and recovery percentage (in kernel corn stripped from the cob).

Good yields have been obtained from the varieties Terrific, Rosella 422, Rosella 425 and Golden Treasure. Other varieties grown include NK 195, Iochief, Stylepak and Golden Fancy. All of the above varieties are susceptible to maize dwarf mosaic and leaf blight and problems could arise if they are used for late summer plantings.

A sweet corn breeding programme (initiated by Ian Martin at the Department of Primary Industries' Research Station at Kairi, North Queensland) has developed lines which are resistant to this virus. QK 467S is one promising line from this breeding programme.

This programme is continuing with further selection and district evaluation to produce a processing variety which has virus resistance and produces both satisfactory yield and quality.

Nutrition

Sweet corn is a heavy feeder and responds to a high level of soil fertility. A balanced, well-timed fertilizer programme is essential for optimum yields.

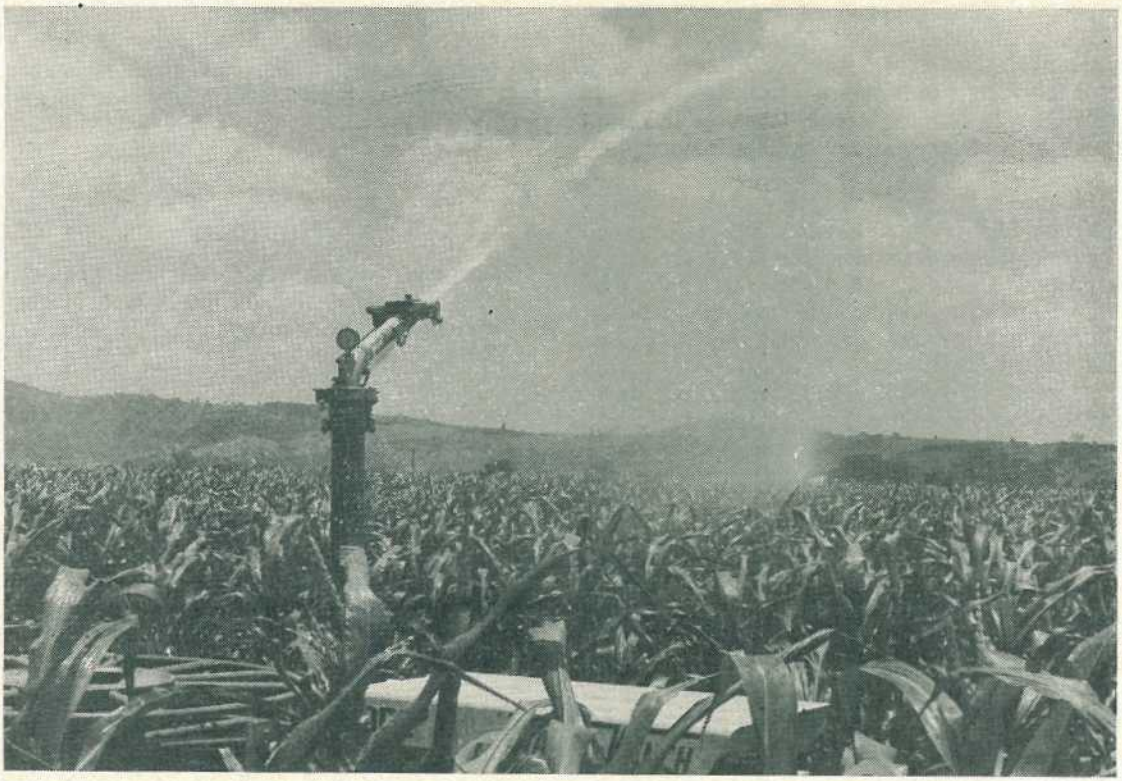
Basal fertilizer should be applied at sowing in a band 5 cm to the side and 5 cm below the seed in the soil. This will promote rapid, uniform seedling growth with a minimal risk of fertilizer injury to seedlings.

Additional nitrogen fertilizers are normally applied as a banded side-dressing when the plants are 60 to 70 cm high.

Fertilizer rates will vary depending on soil type, plant populations, cropping history, and other factors. A preplanting soil test will be useful in predicting a fertilizer programme. On heavy clay loams of high natural fertility, nitrogen is the only nutrient generally applied. The recommendations in table 2 will serve as a guide for sweet corn crops grown on the soils of the Lockyer and Fassifern Valleys and the Beaudesert District.

TABLE 2

Soil Types	Heavy	Medium	Light
Textures	Heavy clay loam, Medium clay loam	Light clay loam	Loam, sandy loam, loamy sand
Fertilizer Rates kg/ha	N Basal .. 30 Side .. 140 170	N Basal .. 40 Side .. 160 200	N Basal .. 70 Side .. 150 220
	P (all basal) Nil	P 10	P 20
	K (all basal) 25	K 40	K 50



Irrigating sweet corn with a water winch.

Zinc deficiency

In the Lockyer Valley, disorders due to zinc deficiency have been noted. Symptoms characteristic of this deficiency are interveinal chlorosis giving the appearance of yellowish-striped leaves. Where the problem is known to exist, a soil dressing of 30 kg per ha of zinc sulphate (monohydrate) or 45 kg per ha of zinc sulphate (heptahydrate) should be applied.

Where zinc deficiency is discovered in a young crop or where a mild deficiency occurs, a number of foliar applications of zinc sulphate (heptahydrate) at the rate of 150 g per 100 L of water can be used.

Irrigation

Sweet corn has a very high water requirement. As with all intensively-grown vegetables it is important that the crop does not suffer moisture stress. The critical times are at tasselling and during cob fill. However, a shortage of moisture at any stage of growth will have a detrimental effect on yield.

A suggested irrigation programme is as follows:

- Pre-irrigate to germinate weed seeds and to provide moisture for sowing.
- Immediately after sowing except on soils liable to crust.
- Following applications of side-dressing fertilizers.
- Heavy watering during tasselling and cob fill.

The amount required on each occasion will be dependent on prevailing weather conditions and soil types. In general, 25 to 50 mm per week will be required.

Because sweet corn is a tall-growing crop, the most suitable systems of irrigation are with travelling irrigators or furrow irrigation. Spray lines are not effective in sweet corn approaching maturity without the use of risers.

Weed control

Sweet corn yields can be reduced drastically by the presence of excessive weed growth early in the crop. In addition, heavy weed

Bell vine can be a problem weed in sweet corn.

Weed control with inter-row cultivation.

growth can seriously affect the speed and efficiency of machine harvesting. Bell vine (*Ipomoea plebeia*) is particularly troublesome in sweet corn. Effective weed control requires attention to soil management, inter-row cultivation and, in some cases, the use of herbicides.

Inter-row cultivation

Weeds which germinate when the sweet corn is from 10 cm to 60 cm tall can be controlled by inter-row cultivation. Weed growth within the rows can be smothered by throwing sufficient soil into the row to bury these weeds. The operation must be carried out when the weeds are small if they are to be effectively smothered.

One efficient inter-row cultivation is often sufficient, but two may be necessary. Cultivation must cease when the maize is too tall to be straddled, but at this stage shading will suppress new weed growth. Where soils have crusted, inter-row cultivation may have beneficial effects apart from weed control, and movement of soil into the rows may assist secondary root development and help the plants to resist lodging. Care must be taken with inter-row cultivation to avoid excessive root damage.

Chemical weed control

Management and tillage usually provide sufficient weed control to produce satisfactory crops of sweet corn. Herbicides may be necessary in very weedy ground or where particular weeds give trouble, such as bell vine. Band sprays of herbicides in conjunction with inter-row cultivation will reduce chemical costs.

The choice of a herbicide depends on the timing of treatment, weed species present and the residual nature of the herbicide in relation to follow-up crops. For example, atrazine is very effective for weed control in sweet corn but soil residues are a problem in follow-up crops particularly in the Lockyer Valley with its diversity of cropping.

Effective herbicide application requires good equipment and it demands attention to details including nozzle type, pressure, volume, tractor speed, calibration as well as careful measurement of materials.

Herbicides recommended for use in sweet corn are listed in table 3.

TABLE 3

HERBICIDES FOR USE IN SWEET CORN

Herbicide	Rate of Product per Sprayed Hectare	Timing of Application	Weeds Controlled	Remarks
EPTC emulsifiable conc. (Eptam) 720 g/l EPTC	5·5 l	Seedbed incorporated pre-emergent	Nut grass and some grasses and broad-leaved weeds from seed	Delay planting until after 7 days following application and plant seed no deeper than 5 cm
Atrazine (several 80% wettable powder products)	2·8–4·2 kg 2·8–4·2 kg	pre-emergence .. post-emergence ..	Most annual broad-leaved weeds and grasses.	Light rain or irrigation after application desirable. Use higher rate where grasses main problem. DO NOT USE IF FOLLOW UP CROPS SUSCEPTIBLE TO RESIDUES. (Refer to label)
Atrazine (several 50% flowable products)	4·5–6·5 l 4·5–6·5 l	pre-emergence .. post-emergence ..	Most annual broad-leaved weeds and grasses	Light rain or irrigation after application desirable. Spray when weeds are less than 1 cm high. DO NOT USE IF FOLLOW UP CROPS SUSCEPTIBLE TO RESIDUES (Refer to label).
Propachlor wettable powder 650 g/kg (Ramrod 65)	6·5 kg	pre-emergence ..	Annual grasses and some broad-leaved weeds	Rain or irrigation after application. Use at least 200 l water/ha
Metolachlor (Dual)	2–4 l	pre-emergence ..	annual grasses	Use higher rate on heavy soil or where heavy grass population is expected
Metolachlor (Dual) mixed with atrazine (Flowable Gesaprim) or (Gesaprim 80)	2–4 l 2·5 l 1·7 kg	pre-emergence ..	annual grasses plus broad-leaved weeds	Tank mix. Use higher rate on heavy soil or where heavy grass population is expected
2,4–D amine salt several 50% products	1 l	post-emergence spray when crop 10–30 cm high	broad-leaved weeds	Weeds susceptible only when very young. Avoid spray drift onto neighbouring susceptible crops

Insect control

Sweet corn is attacked by a range of insects including corn ear worm or *heliothis,* aphids and leaf hoppers. Cutworms and earwigs can be important pests during the seedling stage.

The corn ear worm or *heliothis* is the most damaging of all insects attacking sweet corn. Severe losses in yield are common where spray schedules are not strictly followed. Effective control of this insect depends on careful timing of sprays because once larvae enter the cobs, chemical control is not possible.

Spraying should commence when the silks are just emerging from the cobs. Applications can stop when the silks are fully exposed and starting to wither at the tips. This stage generally corresponds with maturity of the cob. The most effective control is achieved with a 2 to 3 day interval between sprays. In general, this will involve 4 to 6 sprays over the critical silking period. Spray programmes with longer periods between applications are far less successful in obtaining good control.

The best control (see table 4) will be achieved by good chemical coverage of the silks. Boom sprays fitted with droppers and adjustable for height will provide the best coverage. Conventional-type boom sprays are not as effective as boom sprays fitted with droppers because of inferior penetration and coverage of the silks. Where aerial spraying is used for *heliothis* control, improved penetration and coverage is obtained by cross spraying. This involves two runs across the crop. Improvement in control is also achieved when aircraft are equipped with micronair.

Cutworms may reduce stands of seedlings and such reductions may affect uniformity and final yield. Aphids and leaf hoppers are occasional pests.

Disease control

In the Lockyer and Fassifern Valleys and the Beaudesert district, the most important diseases are maize dwarf mosaic virus (MDM) and leaf blight. Other diseases include rust, wallaby ear, and maize stripe (see table 5).

The characteristic symptoms of maize dwarf mosaic are mosaic, ringspotting and chlorosis on the leaves. Severe early infection often produces stunting, excessive tillering, and poor

Heliothis *damage at the cob tip.*

Spraying for Heliothis *control must commence at the first appearance of green silk.*

A plant showing symptoms of maize dwarf mosaic virus and leaf blight.

cob set. The disease is caused by a Johnson grass strain of sugarcane mosaic virus which is maintained between seasons in Johnson grass and standover forage sorghums. The virus is spread by several species of aphids. The only effective means of control for this disease is the development of sweet corn varieties resistant to the virus.

Turcica leaf blight can be recognised by long, grey to light brown, spindle-shaped leaf spots extending along the leaves. As the disease progresses, these may coalesce to cause blight of almost the entire leaf surface. *Drechslera turcica,* the fungus responsible for the disease, is favoured by humid, warm conditions and plant to plant spread is rapid during showery weather. Heavy, early infections can reduce yields but infections late in the crop produce minor yield losses and chemical control is not economic.

TABLE 4

INSECT CONTROL

Insect	Description	Insecticide Active ingredient and some commercial preparations	Rate of Commercial Preparation		Remarks
			per 100 l	per ha	
Heliothis caterpillar	40 mm long when fully grown green to brown in colour. Damages husks and attacks kernels	methomyl (Lannate) permethrin (Ambush)	150–200 ml of 22·5% product 15–20 ml of 50% product	1·5–2·1 l of 22·5% product 100–200 ml of 50% product	Apply every 2–3 days at green silk Apply at tassel emergence, then 3–7 day intervals as necessary
Cutworm	Grey-green or grey-brown caterpillar 40 mm long with 8 pairs of legs	chlorpyrifos (Lorsban) or trichlorphon (Dipterex) (Klorfon)	85 ml of 60% product	700 ml of 50% product 900 ml of 60% product	Direct spray to base of plants only when pests are present

TABLE 5

Disease	Description	Control
Maize Dwarf Mosaic ..	A virus disease frequently reaching a high incidence. Causes ringspots or mosaic patterns of light and dark green and may sometimes give the appearance of chlorotic stripes. Stunting and yield loss occur, especially with early infection	Transmitted by aphids. Resistant varieties available
Leaf Blight	Long, narrow spots up to 150 mm long and 25 mm wide extending along leaves. Spots coalesce causing blight of leaf surface	Chemical control not considered economic. May not seriously affect yields when infection occurs late in crop growth
Rust	Small reddish-brown spots on leaf blades. Leaf sheaths, ear husks and tassels are rarely affected	Generally not necessary as disease usually appears only when plants near maturity
Wallaby Ear	Leaves on affected plants dark green, crinkly and rolled inwards. Disease produces narrow, white galls on the secondary veins on the under surface of the leaves	Late plantings in coastal areas more often affected than spring sowings. Disease transmitted by leafhopper. Insecticide applications often control disease
Maize Stripe	Virus disease. Produces long, light yellow stripes along the leaf blade parallel to the midrib	Disease transmitted by maize leafhopper. Control measures seldom warranted

Other problems in sweet corn

Environmental factors

HIGH TEMPERATURES. Extremely high temperatures (above 38°C) can cause faulty pollination. Sweet corn is particularly susceptible to this kind of damage when hot weather is accompanied by drought and wind. Under these conditions the pollen grains are 'blasted' and become sterile. This can result in cobs without grain. Leaf scalding can also occur under these conditions.

EXCESS MOISTURE. Lower leaves of young plants in waterlogged soils turn yellow and die. Plants up to 25 cm tall have low tolerance to wet soils.

BIRD DAMAGE. Crow damage to sweet corn cobs can cause extensive losses. Scare guns, shooting and other devices may be necessary to reduce this problem.

Bird damage can cause severe losses.

Chemical damage

FERTILIZER BURN. Excessive quantities of nitrogen or potassium placed close to the seed may prevent germination. Seedlings often emerge and then die from fertilizer root burn. Boron in the basal fertilizer is especially toxic to sweet corn seedlings.

2,4-D INJURY. 2,4-D may cause injury following high application rates or when the spray is directed into the whorl. Leaves remain wrapped in a tall spike, with brittleness at the lower stem nodes and the upcurling of brace roots are typical symptoms.

Maturity assessment

To obtain a quality product, sweet corn harvesting must be completed when the crop is at optimum maturity. The optimum picking time for whole kernel corn coincides with grain moisture in the range of 75 to 78% for freezing. This range represents 2 to 4 days in the field depending on temperature at the time of maturation.

A grain moisture of 72% is commonly used for canning purposes. Quality declines after optimum maturity through loss of moisture and conversion of sugars to starch. In the Lockyer Valley, the rate of moisture loss as the grain matures is approximately 1·5% per day under summer weather harvest conditions. This rate can rise to 2 to 3% moisture loss per day under hot, dry and windy conditions.

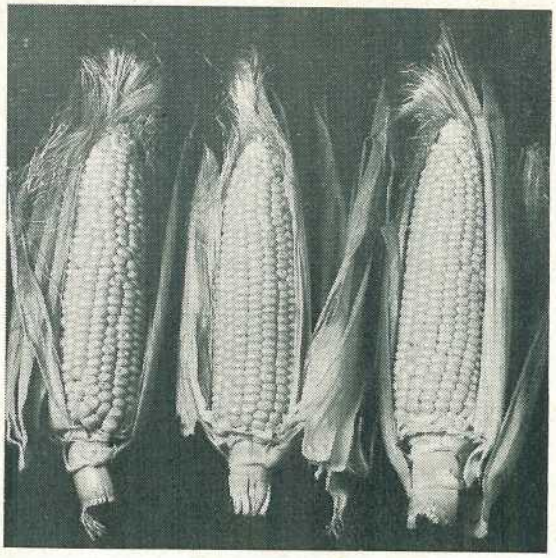
Sweet corn matures in 65 to 95 days from planting depending on temperature, moisture and variety. Harvesting time based on maturity of the crop is normally determined by the processing companies' field officer. Maturity is assessed either visually or with the aid of a refractometer. The relationship between moisture content and refractive index makes this test extremely useful in determining optimal maturity and quality. Moisture content = 87 — 580 (Refractive Index of Sample — 1.35). From this assessment of moisture content, the actual date of harvest can be calculated based on average daily moisture loss in the crop.

The best visual signs of high quality sweet corn are kernels that are creamy-yellow and plump, but never indented. Yellow or indented kernels are a sign of over maturity and moisture loss. Cobs with immature kernels at the tip are more likely to be sweet and tender than cobs with full size kernels to the tip. Harvest maturity based on these points will enhance, but not assure high quality sweet corn because changes in chemical and physical composition of kernels are more rapid than external changes.

Harvesting

Harvesting is normally carried out by the processing company with twin row or single row sweet corn harvesters. Twin row machines can harvest at a rate of approximately 1 ha per hour. Harvesters separate cobs from other plant parts. The sheaths

A twin row sweet corn harvester.



Full cobs of corn.

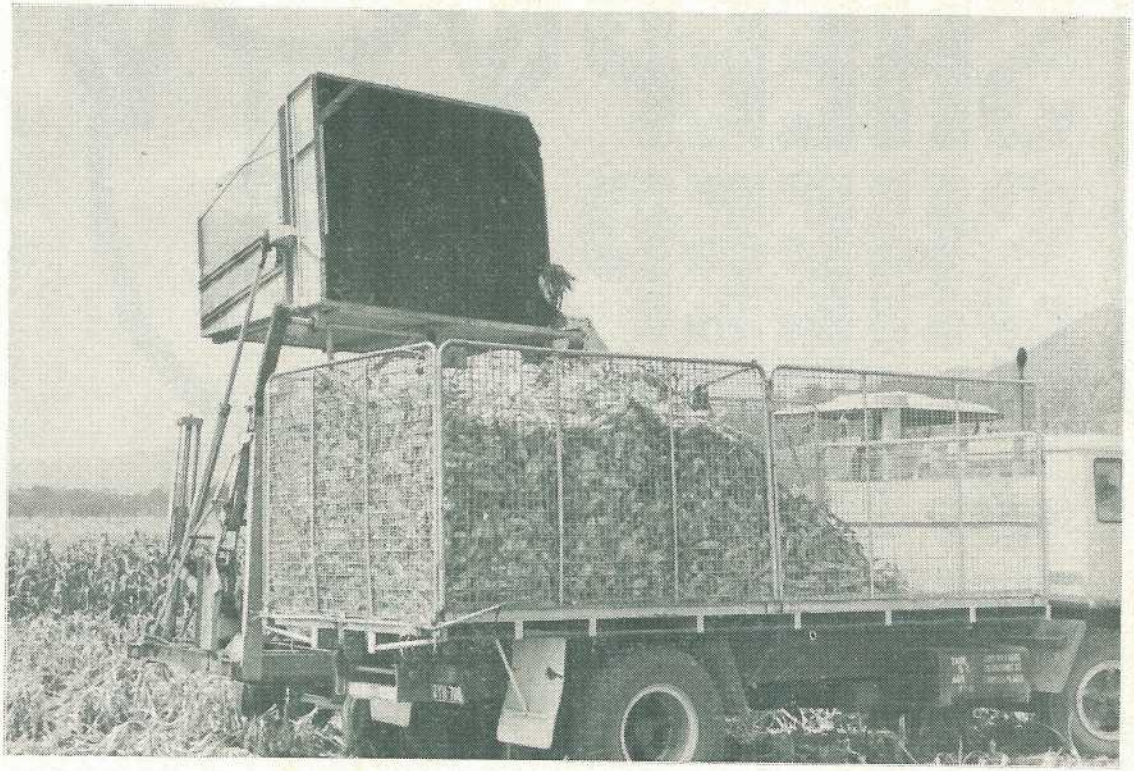
surrounding the cob are not removed in this operation as they protect the kernels from physical damage and moisture loss.

Operators of sweet corn harvesters must be thoroughly conversant with their machinery to achieve maximum efficiency with few cobs being left in the field. Operators must also be familiar with the safety aspects of harvester operation. It is particularly important to disengage the drive to the stripper chains before attempting to remove jammed corn stalks.

Transport

Sweet corn is transported to factories in bulk on tipping trucks or in bulk crates. Sweet corn has a very high respiration rate so it is essential that no time is wasted from harvesting to processing.

Time and temperature are critical because sucrose (sugar) changes rapidly to starch after harvest. This change occurs at 10 times



Bulk handling of sweet corn for factory processing.

the rate at 20°C as at 0°C, and 20 times the rate at 30°C. During an 8 hour period, sweet corn will lose about 10% of its sucrose content if held at 20°C. For this reason, it is advisable to harvest the day's requirements early in the morning before field heat accumulates in the cobs.

Yield

The average yield in the Lockyer Valley is 7 to 10 t per ha. Yields of 14 to 19 t per ha have been obtained from well grown spring crops. Late autumn crops are generally more severely affected with virus and leaf diseases and produce lower than average yields.

Quality requirements

Quality of sweet corn for processing is strictly supervised. Standards of quality are as high for processing as for fresh market. Rejections may be made at the factory for grub damage, disease or rots in the kernels, and blind or poorly pollinated cobs.

Bev Quinlan - - - a dairy farmer making the most of his resources

BEVAN Quinlan farms a 217 ha property at Grindstone near Nanango.

His 90 cow herd produced 14 493 kg of butterfat (321 000 L of milk) in 1978–79 for a gross income of $35,508. Variable costs of production were only 29% of total income.

These statistics are quite remarkable for a dryland dairy farm operated by one man.

Bev Quinlan summed up the secret of his success. 'It is a case of fully using all the resources available to me and my wife,' he said. 'Besides, I do not do anything else; dairying is our life, we enjoy it, and a good deal of planning goes into managing our farm.'

Farming background

Bev Quinlan, his three brothers and two sisters grew up with their parents on a small dairy farm at Byee near Murgon. Bevan attended one-teacher schools at Wheatlands and Grindstone and left school at the age of 13. The Quinlan family moved to their present property at Grindstone near Nanango in 1949. Bev continued to work with his father, a policy that was traditional for dairy farmer's sons in the earlier days of the Queensland dairy industry.

He and his wife Betty were married in 1959 and now have a family of two boys and two girls.

The present farm

The Quinlans assumed greater responsibility in 1961 by operating the business on a share farming basis. In 1963, they purchased the present property and stock for £15,000 ($30,000). The farm is now paid for and debt free.

by W. B. Oliver, Dairy Field Services Branch

Cream and pigs were the main source of revenue until 1972 when the conversion to bulk milk took place. Pigs were phased out of the farming system shortly afterwards.

The herd

Bev Quinlan made two important decisions in the 1960s that later played a major role in developing a top class dairy herd. In 1966 he joined the Herd Recording Scheme and one year later introduced artificial insemination into his herd.

Proven Friesian sires were used over his Jersey herd. His policy has been to retain 25% of his herd as pure Jersey with the remainder being Friesian-Jersey crosses. Bevan is trained to do his own artificial breeding.

Herd recording records have been used for selecting cows to be culled or to be used for breeding herd replacements. Replacement heifers are usually home bred. A beef bull is kept on the property to cross with the lower producing cows; this maximizes profit through sales of bobby calves.

Pastures

During the 1960s a further 50 ha of land was cleared giving the farm a total of 120 ha under cultivation. Since 1964, 13 km of contours have been constructed.

Maximum use was made of the Dairy Pasture Subsidy Scheme. About 24 ha of lucerne and permanent stands of Rhodes grass were planted.

Bev attended a nutrition school for dairy farmers at Nanango in 1971 where the basics of nutrition were discussed.

Change to bulk milk

1972 saw the introduction of bulk milk to the area and the Quinlans quickly seized the opportunity to participate in this more viable and stable section of the dairy industry. It cost $4,900 to renovate the dairy, install new milking machines and a bulk vat.

Production gradually increased and in 1973–74 annual production was 6 337 kg of butterfat. Although satisfactory, these figures were below the district average of 7 300 kg BF.

Farm re-payments had to be met at the time. After variable costs of production were calculated, new return was low. Farm resources were good—the herd was a good one and disease-free.

Joining a discussion group

At that time (1974), the Nanango QDO decided to form a farmers' discussion group. Bev Quinlan was one of the main instigators and has been secretary since the group started. The Nanango Discussion Group has continued to function and operate successfully up to the present time.

Following the 1971 nutrition school, feeding dairy cattle was the chosen topic for discussion in the first 12 months of the discussion group. The Dairy Advisers and Husbandry Officer followed the meetings by visiting individual farmers to encourage the adoption of better farming practices.

Success

The Bev Quinlan story is one of remarkable success. His production figures and financial returns are shown in table 1.

During the past 5 years, production has increased by 129% and gross income 230%. There was a slight decrease in production in 1976–77 and 1977–78 caused by drought.

An important factor of Bev Quinlan's success has been cost control. Bev is a member of the Dairy Accounting Scheme which originated in the first year of the Nanango Discussion Group. The variable costs of production on the Quinlan farm compare very favourably with other group members. This is illustrated in table 2.

Feeding

While Bev feels that genetic improvement has played a major role in increasing production, he claims that an improved feeding programme has been the major single reason for success.

The feed year programme at the Quinlan's dairy farm consists of 85 ha of native and Rhodes grass pastures, 10 ha of paspalum/clover mix, 30 ha of winter oats and 60 ha of grain. 24 ha of lucerne was destroyed by aphids in 1977 and grain crops are growing on this area.

A predominant factor in his routine winter feeding programme is the daily feeding per cow of 1·5 kg of peanut screenings, 1·5 kg of home-grown grain and 60 grams of bone-char (20% P, 36% Ca). In the summer, the ration is altered to 3 kg of straight grain daily.

Another feature of the feeding programme is that cows are allowed to selectively graze paddocks up to 20 ha in size. Bev strongly believes that the cow's ability to select the best feed should not be restricted as this reduces feed intake. The pastures, combined with large areas of stubble from grain crops, are usually plentiful and favour selective grazing.

Peanut screenings (15 to 20% crude protein) contain a good percentage of peanut kernel mixed with peanut shell. Bev has a contract with a peanut grower-processor and obtains sufficient high protein feed to last during the winter months.

TABLE 1

	1973–74	1974–75	1975–76	1976–77	1977–78	1978–79
Production Kg BF*	6 337	7 451	11 703	10 877	9 986	14 493
L Milk†	158 400	186 300	292 600	271 900	249 700	362 325
Gross Income	$10 773	$13 334	$21 065	$21 101	$22 668	$35 508

* Actual figures. † Calculated on basis of 4% fat.

TABLE 2

Extract from South Burnett Dairy Farm Accounting Scheme Summary 1978–79 showing Figures for B. Quinlan and District Average.

Item	Quinlan	District Average
RETURN CENTS/LITRE*	11·2	11·1
RETURN $/KG B.F.*	$2.47	$2.56
COSTS: CENTS/KG B.F.		
Feed	9·0	34·3
Fertilizer	10·9	8·1
Harvesting and Casual Labour	4·2	5·8
Seed	5·4	4·8
Chemicals	..	0·5
Fuel	8·4	8·9
Electricity	7·0	10·0
Water	..	0·7
H.R. and A.I.	2·9	1·2
Dairy Requisites	2·3	2·9
Health	2·0	3·5
Cartage	16·4	18·2
Levies	3·7	5·5
Agistment	..	1·3
Sundries	..	1·2
TOTAL VARIABLE COSTS	72·2	106·9
Variable Costs as % of Milk Income	29·2%	41·8%
Feed and Fertilizer as % of Milk Income	8·0%	16·6%
Cattle Sales	$3 518	$3 471
TOTAL PRODUCTION Litres, milk	321 033	182 774
Butterfat (kg)	14 493	7 960
AVERAGE TEST %	4·38%	4·23%
% Supplied as Market Milk	22·6%	..
Average No. of Cows	73	59
Maximum No. of Cows	93	74
Production Average/Cow, Litres	4 398	3 162
Gross Return, Average/Cow*	$492	$351

* Excludes proceeds from sale of cattle, includes deferred and winter pay.

Excess grain is sold for cash, but this does not add substantially to his income.

Calves are fed on a 20% protein ration until weaning. Heifers are well grown and calve at 24 to 30 months of age.

Dry cows have at least 8 weeks' spell and are allowed the same feeding privileges as milkers 3 weeks before calving. However, this period is increased during dry seasonal conditions.

The feeding system for milkers, dry cows and calves differs little from the usual systems adopted by other successful South Burnett dairy farmers. The ration has a good balance of energy and protein, and the phosphorus supplementation is adequate.

The difference

If there is a difference with the Quinlan approach, it is the grazing method he uses, allied with good cowmanship.

Bev Quinlan's success is an example of the benefits derived when a farmer uses all the resources available to him.

Schemes such as Herd Recording (13 years), Artificial Breeding (12 years), Bull Proving, Dairy Pasture Subsidy and Dairy Accounting have been and are still well used.

Discussion groups, a nutrition school and an A.I. school have been used by Bev Quinlan to improve his technical proficiency.

It is important for a farmer to keep abreast with industry affairs. He is a Director on the

Board of the Nanango Co-op. Dairy Association, an active member of the Q.D.O., and a secretary of the Nanango Discussion Group.

The future

The 1977 drought revealed deficiencies in stock water supply on his farm. Underground supply is too high in mineral content, so reliance is now placed on surface water. It is intended to build two large dams to overcome this problem.

New herringbone bails are planned, equipped with automatic teat cup removers.

Bev does not plan to increase herd size above 100, but he intends to improve feed supply and use to maintain or improve per cow production.

Bev Quinlan knows what he is doing—he puts theory into practice and most importantly is a happy and contented family man.

A.I.—25 years of service to stock industries

The Department of Primary Industries has entered its twenty-fifth year of providing an artificial breeding service to the stock industries of Queensland.

Mr. V. B. Sullivan, Minister for Primary Industries, made this comment when announcing the results of the dairy cattle progeny testing programme for 1979. He said the bulls selected as A.I. Proven for the 1980 breeding season were Nindethana Spotted Prince (Jersey), New Park Gay King (AIS) and Lawes Priscilla Greypad and Doro Park Sweet Neil (Friesian).

"In this jubilee year of artificial breeding in Queensland, it is fitting that a grandson of the original Jersey Proven Bull, Glenrandle Spotted Lad, should be declared A.I. proven," Mr. Sullivan said.

"This confirms the effectiveness of the Department's bull breeding and progeny test programme."

Mr. Sullivan endorsed the Silver Jubilee theme of 'Service and Experience'.

From a humble beginning in 1955 when four Jersey bulls were used to start a progeny testing programme at the Rocklea (Brisbane) Research Farm, the A.I. service had developed to the stage where bulls in five dairy breeds were being tested annually.

"Today," the Minister said, "130 top quality beef and dairy bulls, including some privately-owned sires, are located at the Wacol Centre and the A.I. Export Centre at Ormiston."

With a semen bank of half-a-million doses, the Department's centres are meeting the artificial breeding needs of Queensland cattlemen and the rapid growth in interstate and overseas demand for semen from Queensland.

Mr. Sullivan said his Department had kept ahead of changes in the dairying and artificial breeding industries and was looking forward to further dramatic developments over the next decade.

A consolidated Artificial Breeding of Stock Act 1979 was assented to in December last year to up-date the legislation controlling all stock in Queensland. The Minister indicated that embryo transfer now was feasible and should, within a short time, become a significant part of the field application of artificial breeding.

By the mid 1980s, the National Dairy Herd Improvement Scheme for dairy cattle and the Sire Evaluation Programmes in some of the beef breeds should be well established.

Mr. Sullivan added that his Department was committed to fulfilling the primary role of artificial stock breeding in the State.

This must assist producers to improve the genetic worth of their cattle and, as a consequence, lift production and profitability.

Chemical weed control guide—winter cereals 1980

by B. J. WILSON, Queensland Wheat Research Institute

THIS chart is a guide to the chemical control of weeds in winter cereal crops. Chemical herbicides have a valuable part to play in supplementing other weed control measures.

Each year, the number of chemicals commercially available increases. The successful use of these chemicals depends on a number of factors. These include the choice of the most efficient chemical, the correct timing of the spraying and the rate and methods of application. Careful attention should also be given to applying the chemical at the correct stage of crop growth so that the possibility of injury to the crop is minimized.

It is important that the weed should be correctly identified before selecting the chemical to be used. The weeds listed in the guide are those that occur most frequently in winter cereal crops in Queensland.

The explanatory notes are most important and should be read in conjunction with this guide.

When applying herbicides, producers should take care to avoid spray drift.

Further information on weed control may be obtained from your local agricultural extension officer.

HERBICIDE RATES IN MILLILITRES PER HECTARE

(The figures in heavy type are the Departmental suggestions for the control of the particular weed for expected cost/efficiency)

Chemical	Trifluralin	Pendimethalin	2, 4–D Amine (50%WV)	MCPA (27%WV)	Picloram + 2, 4–D	Picloram + MCPA	Dicamba (20%WV)	Dicamba + MCPA	Bromoxynil	Bromoxynil + MCPA	Linuron
Trade names	Several	Stomp 330E	Several	Several	Tordon 50D	Tordon 242	Several	Several	Brominil	Buctril MA Brominil M	Afalon Linuron 50
WEEDS											
Climbing buckwheat ..	..	..	1100 + W	..	**470**	**1000**	700	1700	1400	1400	..
Wireweed	1000	1200–1800	**1700 + W**	..	470 + 2, 4–D (A)	1000	700	1700	1400 + 2, 4–D (C)	1400	..
Turnip-weed	..	..	**700**	**1400**	470 + 2, 4–D (A)	1000	700 + 2, 4–D (C)	1700	1400 + 2, 4–D (C)	1400	550–850 g
Mustards	..	..	**1100**	**2100**	470 + 2, 4–D (A)	1000	700 + 2, 4–D (C)	1700	1400 + 2, 4–D (C)	1400	550–850 g
Wild radish	..	..	**1100**	**2100**	470 + 2, 4–D (E)	1000	700 + 2, 4–D (E)	1700	1400 + 2, 4–D (C)	1400	550–850 g
Variegated thistle ..	..	..	**1100**	2100	470 + 2, 4–D (A)	1000	700	1700	1400 + 2, 4–D (C)	1400	..
Hexham-scent ..	..	..	**1700 + W**	..	470 + 2, 4–D (A)	..	700 + 2, 4–D (C)	1700	1400 + 2, 4–D (C)	1400	..
New Zealand spinach	..	..	..	..	**470**	**1000**	**700**	..	..	..	..

HERBICIDE RATES IN MILLILITRES PER HECTARE—continued

Chemical	Trifluralin	Pendimethalin	2, 4–D Amine (50%WV)	MCPA (27%WV)	Picloram + 2, 4–D	Picloram + MCPA	Dicamba (20%WV)	Dicamba + MCPA	Bromoxynil	Bromoxynil + MCPA	Linuron
Trade names	Several	Stomp 330E	Several	Several	Tordon 50D	Tordon 242	Several	Several	Brominil	Buctril MA Brominil M	Afalon Linuron 50
Mintweed	..	..	1100	..	..	..	700+ 2, 4–D (C)	..	..	1400	..
Saffron thistle ..	..	..	1700+W	3500	..	1000	700+ 2, 4–D (C)	1700	1400+ 2, 4–D (C)	1400	850 g
Docks	..	..	1700	..	470	..	700	1700	..	..	..
Vetches	..	..	..	..	..	..	700+ 2, 4–D (C)	1700	..	..	..
Deadnettle	..	..	..	..	..	..	..	..	..	..	550–850 g
Spiny emex	..	..	1700+W	..	470	1000	700	1700	..	1400	550–850 g
Mexican poppy ..	..	..	1700	..	..	..	..	..	..	1400	..
Sunflower	..	..	1100	..	470+ 2, 4–D (A)	..	..	..	..	..	..
Approximate cost per litre January 1980	$4·45	$5·16	$2·65	$1·71	$10·68	$6·25	$6·78	$4·62	$7·66	$9·36	$11·68 kg
CROP TOLERANCE											
Wheat	non-tol.	1800	2200	5600	470	1000	700	1700	2100	2100	850 g
Barley	1000	1800	1700	4200	470	1000	700	1700	2100	2100	850 g
Oats	non-tol.	non-tol.	1100	4200	470	1000	700	1700	2100	2100	850 g
Canary seed	non-tol.	non-tol.	1100	4200	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Linseed	non-tol.	N.R.	non-tol.	2100	non-tol.	840 note 10	N.R.	non-tol.	1400	1400	N.R.
Chickpea	N.R.	N.R.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	N.R.	non-tol.	N.R.
Lupins	N.R.	N.R.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	N.R.	non-tol.	N.R.
Safflower	1000	N.R.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	non-tol.	N.R.

HERBICIDE RATES IN MILLILITRES PER HECTARE—continued

Chemical	Trifluralin	Pendimethalin	2, 4–D Amine (50%WV)	MCPA (27%WV)	Picloram + 2, 4–D	Picloram + MCPA	Dicamba (20%WV)	Dicamba + MCPA	Bromoxynil	Bromoxynil + MCPA	Linuron
Trade names	Several	Stomp 330E	Several	Several	Tordon 50D	Tordon 242	Several	Several	Brominil	Buctril MA Brominil M	Afalon Linuron 50
CROP GROWTH STAGE											
Wheat	non-tol.	pre-plant	tillering	tillering	tillering	tillering	5 leaf to mid tillering	5 leaf to mid tillering	2 leaf through tillering	3 leaf through tillering	2 leaf through early tillering
Barley	pre-plant	pre-plant	tillering	tillering	tillering	tillering	5 leaf to mid tillering	5 leaf to mid tillering	2 leaf through tillering	3 leaf through tillering	2 leaf through early tillering
Oats	non-tol.	non-tol.	tillering	tillering	tillering	tillering	5 leaf to mid tillering	5 leaf to mid tillering	2 leaf through tillering	3 leaf through tillering	2 leaf through early tillering
Canary seed	non-tol.	non-tol.	tillering	tillering	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
Linseed	non-tol.	N.R.	non-tol.	8 to 20 cm	non-tol.	8 to 20 cm	N.R.	non-tol.	5 to 15 cm	5 to 15 cm	N.R.

Notes

1. ALWAYS READ LABELS THOROUGHLY BEFORE USING CHEMICALS AND APPLY IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
2. Sprays should be thoroughly mixed before application.
3. Non-tol. = The crop is not tolerant to this chemical.
4. N.R. = The chemical is not registered for use on this crop.
5. 2, 4–D and MCPA formulations vary in the percentage of active ingredient—check the label and adjust the rate accordingly.
6. +W indicates to add 1 part of 50% to 60% non-ionic wetting agent to 1600 parts of spray mixture.
7. + 2, 4–D (A) indicates add 470 mL per hectare of 50% 2, 4–D amine.
8. + 2, 4–D (C) indicates add 700 mL per hectare of 50% 2, 4–D amine. When 2, 4–D is added to Brominil or dicamba, the application of the mixture must be restricted to the tillering stage of the crop.
9. 2, 4–D (E). Consult an agricultural extension officer for the rate of additional 2, 4–D to control wild radish. Application must be restricted to the tillering stage of the crop.
10. Cook Wheat and Corvette barley may be damaged by dicamba application under certain seasonal conditions. Seek advice before spraying these and other recently released varieties.
11. Rate of application of linuron varies with the growth stage of weeds and growing conditions. Consult the manufacturers' labels for details.
12. Tordon 242 is recommended for spraying linseed. The crop should be 8 cm to 20 cm in height before spraying. The rate of chemical is 670 to 840 mL per ha. The higher rate is necessary when climbing buckwheat is present in the crop.
13. For cereals undersown with lucerne, 2, 4–DB may be used to control some broad-leafed weed species. Consult an agricultural extension officer.
14. Some chemicals have a residual activity in the soil and may restrict the choice of the subsequent crops. Consult the manufacturers' labels.
15. CONSULT YOUR SHIRE EXTENSION OFFICER.

The nature of beef cattle prices

by I. F. Whan, Economic Services Branch

CATTLE prices in Australia are determined by the free interplay of supply and demand.

There are essentially no restrictions on beef exports so, apart from the distinction between table and manufacturing beef, there is direct competition between the local and export markets for the available supplies of Australian beef.

Exports are an important component of total demand. During the 1970s, the level of exports accounted for between 42 and 62% of total production—the proportion being highest when export demand was strongest.

The strength of export demand is mainly determined by the proportion of total exports going to a few markets, especially the U.S., Japan and Canada. In 1973, a year of boom prices, the U.S. took 55% of total exports. But in 1976 when prices were depressed and total exports lower, the U.S. took only 47%. The corresponding figures applying to the Japanese market were 19% and 12%. By contrast, beef exports to low price markets such as the Middle East and parts of Asia increased substantially during the slump period 1974 to 1978.

The supply of Australian beef also affects price. If a period of low demand by preferred export markets corresponds with heavy supplies in Australia, the need to divert a high proportion of exports to low price markets will dilute the average return from all markets. In the saleyard, producers receive a price for cattle which reflects the average return from all markets (the domestic market and all export markets).

Long term movements and trends

Excluding the last 10 years, cattle prices in Australia have been no more unstable than wool or wheat prices. Throughout the 1970s, however, beef prices were very unstable. This was partly caused by an increasingly jittery world economy. Some of the countries to which we export have periodically saved on beef imports in order to buy oil and other imports.

One major problem has been our high dependence on the U.S. market. Exports to the U.S. are governed by an annual quota determined mainly by expected levels of U.S. beef production. Given a 'beef cycle' of 10 years, Australia's cattle industry potentially faces a cyclical pattern of 5 good years followed by 5 lean years.

The way things look, Australia is now locked into a cyclical pattern of beef prices linked to the U.S. beef cycle. As the U.S. has introduced 'counter-cyclical legislation' to control beef imports, the boom and bust situation facing Australia will be aggravated.

The best hope for stablizing the Australian beef industry lies in developing further high price markets, preferably with economies not too synchronized with the U.S. economy. Development of such markets would bring greater economic stability to our beef industry. In this regard, those Middle East countries with burgeoning oil incomes offer the greatest potential.

Retail beef and veal prices in Australia have followed inflation trends. Figures issued by the Bureau of Statistics show that retail beef prices have more than kept pace with other goods for the period 1966 to 1979. In doing this, beef prices increased by over 70% between June 1978 and June 1979 following a period of very low prices. The relationship between retail prices and saleyard prices depends on the nature of the marketing margin made up of transport, killing, wholesaling and retailing costs. This aspect of beef marketing was investigated by the Prices Justification Tribunal.

Short term and local determinants of prices

The discussion to this point has centred on the major determinants of beef prices. The nature of export demand was central to the

discussion. In practice, the situation is more complex with cattle prices varying from week to week, between classes of cattle and between selling centres. Several generalisations are outlined in the following.

Saleyard prices in Australia tend to parallel beef prices in the U.S. However, demand from other markets can result in substantial short term movements in price. As there are over 100 export abattoirs operating throughout Australia, this type of fluctuation may be very localized and virtually impossible to predict, at least in the case of small contracts.

At the local level, movements in price can result from supply variations due to weather and seasonal conditions. For instance, a period of excessively wet weather will prevent the usual numbers of cattle from being mustered and transported to market, thus forcing up local prices. On a broader scale, good rain following a drought can cause prices to rise as producers go after stores for fattening and breeders for herd rebuilding.

The price paid for cattle is governed by the class of animal and the phase of the beef cycle. When export demand is strong, the price differential (measured in cents per kilogram) between classes narrows. When the general level of demand is weak, price differentials tend to widen, favouring cattle suitable for the local trade. In such times, the value of store cattle tends to suffer most. Prices for store cattle move through a greater range than do fat cattle being higher priced when demand is strong and lower priced when demand is weak. Thus store breeders are excessively affected by movements in the cattle price cycle.

Price also varies due to location of the selling centre. As most cattle are either processed or consumed on the eastern seaboard, prices paid in western saleyards tend to be discounted by the particular transport cost differential involved. Prices may be relatively low in small saleyards because of small lot size. Research carried out by the Bureau of Agricultural Economics has indicated that buyers have a preference (shown through price) for larger lot sizes. There is obviously more scope for lot building in big saleyards.

Management implications of price variability

The short and long term variations characteristic of beef prices pose a commercial risk for the producer. This risk can be reduced by a positive approach to management and marketing.

For example, the producer might react to underlying movements in price by adjusting his herd numbers. The strategy used by most producers has been to run down numbers when prices fall and to rebuild when prices rise. Certainly, this has been the case in areas where there is scope for different enterprises.

In mixed farming areas, even a modest decline in beef prices can make this enterprise relatively unprofitable and therefore cause a movement out of beef production. The producer who can diversify should either have a permanent mix of enterprises (to give risk protection) or should try to anticipate basic movements in price so that he is not buying in at high prices and selling out at low prices. Successful application of the latter approach clearly requires good market intelligence.

In Queensland, there are many specialized beef producers. This group has little scope for switching enterprises and so it must adopt a different approach to price movements to that used by the mixed producer group.

The experience of the last 5 to 6 years is certain to have caused some specialized beef producers to think and act in a counter-cyclical fashion. These producers will plan to run-down their herds during a high price phase and rebuild during a low price phase. To the extent that such behaviour is practised throughout the industry, and saleyard prices are sensitive to levels of supply in Australia, the bad effects of temporary decreases in overseas demand could be greatly reduced.

Breeders generally, and store producers in particular, are more adversely affected by low prices than fatteners. Fatteners can keep their margin fairly well intact because the cost of stores tends to move up and down with the price of beef. To improve his situation, the store producer might diversify (for example, up-grade his feed to allow turn-off of fats) or over-sell during high periods and use lower-priced periods for rebuilding numbers.

Store cattle prices suffer most when general drought and low export demand coincide. Having a feed reserve that will allow cattle to be turned-off fat could therefore be good insurance against excessively poor returns. The probable economics of intensive fattening for any given situation should be investigated before a significant investment in feed and equipment is made.

Short term price risk can be reduced by use of the futures market. The producer most likely to use the futures market to avoid a price fall will have a certain cost at risk and will normally face a low output risk. Feedlot users fall into this category. It can be expected that interest in the futures market will strengthen now that beef prices are on a relatively high plane, thus allowing potential profits that are worthwhile locking in.

Conclusions

Cattle prices are determined by a free market. Many people would argue that this is a good thing, but it does mean that cattle prices and producer incomes can be very unstable. It would seem that, for the present at least, the cattle producer will have to accept this situation and cope with it as best he can. It is hoped that through developing an understanding of how his market works, the producer will have a solid basis for industry discussion and managerial decision making.

New energy publication

ENERGY TOMORROW is a valuable source of information on the presently available alternatives to oil. It evaluates and analyzes the advantages and procedures of solar energy applications, the use of wind turbines, biomass, chemical and nuclear energy, the power of the sea, rivers and geothermal energy sources.

The oil crisis and its economic consequences are the guiding principle of the book. The author suggests economic planning of energy resources and the switch to electrifying the various sectors of industry and transportation.

An informative chapter deals with the electric car—its history and present development. Practical suggestions are worked out toward the transition and the operational system of the future electric car era.

The political and economic aspects of energy plans are examined in this book with plan objectives suggested by the author to solve the energy crisis and to stop inflation.

This publication is available from the Academic Publishing Company, P.O. Box 42, Snowdon Station, Montreal 26, Quebec, Canada.

Conservation cropping . . .

a new way of farming for the South Burnett?

DESPITE intensive protection from contour banks, most of the cultivated lands of the South Burnett still experience soil erosion.

In part, the continuing erosion can be attributed to the dominance of summer annual legume crops and the particular way in which they are grown.

The legume crops are slow to develop a full canopy and provide minimal soil protection against early summer storms. Following harvest, there is scant soil protection from the low stubble levels that ensue. Numerous cultivations to prepare the seed bed and later inter-row cultivation break up soil structure and make the soil more likely to erode.

In order to protect these valuable soils, a cropping system is needed which involves fewer cultivations and provides greater surface protection from stubble than existing systems.

The new system will involve sowing crops in a preferred sequence under stubble mulch conditions. (See illustration.)

The preferred sequence that optimizes ground cover is a summer legume crop followed by winter cereal, summer grain, winter fallow, then back to summer legume, giving three crops in 2 years. Alternatively, following early summer grain harvest, winter cereal can be sown before the late summer legume, giving two crops a year.

The crops

Peanuts are the more popular summer legume grown on the red soils. Navy beans and soybeans are sown later, which allows more time to prepare the land following winter cereal.

by R. J. Bateman and R. W. Rowlings, Soil Conservation Branch.

The major winter cereal grown in the South Burnett has been barley, though wheat is making substantial inroads into this area. In this system, either can be sown while the longer season triticale is not preferred. The summer grain component consists of either maize or sorghum, with maize being favoured when double cropping back to winter cereal. Fallowing after sorghum harvest ensures that sorghum regrowth is killed.

Sowing time

The system is geared to sow all the crops at the optimum time. Virginia Bunch peanuts are sown from mid-October onwards and could be expected to be harvested in April. This allows time for weed control and land preparation (if necessary) for an early June barley/wheat sowing. Sowing at this time increases winter cereal reliability, allows the use of high yielding varieties and reduces disease potential.

The later-sown soybean (December) and navy bean (January to mid-February) area can also be sown to winter cereal at this time.

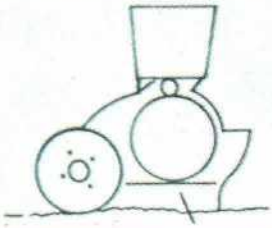
There is more latitude with sowing times for the summer grains due to the widespread maturities available. However, a December sowing using mid-season varieties is practical and harvest can be in July.

Tillage operations and machinery

Stubble mulch is an important component of this system; therefore, destruction of crop residues is not required. Hence, tillage operations differ in type and number compared to conventional farming. Tillage is used to control weeds; break-up compaction, if it exists following harvest, provides a loose surface tilth for seed coverage and applying fertilizer or incorporating chemicals.

A CONSERVATION

CULTIVATE WITH SWEEPS AND ROD WEEDER ONCE OR TWICE DEPENDING ON CONDITIONS APPLY HERBICIDE



ROD WEED AND PLANT

OCT

PLANT NAVY BEANS

JAN

DISADVANTAGES

1 PRESENT MACHINERY LIMITATIONS

2 BETTER MANAGEMENT REQUIRED BECAUSE EAC OPERATION MUST BE SUCCESSFUL WEED CONTRO

3 LIMITED EXPERIENCE

DEC

SLASH CULTIVATE WITH SWEEPS AND ROD

AUG

WINTER FALLOW

WINTER GRAIN

DEEP CHISEL IF NECESSARY

MAIZE SLASH CULTIVATE AND PLANT

JULY

SORGHUM CULTIVATE WITH SWEEPS

OR

HARVEST

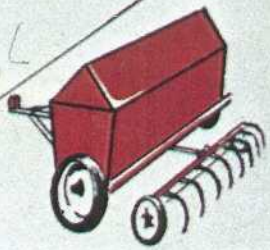
CROPPING SYSTEM

SUMMER LEGUME

HARVEST

MAY

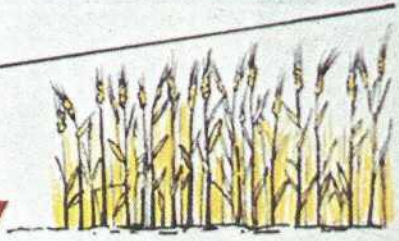
SPREAD STUBBLE OR SLASH WINDROWS



CULTIVATE IF NECESSARY AND DIRECT SEED

JUN

WINTER GRAIN



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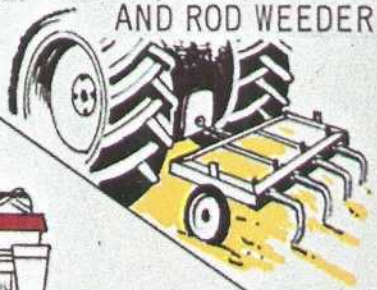
HARVEST EARLY AND DRY, SLASH STUBBLE CULTIVATE WITH CHISELS, THEN SWEEPS AND ROD WEEDER



DEC

SUMMER GRAIN

ROD WEED PLANT AND APPLY HERBICIDE

ADVANTAGES

1 REDUCED TILLAGE OPERATIONS SAVE TIME AND FUEL

2 MAXIMUM SOIL PROTECTION FROM STUBBLE

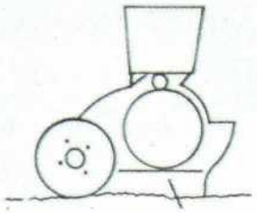
3 CROP SEQUENCE SIMPLIFIES

4 BALANCED ROTATION BENEFITS SOIL FERTILITY, DISEASE AND WEED CONTROL

5 WINTER CROP RELIABILITY IS INCREASED

A CONSERVATION CROPPING SYSTEM

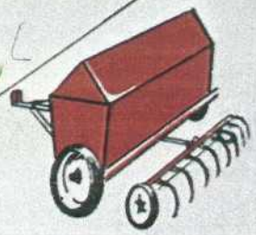
CULTIVATE WITH SWEEPS AND ROD WEEDER ONCE OR TWICE DEPENDING ON CONDITIONS APPLY HERBICIDE



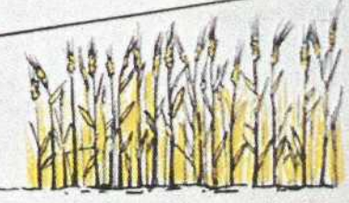
ROD WEED AND PLANT

SUMMER LEGUME

SPREAD STUBBLE OR SLASH WINDROWS

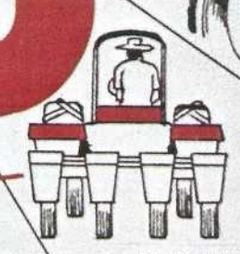


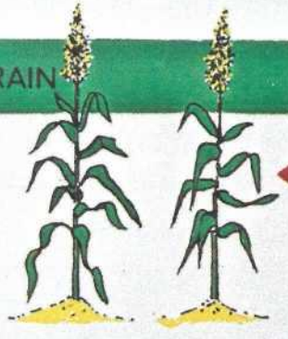
CULTIVATE IF NECESSARY AND DIRECT SEED



HARVEST EARLY AND DRY, SLASH STUBBLE CULTIVATE WITH CHISELS, THEN SWEEPS AND ROD WEEDER

ROD WEED PLANT AND APPLY HERBICIDE





DEEP CHISEL IF NECESSARY

SORGHUM CULTIVATE WITH SWEEPS

OR

HARVEST

PLANT NAVY BEANS

SLASH CULTIVATE WITH SWEEPS AND ROD

MAIZE SLASH CULTIVATE AND PLANT

OCT

AUG

DEC

JAN

MAY

JUN

NOV

JULY

DEC

WINTER FALLOW

WINTER GRAIN

WINTER GRAIN

SUMMER GRAIN

DISADVANTAGES	ADVANTAGES
1 PRESENT MACHINERY LIMITATIONS	1 REDUCED TILLAGE OPERATIONS SAVE TIME AND FUEL
2 BETTER MANAGEMENT REQUIRED BECAUSE EACH OPERATION MUST BE SUCCESSFUL WEED CONTROL	2 MAXIMUM SOIL PROTECTION FROM STUBBLE
3 LIMITED EXPERIENCE	3 CROP SEQUENCE SIMPLIFIES
	4 BALANCED ROTATION BENEFITS SOIL FERTILITY, DISEASE AND WEED CONTROL
	5 WINTER CROP RELIABILITY IS INCREASED

The most suitable implement to perform these operations is a chisel plough that exhibits stubble handling capabilities and on to which can be fitted a range of ground tools. A semi chisel with 15 cm ground tools is used for the initial land preparation for the summer crops. This is normally deep working (up to 15 cm), and some weed control can be obtained by using that particular tool. Later workings are primarily for weed control, and 40 cm sweep ground tools are fitted.

A rod weeder, either as an attachment to the chisel plough or as a separate unit, has been used for weed control.

After winter cereal harvest, it may be necessary to slash the stubble to 30 cm lengths if the crop was heavy. This aids sowing and inter-row cultivation of the following summer grain crop but will result in accelerated stubble loss. Nitrogen fertilizer in the form of aqua ammonia is applied prior to the summer grain sowing in conjunction with the sweep weed control operation. For the legume crops, this operation is carried out when the pre-emergent herbicides are applied.

Inter-row cultivation is carried out using rear-mounted tines fitted with 40 cm sweep ground tools.

Sowing machinery

The conventional cultivator/seeder cannot handle the stubble efficiently, and its effect on the seed bed is disruptive. In addition, its weed control ability is questionable; therefore, its sowing and weeding functions should be separated.

A rod weeder, with its low draught requirements, can be easily worked half-a-day ahead of the seeder and would give a good weed kill, minimum disturbance to the seed bed and leave the soil in a suitable condition for sowing.

With the sowing of the winter crop, it is often necessary to seed on to moisture at depth (15 cm), and hence a strong seeding tine is essential. For both summer and winter seeders, press wheels are mandatory.

Can it be done and will it pay?

Growing these crops into stubble in particular sequences has been under investigation for the past 5 years at the J. Bjelke-Petersen Field Station at Kingaroy. For the past 2 years, two local farmers have been growing crops under this system. Results to date indicate that the system is feasible, as all crops have been satisfactorily sown and given acceptable yields.

As the number of tillage operations are reduced, each one that is done takes on a new importance, especially with regard to timing. A high degree of managerial skill is required to ensure that crops are harvested as soon as possible, allowing sufficient time to prepare land for the next sowing.

Apart from reducing the number of tillage operations, savings can be made by replacing high draft-demanding implements such as one-way disc ploughs with less draft-demanding tine ploughs and rod weeders. In addition, using the one implement for the majority of all tillage operations reduces the on-farm machinery capital cost component.

Early results from the two farmers have shown savings in establishing summer crops of the order of 40% and for winter crops, 70%.

At the present time, the sowing of the winter cereals into summer legume stubble is a reality and has been accepted by the farming community. Maize and sorghum grown into winter cereal stubble can be recommended, while work is continuing on the weed control component for summer legumes.

Rice—a new crop at Mareeba

by P. E. A. Tonello, Agriculture Branch

THE potential for rice growing at Mareeba was first demonstrated on the heavy clays of the Arriga complex during the early 1970s.

In 1975, 24 ha were sown as a summer crop and yielded 5 t per ha.

From this modest beginning, plantings increased to 240 ha in 1977 and 720 ha in 1978 with the average yield of 5 t per ha being maintained. Plantings in 1979 reached 1 000 ha. The Mareeba rice industry, currently valued at $500,000 will expand in the future but at a much slower pace.

Climatic conditions

The availability of an abundant water supply from the Tinaroo Dam enhances Mareeba's tropical climate (see table 1) and ensures that high crop yields are attained.

The amount of water used varies according to the season. Winter plantings (June/July sowings) need more water because of their extended growth period and increasing evaporation losses as the crop reaches maturity. In summer plantings (December/early January) rainfall contributes a large proportion of the water requirements, even though crop water use is high because temperatures and evaporation are high. When rainfall is excessive as it was in 1979, banks may need to be broken to allow rapid drainage.

Summer and winter rice crops normally use 6 and 8 ML of irrigation water per ha respectively.

Winter plantings are the more risky. Early storms can severely hamper harvesting, cold spells can increase the incidence of sterile florets and weather conditions at maturity are not conducive to uniform drying of grain in the field. Alternate rapid loss and absorption of moisture by the grain causes development of internal cracks. This is the main reason for the poor 'millouts' obtained from winter plantings.

Mareeba rice land in virgin state. Ti-tree (Melaleuca viridiflora) *box* (Tristania *spp.) and poplar gum* (Eucalyptus alba) *are the main tree species.*

TABLE 1

CLIMATOLOGICAL DATA—MAREEBA

Month	Screen Temperatures °C		Evaporation * (mm) (14 years)	Average Cloudiness 9.00 a.m. (⅛'s of Sky Covered)	Humidity 9.00 a.m. %	Average Monthly Rainfall (mm) (more than 30 years)
	Maximum	Minimum				
January	31·2	20·8	6·07	4·7	74	223
February ..	31·8	21·2	5·16	4·8	79	234
March	29·6	19·9	5·08	4·0	80	194
April	28·4	17·1	4·70	3·7	76	53
May	26·6	14·8	3·99	2·8	75	15
June	25·1	12·9	3·71	2·7	75	16
July	25·3	11·2	3·86	2·7	75	7
August	26·6	11·7	4·50	2·4	71	6
September ..	28·1	12·9	5·92	2·7	64	5
October	30·7	15·6	6·93	2·3	58	14
November ..	31·9	18·4	7·04	3·2	62	38
December ..	32·1	19·8	6·78	3·6	68	106

SOURCE: Bureau of Meteorology

* Parada Research Station, Department of Primary Industries records

Soils

The grey and brown clays of the Arriga flats, Biboohra and the Upper Mitchell flood plain north of Biboohra are well suited to the crop. These heavy-textured soils are flooded intermittently and pronounced gilgai development is evident in some areas.

The grey soils occur on the lower portions of the plains while the brown soils occupy the slightly better-drained portions. These soils have a grey-brown clay or silty clay over mottled silty clay or heavy clay subsoil.

Within or adjacent to these areas, small pockets of soil with higher sand and silt content occur. These soils have a grey sand to fine sand grading into sandy clay or mottled clayey sand profile. Over the last couple of seasons, these soils have grown good crops. Banks have not eroded as some expected and water usage has been similar to crops grown on the more heavy-textured soils. These sandy soils offer better and more uniform germination, quicker drying and earlier harvesting.

The rice soils at Mareeba generally have a surface pH which is slightly acid and when flooded, the soil reaction rises to neutral. Subsoils are strongly alkaline with magnesium and sodium the dominant cations. Available phosphorus levels are low.

Land preparation

Once the land has been cleared, initial cultivation is usually carried out with offset discs. If the soil is dry, a chisel ploughing is usually needed to break up the ground before discing. Several workings are then necessary to obtain a firm, fairly fine tilth for sowing to enable levelling with a land plane. In gilgaed country, ripping to greater depth loosens more soil for subsequent levelling.

Levelling eliminates any small hills and hollows. Water accumulatng in hollows can rot seed and cause patchy emergence at planting. Further, when permanent water is applied, young rice seedlings in the hollows can be submerged and the resultant bare water patches attract wild ducks which cause considerable damage to young seedlings. The hills encourage weed growth and act as a reservoir for weed seeds.

Uniform irrigation and rapid drainage are essential both during germination and at maturity. An adequate irrigation and drainage system must be established from the outset if costly construction mistakes and continued high operating costs are to be avoided.

Irrigation layout

The crop is grown in paddy culture under continuous flood using contour bays. The vertical fall between contour banks is usually 125 mm. The slope of rice land in the area is moderately steep and considered marginal for rice production. However, land with a slope of 300 mm per 20 mm is satisfactorily growing rice.

Narrow bays on sloping land at Mareeba.

Water depths are 150 to 175 mm on the lower and 50 mm on the upper side of the bay. On steeper country, bays can become very narrow and the banks must be larger. In some cases, 20% of the land may be occupied by banks.

Contour banks should have at least 100 mm freeboard to enable the harvesting of storm water. At the bottom side of the bay, an overflow drains excess rain-water away from the bay. This must be large enough to drain heavy rain quickly. A second overflow point is usually installed in larger bays.

Varieties and planting

Bluebonnet 50 is the only variety grown. It is a long grain, high yielding, dry-cooking quality rice which commands a ready market and a premium price. The variety is prone to lodging when excessive nitrogen is used.

The main crop is planted in December. Summer crops planted later than December have yielded less and have a higher incidence of sterile florets. Late November and some early December plantings have, however, run into harvesting difficulties during an extended wet season. The summer crop is ready for harvest in approximately 140 days.

All winter plantings should be completed by the end of June. The winter crop is normally ready in 160 days but may take as long as 180 days to mature when low temperatures during the vegetative stage slow crop growth.

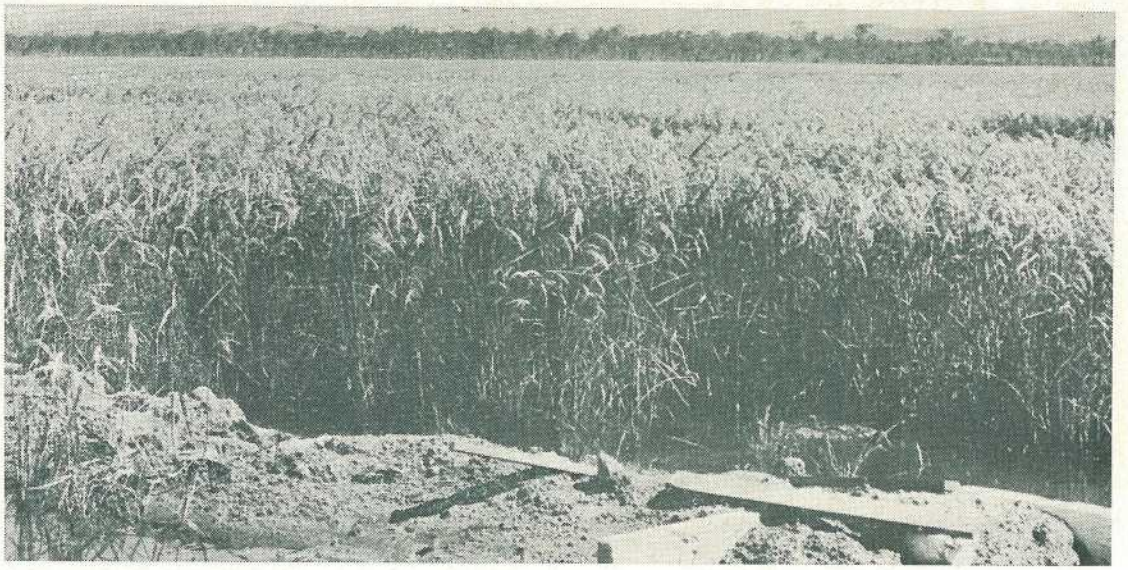
The seed is planted with a combine seed drill in 150 to 175 mm rows at a depth of not more than 25 mm. The seed is treated with a fungicide prior to planting to minimize seed rotting. After sowing, the bays are flushed (flooded with irrigation water) and then drained as quickly as possible.

During summer, seedlings emerge 5 days after flushing. In winter, seedlings normally emerge in 10 days but have taken up to 20 days. Reflushing may be necessary to aid emergence. This most often occurs with winter plantings.

Water management

Permanent water is normally applied 2 to 3 weeks after the crop is established. By this time, the rice seedlings should be about 150 mm high. The water depth is normally 150 to 175 mm on the lower side and 50 mm on the upper side of the bay.

Deciding when to apply permanent water is critical. Deep or early flooding can damage rice seedlings and reduce the plant stand. On the other hand, water maintained at this depth for a period of 3 weeks smothers young grassy weeds and enhances chemical weed control. If permanent water is delayed to allow the rice to grow to a desirable height, the weeds can be too advanced for effective control.



A crop of Bluebonnet 50 at Mareeba just prior to draining.

Permanent water is drained when a third to half of the head grains have changed from green to brown and/or when the lower grains of most heads are past the milk stage. Harvesting normally commences 2 to 3 weeks after draining.

Fertilizers

Nitrogen is the key element to high rice yields. Nitrogen is generally applied as urea although sulphate of ammonia has been used at planting.

Both summer and winter crops receive about 110 kg N per ha. This is usually applied as a split dressing, half basally and half as an aerial application at head initiation.

Some rice growers apply the initial nitrogen dressing just prior to or just after permanent water. This minimizes the effect of the fertilizer on germination, reduces denitrification losses following first flushing yet ensures adeqate nitrogen is available at tillering.

Excessive nitrogen predisposes the crop to lodge, and may also increase the number of unproductive tillers.

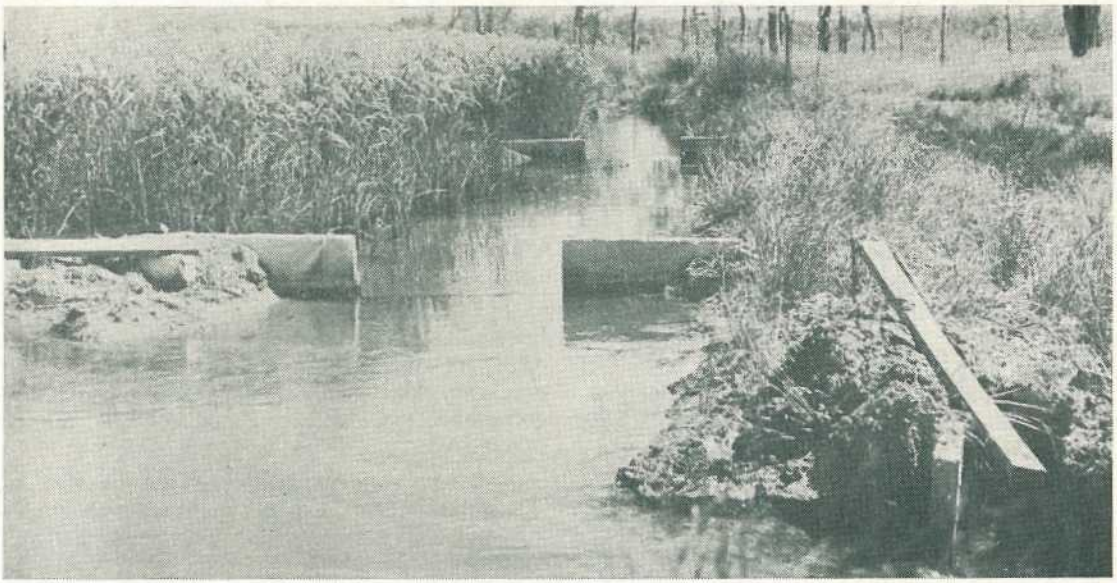
Mareeba rice soils are low in available phosphorus and both summer and winter plantings respond to phosphatic fertilizers. The response on new land is spectacular. Currently, growers are applying about 25 kg P per ha annually as superphosphate in one application at seeding.

The soils have a fair level of potassium and so far no visual response to potash fertilizers has occurred. No trace element deficiencies have been observed so far in Mareeba rice paddies.

Weed control

Weeds are not normally a problem on new land but barnyard grass (*Echinochloa colonum*) becomes the main pest after a couple of years. Sedge (*Cyperus iria*) has become a problem in summer crops especially when rainfall is early and above average. Of the other weeds which occur in rice paddies, *Ischaemum rugosum* has caused isolated problems. These weeds have been controlled by permanent flooding and the post-emergent herbicide propanil which is marketed as Stam.

Until the 1979 summer crop, weeds were controlled by propanil applied at 11 L per ha. A shortage of chemical and some previous disappointing results led to a mixture of propanil and 80% W/V, 2, 4, 5-T butyl ester being tried. The mixture gave good control



Bay to bay flood irrigation with concrete checks. Water is being drained from this crop.

A tracked header off-loading into a paddy bin.

of barnyard grass, sedges and most broadleaf weeds. The addition of 2, 4, 5-T butyl ester to propanil had a synergistic effect which allowed application rates to be significantly reduced.

Where barnyard grass is at the three to four leaf stage and sedges are few, 3.5 L of Stam and 700 ml 80% 2,4,5-T butyl ester/ha gave good control. When barnyard grass is at the four to five leaf stage and sedges and broadleaf weeds are significant 5·5 L Stam plus 1·0 L of 80% 2,4,5-T butyl ester/ha gave good control. Further research is planned to determine the most effective use of these chemicals.

The Mareeba rice crops are rogued each year for red rice and other off-types. Some are not easily detected and when they mature earlier than the crop, the infestation can rapidly build up. Red rice and other off-types were present as contaminants in seed and have infested every farm on which rice has been grown.

Vermin

Ducks, geese, brolgas and water hens have caused some sporadic damage. The ducks and geese cause considerable damage to young seedlings especially in low spots. Flashing lights and other control strategies have had limited success.

Insect pests

Until the 1979 summer crop, insect pests were not of economic importance in the Mareeba area. In that season, leaf hopper (*Nephotettix* spp.), leaf folders (*Cnaphalocrocis* spp.), lawn armyworm (*Spodoptera mauritia*) and the white rice stemborer (*Tryporyza innotata*) were noted in all plantings with stemborer infestations being severe in some ratoon crops.

Brown plant hoppers (*Nilaparvata lugens*) were first detected in the district during late January, 1979. These hoppers suck sap from the stems at just above water level. The first visual symptom was a rapidly spreading yellowing of the crop in irregular patches, which could be mistaken for nitrogen shortage.

Diazinon and carbaryl were recommended for control. Applications, however, were not always thoroughly effective. The crop canopy and low spray volume probably prevented sufficient insecticide reaching the feeding site. Although the insecticides had a good knockdown effect, surviving adults and emerging nymphs presented a continuing problem. In addition, continual rain hindered control and the weather was well suited to insect development. With a change in weather conditions, the hoppers disappeared.

Overseas experience indicates that the first spray application should be 20 days after the migratory form is detected and that granular insecticides may be better in situations where crop canopy is a problem. However, such products are not yet economically available in Australia.

Stemborer infestations were also severe in the 1979 summer crop. Population development in old season rice stubbles was probably responsible for these infestations. Adverse weather had largely prevented their destruction. Furthermore, insecticides applied to control brown plant hoppers also killed the natural occurring parasites and predators of the stemborer. Once spraying for brown plant hopper ceased, stemborer activity increased dramatically.

Diseases

Diseases have been of little importance in the area to date. Several diseases have been identified and show up occasionally on some crops. These include: leaf spots (*Cercospora oryzae, Nigrospora oryzae* and *Drechslera oryzae*), kernel smut (*Tilletia barclayana*) and crown sheath rot (*Gaeumannomyces graminis* var. *graminis*).

Harvesting

Tracked headers harvest the crop when grain moisture is between 18 to 22%. At that moisture, grain cracking which increases significantly below 16% moisture is avoided.

The winter crop is the more difficult to harvest as midsummer storms alternatively wet and dry the grain. This increases grain cracking. Harvesting of the winter crop should commence at 22% moisture to reduce cracking.

Weather conditions during the harvest of the summer crop are less conducive to cracking and the grain can be harvested at 18% moisture.

Marketing

All rice growers are issued with quotas based on past production by the Rice Marketing Board.

Following harvest, the paddy is delivered to the storage and handling complex at Mareeba and dried to below 15% moisture before railing to Home Hill for milling by the Rice Marketing Board.

The Mareeba complex has a current capacity of 850 t and was designed to handle a throughput of 2 000 t in any one harvest. The complex was able to handle the 2 700 t produced from the 1978 summer crop because the grain moisture intake requirement was reduced to 18%.

The lack of storage at Mareeba has necessitated the Rice Marketing Board to request growers to grow both summer and winter crops. Growers are reluctant to plant significant areas of winter crop because of the harvesting problems but production has had to be split into summer and winter crop quotas so that the crop can be handled.

Red rice and other off-types reduce consumer acceptance and penalties have been introduced for crops containing more than 2·5% red rice in the sample. The crop is rejected if the sample contains more than 14% red rice. Samples containing more than 2% broken grain also incur a penalty.

The grain attracts a premium with growers receiving $170 per tonne for paddy delivered in the 1979 summer crop.

Cropping systems

Ratoon cropping has limited application at Mareeba as ratoon winter crops have yielded from 2 to 2·75 t per ha of inferior grain. Double cropping is also difficult because weather conditions in December–January usually hinder harvest and subsequent land preparation.

Crop rotations

Some measure of control over the build up of off-types, pests and diseases could be achieved through planned crop rotation systems. Several alternative crops are being investigated, the most promising being soybean, barley, oats, sunflowers and lupins, but none are grown commercially at persent in rotation with rice.

A viable crop rotation would supplement the rice pure seed scheme which has been instigated to reduce the level of off-types in commercial crops.

Better beef from quiet cattle

by Jennifer R. Wythes, Beef Cattle Husbandry Branch and W. R. Ramsay, Slaughtering and Meat Inspection Branch

ADEQUATE rest is vital for animals before they are slaughtered. This fact is well recognised by authorities in meat inspection, meat science and meat processing.

The physiological basis of the need for rest may be simply explained in terms of the acidity reached by muscles of the carcass after death. The indicator for acidity is pH.

Muscles from adequately rested animals contain large amounts of a muscle carbohydrate, glycogen, which is converted into lactic acid after death. This determines the pH. In general terms, the more glycogen present, the more lactic acid produced and the lower the pH reached. Conversely, the lower the glycogen levels, the less lactic acid and the higher the pH of the muscle.

In beef, pH affects several important characteristics: tenderness, colour, keeping quality, and water holding capacity.

Beef with a high pH means that the meat is less acceptable to end users, for the above reasons. It is also less profitable to market and has a shorter shelf life no matter what method of preservation is attempted. Such meat is not suitable for ageing in vacuum packages—a process that has become quite common in the industry for tenderising and longer storage.

Glycogen levels are lowered by stress. In the abattoir environment, one important cause of stress is lack of rest.

In the living animal, rest is helped by quietness, stillness and remoteness from people and unaccustomed activity.

On arrival at meatworks, animals may be tired after travelling and so have low glycogen levels. Given adequate rest before slaughter they recover and yield acceptable meat. On the other hand, if rest is not adequate then muscle glycogen levels are not replenished and these animals will yield high pH meat. Rest may be inadequate because of:

- Disturbances
- Unaccustomed sights and intermittent noise
- Unfamiliar movement
- Mixing of abnormals in new groups
- Strange surroundings

Combinations of the above probably have compounding effects. Animals vary in susceptibility and sometimes only individuals may be affected. However, in some cases, whole groups may suffer detrimental effects.

Such is its importance that adequate rest up to the time of slaughter is prescribed by State and Federal laws dealing with conditions under which animals may be slaughtered. This legislation is not enough, abattoir management must also contribute their experience, knowledge and skill, as well as adequate space and facilities.

Strawberry pests

by D. A. H. Murray, Entomology Branch

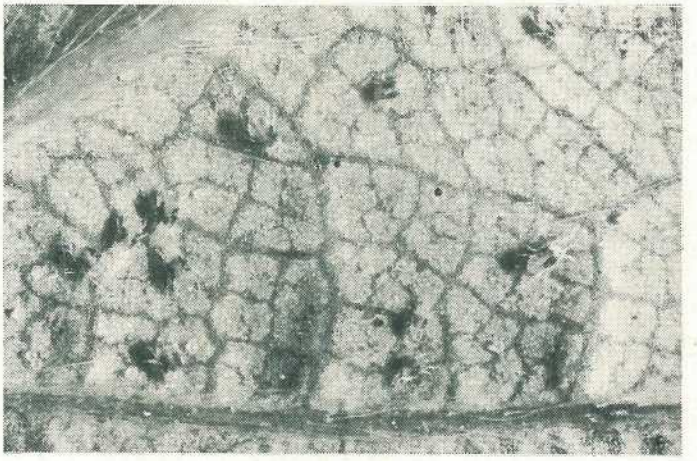
IN Queensland, most commercial strawberry crops are grown in south-east coastal areas.

Insect control is usually necessary for successful production. Most growers apply insecticides at regular intervals against spider mite, corn earworm and cluster caterpillar. Some of the less important pests are also controlled by such routine sprays, but cutworms, crickets and slugs may occasionally require specific attention.

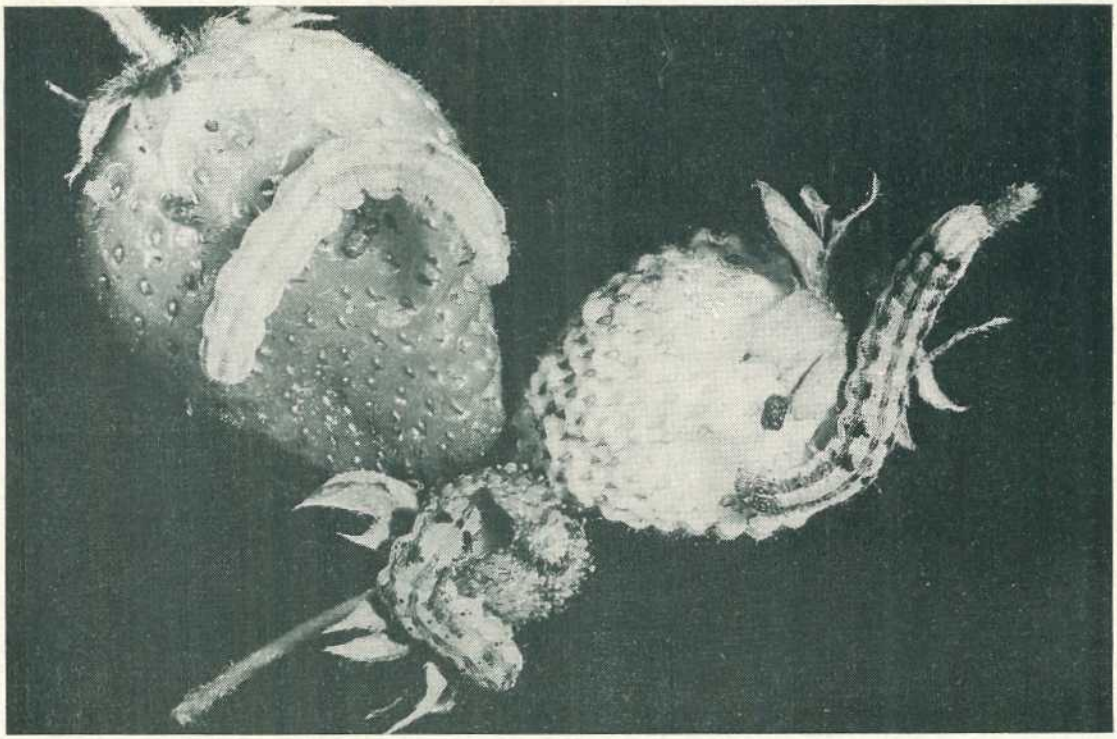
Spider mites

Spider mites (*Tetranychus* sp.; Family Tetranychidae) are the most common pests attacking foliage of strawberry plants. Both nymphal and adult stages feed by piercing cells on the lower leaf surfaces. This causes a blotchy-white or silvery appearance. Foliage becomes harsh-looking and plants suffer a setback in growth thereby reducing yields. In severe cases, fruit may be attacked and the skin scarified with the seeds becoming quite prominent.

Adult mites may be red, yellow or green and are just visible to the unaided eye. The minute, round and glistening eggs are laid separately in large numbers usually near the main leaf veins. Young larvae, with only six legs and almost transparent, moult to become eight-legged nymphs and finally adults. The cast skins shed by the young stages can be seen scattered among the mites, which sometimes spin a fine, silk web covering the undersurface of leaves.



Spider mites on underside of strawberry leaflet (greatly magnified). Note several spherical mite eggs.



Corn earworm larvae attacking strawberries.

As spider mites may take only 2 weeks to complete a generation, their numbers can increase rapidly. Warm, dry weather during winter and early spring favours spider mite build up.

Corn earworm

Corn earworm (*Heliothis armigera* (Hübner); Family Noctuidae) is a serious pest of strawberries. Larvae chew large, irregular holes in the flowers and fruit and occasionally damage the plant crown.

The adult is a stout-bodied moth with a wingspan of about 35 mm, the forewing being streaked with reddish-brown and the hindwings being cream in colour with a dark marginal band. Eggs are laid singly mainly on fruit, flowers, and flower buds. During warm weather, larvae hatch within 3 days and begin feeding. Fully grown larvae are about 35 mm long and are yellow, green or reddish-brown with a variable number of dark markings and longitudinal stripes. Their bodies are sparsely covered with dark, spiky hairs. Development from egg to adult takes 4 to 5 weeks in summer.

Cluster caterpillar

Cluster caterpillar (*Spodoptera litura* (Fabricius); Family Noctuidae) is most troublesome during autumn when small larvae are usually found clustered on the lower leaf surfaces where they cause skeletonization of the leaves. Mature larvae are more solitary and damage flowers and fruit.

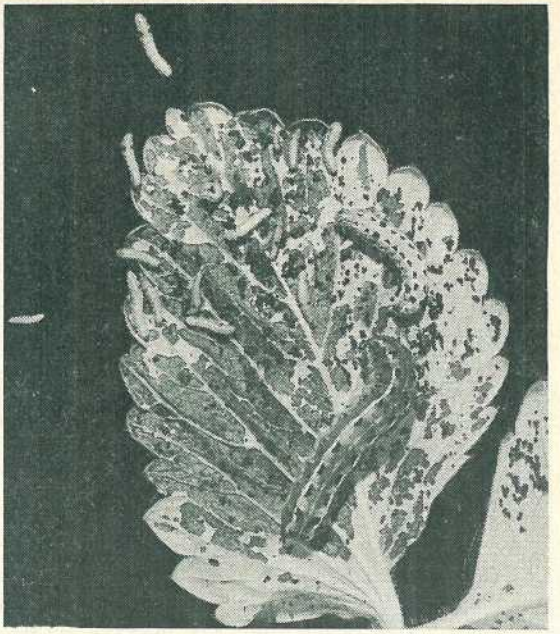
The adult moth has a wingspan of about 40 mm, the forewings being dark with white markings while the hindwings are translucent pearly-white. Eggs are laid in clusters of several hundred, each cluster being covered with fluffy brown scales from the abdomen of the moth. Larvae hatch within a few days and begin feeding. When fully grown, larvae are about 45 mm long and are grey with longitudinal stripes and prominent black triangular markings on each segment. During summer, development from egg to adult takes 4 to 5 weeks.

Brown cutworm

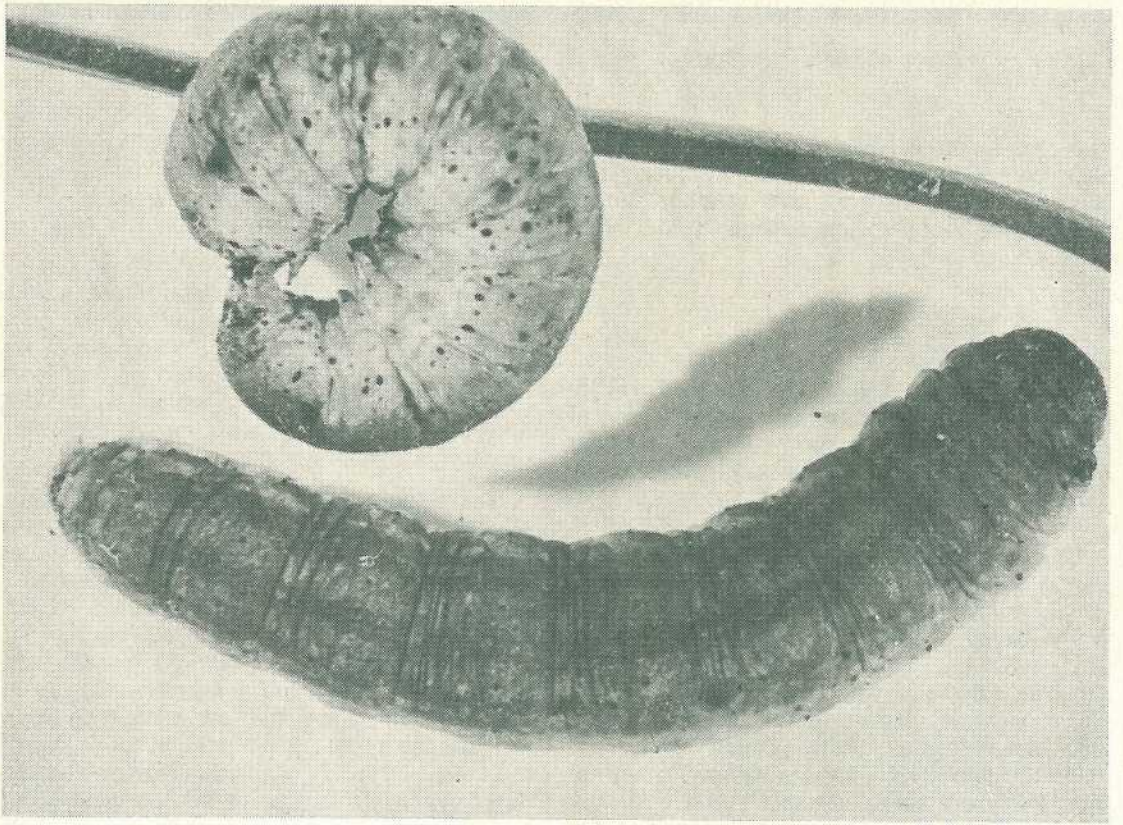
Brown cutworm (*Agrotis munda* Walker; Family Noctuidae) is a serious pest of strawberry runners. Larvae sever the stems of young heart leaves near ground level and may cause heavy losses.

The adult is a dark moth with a wingspan of 35 mm. The forewings are generally dark brown with a darker reniform spot midway along the fore margin, while the hindwings are pale white with veins marked in brown. Eggs are laid at the base of the plant.

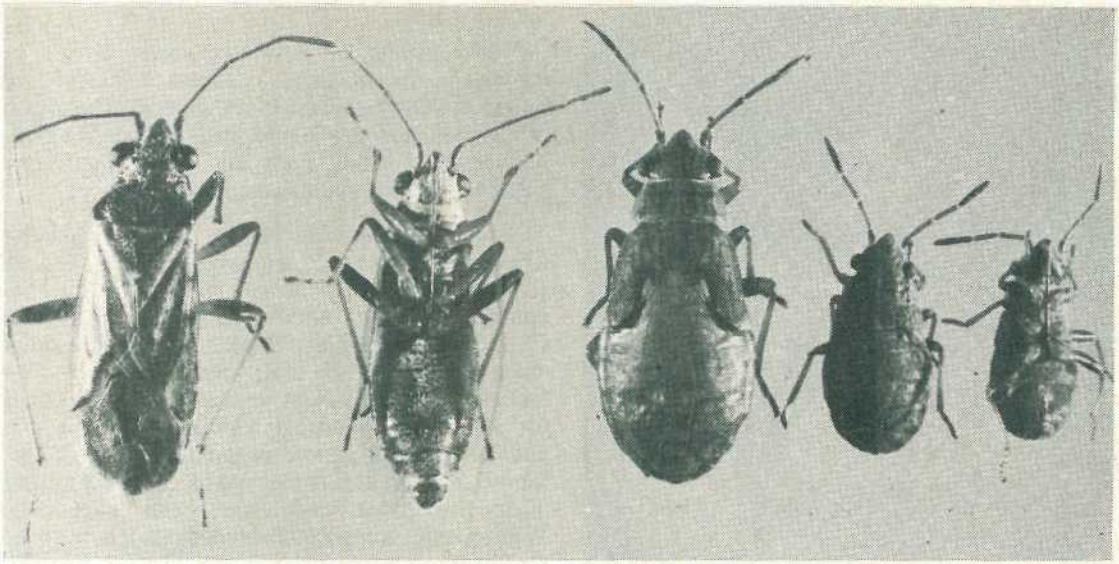
The larvae hatch in 3 days in summer and are fully grown in about a month. Mature larvae are greyish-green to brown and about 45 mm long but are seldom seen as they hide on the ground by day and feed by night. During warm conditions, the total life cycle takes 7 to 8 weeks.



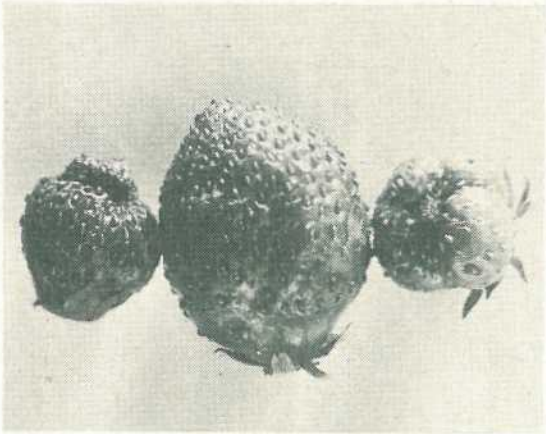
ABOVE. Cluster caterpillars attacking a strawberry leaflet.



BELOW. Cutworm larvae. Note the characteristic curled up position of the lower larva.



Rutherglen bugs. Adults upper and lower views to the left, immature stages to the right.



Rutherglen bug damage. Deformed fruit following attack. Centre fruit normal.

Larvae of all of these moths show the characteristic behavior of curling up if disturbed. When mature, they leave the plant and pupate in the soil.

Rutherglen bug

Rutherglen bug (*Nysius vinitor* Bergroth; Family Lygaeidae) and the closely related grey cluster bug (*Nysius clevelandensis* Evans) are occasional pests of strawberries. In spring and summer months, before a plant crop is ratooned, they may breed on alternative weed hosts growing in the inter-row spaces. When the plant crop is prepared for ratooning and weed hosts are killed, the bugs move on to the strawberry plants. They may also move on to a plant crop from nearby weed hosts. Clusters of them feeding on flower buds, flowers and young fruit can cause flower losses and malformation as fruit develop.

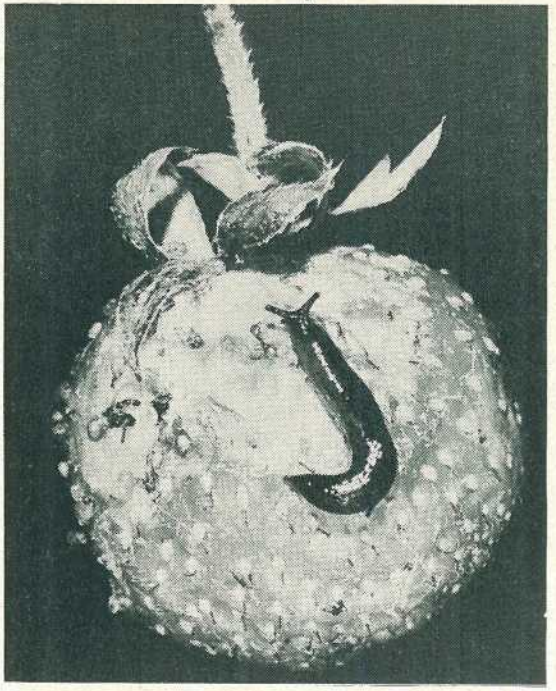
Rutherglen bug and grey cluster bug are very similar in appearance. The narrow-bodied, rectangular-shaped adults are greyish in colour and up to 5 mm long. When breeding takes place on the strawberry plant, large numbers of winged adults and wingless nymphs will be found.

Slugs

Slugs are often a problem in strawberries where shade and moisture favour their survival. They feed on young growth and gnaw holes in ripe fruit. The dark, slime-covered slugs are up to 20 mm long.

Crickets

Both the black field cricket (*Teleogryllus commodus* (Walker); Family Gryllidae) and the mole cricket (*Gryllotalpa* sp.; Family



Slug attacking a ripe strawberry.

Gryllotalpidae) can cause severe damage to strawberries. Most damage occurs after a plant crop has been ratooned, but occasionally newly-planted runners are attacked. When weeds and grasses in the inter-row spaces are killed in preparation for ratooning, crickets may feed on the strawberry plants. Crickets shelter by day and feed at night on the young heart leaves, cutting the leaf stems near ground level. Plants can be severely set back early in the growth season.

The black field cricket is about 25 mm in length and dark brown or black in colour. Adults are winged and have the hind legs modified for jumping. Nymphs are wingless. Where there are large numbers, removal of plastic mulching will reveal a network of runways used by the crickets. In the evening, the stridulation of the crickets can be heard.

Mole crickets are soft bodied, light brown coloured insects up to 30 mm long. The front legs are broadly flattened to aid digging. Only the adults are winged. Unlike the field crickets, mole crickets spend much of their time burrowing in the soil, coming to the surface at night to feed.

White grubs

White grubs occasionally cause losses in ratooned strawberries. These root-feeding larvae severely reduce plant vigour. Damaged plants wilt and are easily pulled from the soil. Larvae feed along beds and generally a few adjacent plants are affected.

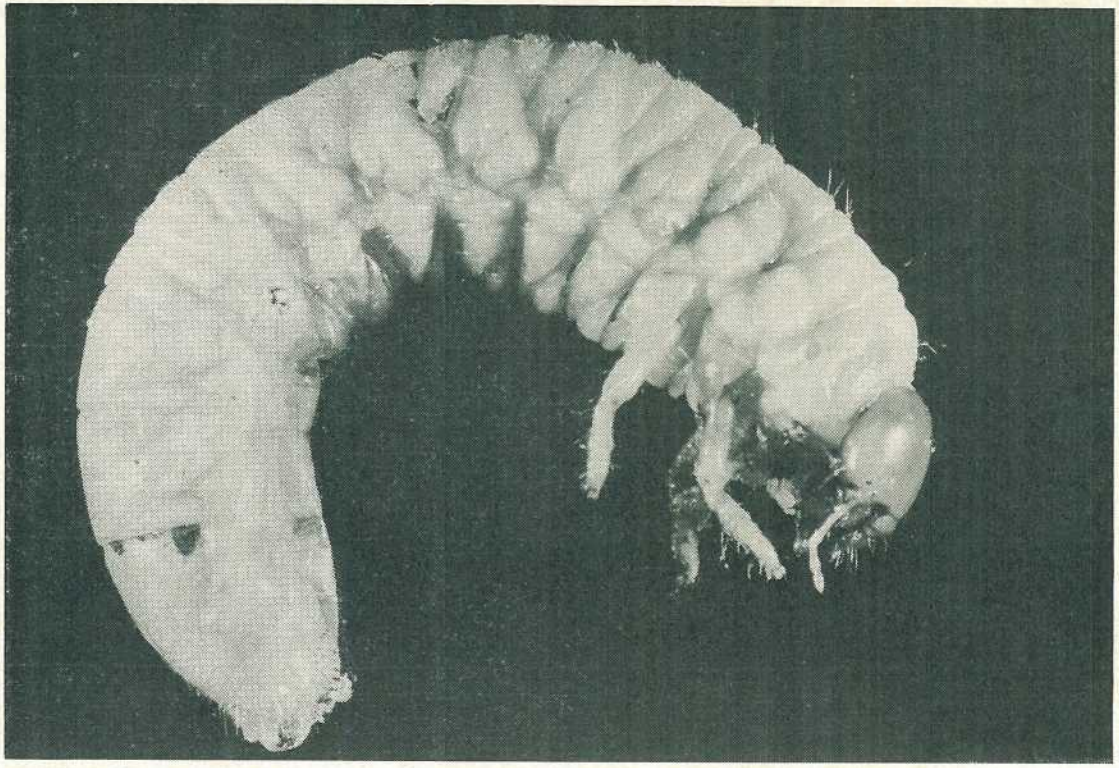
The most common larvae are those of the Christmas beetle (*Anoplognathus porosus* (Dalman); Family Scarabaeidae), a golden-coloured beetle about 23 mm long. The Christmas beetle has a 2-year life cycle. Adults emerge from the soil during November–December and lay eggs in areas being prepared for strawberry planting. Young larvae hatch and begin feeding on organic matter. Older larvae feed on the roots late in the next spring after the plant crop has been harvested. Wilting and complete root destruction may be readily seen when such plants are cut back in preparation for ratooning in late summer.

Black field cricket.

STRAWBERRIES
CURRENT CONTROL RECOMMENDATIONS

Pest	Pesticide	Withholding Period (Days)	Rate of Commercial* Preparation per 100 L	Remarks
Spider mite	cyhexatin or wettable sulphur	2 ..	40 g of 50% 300 g of 80%	Fortnightly sprays may be needed from time mites first appear. Thorough coverage on undersides of leaves is essential. Most control failures are due to inefficient application methods or neglect during busy harvesting periods.
Corn earworm ..	endosulfan or methomyl	5 3	190 mL of 35% 150 mL of 22·5%	Main problems are during the flowering and fruting periods. During intense grub activity spray every 7–10 days.
Cluster caterpillar ..	endosulfan or methomyl or trichlorphon	5 3 2	190 mL of 35% 150 mL of 22·5% 170 mL of 60%	Thorough coverage of undersides of leaves essential.
Cutworm	trichlorfon or endosulfan	2 5	85 mL of 60% 190 mL of 35%	Apply insecticide to freshly planted runners and soil around base of each plant. Grubs feed at night, so spray in late afternoon.
Rutherglen bug and grey cluster bug	endosulfan	5	190 mL of 35%	Routine sprays for corn earworm or cluster caterpillar normally control both bugs. Maintain weed control.
Slugs	metaldehyde methiocarb	.. ..	50 g of 2%m² Normal infestation: 5·5 kg of 2%/ha High infestation: 11 to 22kg of 2%/ha	Powder: place small heaps beside every 2nd and 3rd plant. Pellets: scatter evenly Scatter pellets evenly.
Crickets	chlorpyrifos and bran bait	..	10 mL of 50% EC chlorpyrifos/1 kg bran	Mix 10 ml chlorpyrifos 50 EC with each 1 kg of bran. Add enough water with the insecticide to mix it thoroughly into the bran. Allow bait to stand for 2–3 hrs then broadcast over affected area at 180 kg of bait per ha. Apply in late afternoon. Maintain weed control.
White grubs	..	..	..	Preplant soil treatments are not recommended. Thorough land preparation normally sufficient. Replace losses in ratooned patches with new runners.
Cyclamen mite ..	endosulfan	5	190 mL of 35%	Spot spray affected plants, thoroughly drenching crown of each plant.
Aphids	dimethoate	7	75 mL of 40%	Apply if there is a build up on leaves or fruit.

*Rates shown are for one formulation only.



White grub—larva of a Christmas beetle.

Larvae are white, soft-bodied grubs with hard, brown heads. They assume the shape of a letter 'C' and are about 50 mm long when fully grown.

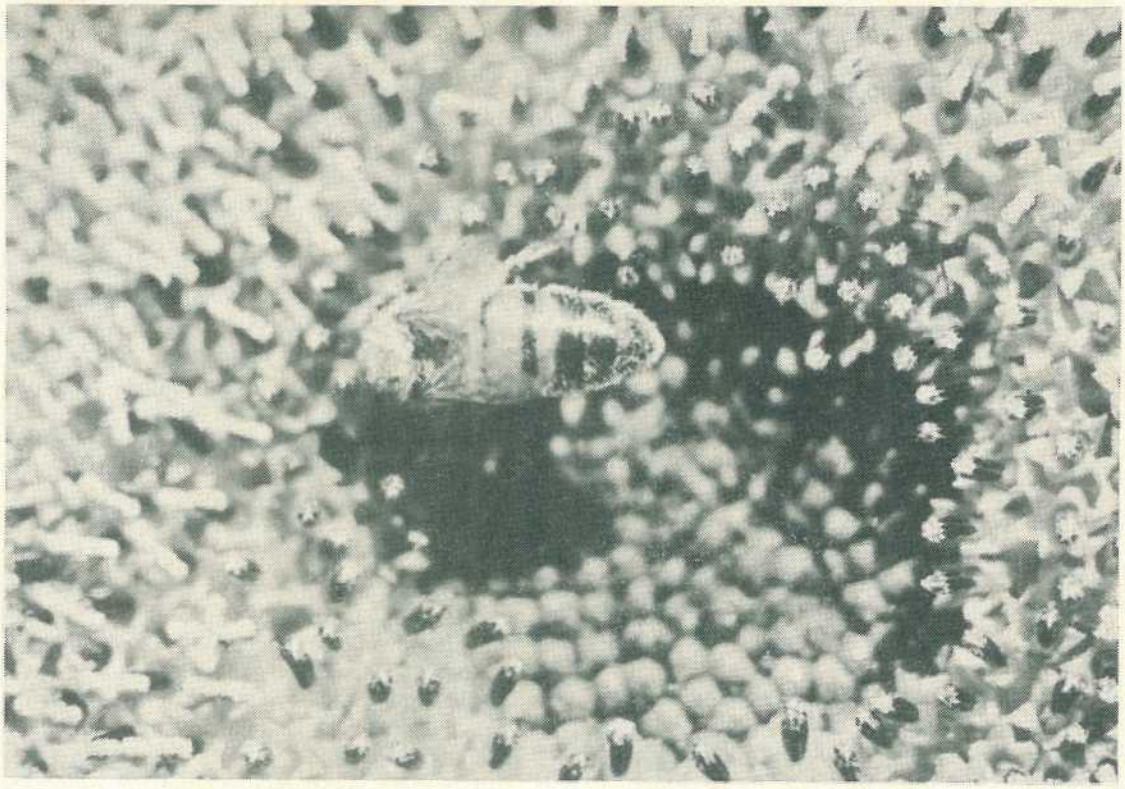
Cyclamen mite

The cyclamen mite (*Steneotarsonemus pallidus* (Banks); Family Tarsonemidae) has been recorded on only a small number of farms in South-east Queensland. Adult and young mites feed on the unopened leaves in the plant crown and cause stunting and dwarfing of the leaves. They also feed on flowers and cause fruit distortion.

As the cyclamen mite is scarcely visible to the unaided eye, infestations are usually first detected by the puckered, twisted appearance of older leaves of affected plants.

Aphids

Aphids (Family Aphididae) are only occasionally a problem on strawberries and infestations usually develop on the undersides of young leaves. Apart from feeding on the sap, aphids are also implicated in the transmission of some viral diseases of strawberries.



Photograph above. A honey bee (Apis mellifera) *pollinating individual florets within a sunflower head.*

Pesticides, bees, and sunflowers

THE area planted to sunflowers in Queensland has risen dramatically from 10 000 ha in 1970–71 to approximately 165 000 ha in 1978–79.

In association with this expansion, there have been increases in the activities of several sunflower pests, and consequently in the frequency of pesticide applications. While control of damaging species is important, it should be realized that pesticides, if used incorrectly, can have detrimental effects on honey bees (*Apis mellifera* L.). These bees may originate from deliberately introduced apiaries, or from wild colonies inhabiting bushland.

by R. H. Broadley, Entomology Branch

The pesticide hazard has two aspects. Firstly, loss of bees may result in a reduction of colony vigour or even death of the hive. This means a loss in the beekeeper's income. Secondly, pollination in sunflower crops may suffer with an ensuing reduction in yield and a loss in farmer income.

Many sunflower varieties possess low levels of 'self-compatibility'. That is, pollen from one flower head must be transferred to another flower head in order for successful fertilization to occur. Honey bees are the main pollinators of sunflowers, and are much more effective than sundry insect pollinators such as Noctuid moths, Heliothis larvae, Rutherglen and grey cluster bugs, ladybirds, and Mirid bugs, which are also found in flowering sunflower crops.

Some of these are unwanted pest species, which may be active either at night or during the day. Honey bees forage only during daylight hours, and this is especially significant in relation to pesticide application.

Honey bees and successful pollination

Sunflowers usually have between 1 000 and 4 000 individual tiny florets within each head, and each floret must be pollinated. Research in Queensland has indicated that an average of one bee per four sunflower heads is required for successful pollination. If there are fewer bees than this, hives may need to be introduced. In very large paddocks, the hives should be placed strategically around field perimeters to ensure uniform pollination.

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

Effects of pesticide on honey bees

There are basically two types of pesticide effects on bees. They may be killed or injured in the field, or they may return to the hives with toxic chemicals adhering to the branched hairs on their bodies or in the honey stomach. In this latter manner, pesticide may be passed around the hive. Carbaryl, for example, has been shown to be toxic for up to several weeks in contaminated pollen.

As a general rule, herbicides and fungicides are not as dangerous as insecticides to honey bees. In sunflowers, herbicides, fungicides, or dessicants are not likely to be used during flowering and hence these groups of chemicals do not present hazards to honey bees. On the other hand, insecticides are commonly employed. A useful guide to insecticide toxicity is that dusts are usually worse than emulsifiable concentrates, apparently because dust particles are picked up by body hairs of the honey bees in the same manner as pollen.

In addition, there are a number of environmental and genetic factors which affect insecticide toxicity. For example, maldison apparently has a fumigant effect in warm conditions but not cold. Maldison diluted in water is relatively low in hazard but when diluted in oil (malathion U.L.V.) is highly hazardous. Damage by insecticide can be more severe when good nectar flow conditions exist but impact may be lessened in colonies with abundant brood, pollen and honey in the hives.

Minimizing effects of pesticides on honey bees

There are several procedures which can be employed to minimize the risks of a pesticide application to honey bees. These are:

- DECIDE WHETHER THE CROP ACTUALLY REQUIRES A SPRAY APPLICATION. For an affirmative decision to be made, the anticipated pest damage must exceed the cost of the insecticide and its application costs. Sunflowers are often quite tolerant to certain types of pest attack, hence spraying may not be necessary.
- DO NOT SPRAY WHEN BEES ARE PRESENT IN THE CROP. Almost all insecticides will cause mortality in honey bees if applied directly to them. Therefore, they should not be used when bees are foraging. The first point to note is that in hybrid crops, at least, flowering may last only 2 or 3 weeks. Thus the possibility of a delay in spraying should be seriously considered. Alternatively, crops should be inspected closely for signs of pest activity at budding so that action may be taken before bees move into flowering crops.

Bees are active in the crop from daybreak, reach a peak between 7 a.m. and 9 a.m., and remain in large numbers during the rest of the day. A spray at dusk is probably the best way of reducing bee losses, as it gives selective chemicals a chance to breakdown before contacting bees the following day. If this is not possible, a very early morning spray may be considered.

- ADVISE BEEKEEPERS OR NEIGHBOURS OF YOUR INTENTION TO SPRAY. There are several options open to the beekeeper. He might close up the hives during the period before or after the spray application (bees must not be enclosed in their hive for long periods under very hot conditions), move the bees out of the crop and this is the recommended option, or erect a protective canopy over the hives.

TABLE I

INSECTICIDES AVAILABLE FOR PEST CONTROL IN QUEENSLAND SUNFLOWERS, WITH A GUIDE TO THEIR EFFECTS ON HONEY BEES

Insecticide	Some Trade Names	Pests Controlled	Effects on Honey Bees		Use Class*	Comments
			Direct Toxicity	Residual Effects		
Carbaryl	Sevin, Bugmaster, Septene	black scarab beetle	high ..	7–12 days	I	rarely, if ever, required at or near flowering
Chlorpyrifos ..	Nabsol, Lorsban ..	cutworms (e.c.), false wireworms (w.p.)	moderate	1 day ..	I	rarely, if ever, required at or near flowering
Dimethoate ..	Rogor, Perfekthion, Cygon	green vegetable bug, jassids	high ..	1–2 days ..	I	
Endosulfan ..	Endosan, Endosulfan, Thiodan	Heliothis, Rutherglen and grey cluster bug, green vegetable bug, aphids, jassids	low ..	less than 5 hours	III	
Fenvalerate ..	Sumicidin	Heliothis	high ..	not known	probably I	
Maldison U.L.V.	Malathion U.L.V. ..	Rutherglen and grey cluster bug, field crickets	high ..	more than 4 days	I	
Methidathion ..	Supracide	Rutherglen and grey cluster bug ..	high ..	3 days ..	I	
Methomyl ..	Lannate	Heliothis, green vegetable bug ..	high ..	less than 1 day	II	
Trichlorfon ..	Lepidex, Dipterex, Klorfon	cutworms	moderate	2–5 hours	III	rarely, if ever, required at or near flowering

*I Hazardous at any time on blooming crops.
II Minimal hazard if sprayed in late afternoon.
III Minimal hazard if sprayed in the late evening, or early in morning when bees not foraging.

Recent American research suggests that covering the colonies with hessian in areas where extensive spraying programmes were maintained, offered a means whereby the effects of pesticides were diminished. Providing an alternative, uncontaminated pollen supply and provision of internal water were also highly beneficial.

- CHOOSE THE LEAST TOXIC PESTICIDES. A number of pesticides are registered for the control of insect pests of sunflower (table 1). If insecticides are chosen judiciously, then the effects of an application on non-target organisms such as honey bees can be considerably reduced. Some pesticides are inherently non-toxic to bees while others have a high initial hazard but a short residual effect. Insecticides should be applied at the recommended dosages.

Agricultural Chemicals Distribution Control Act 1966–1978

Sunflower growers should be aware that when a beekeeper believes that he has lost bees as a result of the spraying of insecticides on to crops on neighbouring property, he has the right to notify the Department of Primary Industries and have his case investigated under the Agricultural Chemicals Distribution Control Act.

Scientific names of pests and other insects mentioned in this article are as follows:

Black scarab beetle	*Pseudoheteronyx* sp.
Cutworms	*Agrotis* spp.
False wireworms	*Pterohelaeus* spp., and *Gonocephalum* spp.
Field crickets	*Modicogryllus* spp.
Green vegetable bug	*Nezara viridula* (Linnaeus)
Grey cluster bug	*Nysius clevelandensis* Evans
Heliothis	*Heliothis armigera* (Hübner) and *Heliothis punctigera* Wallengren
Hoverflies	*Sphaerophoria kerteszi* Klocker
Jassids and leafhoppers	*Austroasca* spp., and *Cicadulina* sp.
Lady birds	*Harmonia arcuata* (Fabricius) *Harmonia conformis* (Boisduval) *Micraspis frenata* (Erichson) *Coccinella repanda* Thunberg *Diomus notescens* (Blackburn) *Coelophora inequalis* (Fabricius)
Mirids	Several species in the family Miridae
Noctuid moths	*Heliothis* spp., *Agrotis* spp. etc.
Rutherglen bug	*Nysius vinitor* Bergroth

The wattles of South-eastern Queensland

phyllodes with two or more prominent veins

Acacia amblygona

The specific epithet is derived from two Greek words *amblys* meaning blunt and *gona* meaning an angle. This name was given to it by Allan Cunningham who first found it in the Brisbane River area. It describes the obtuse angle on the upper margin of the phyllode.

DESCRIPTION. This wattle is always a shrub, in some localities an intricately-branched, prostrate ground cover up to 30 cm high, forming an open mat up to 1 m in diameter. In other localities, it is an erect shrub up to 1 m high.

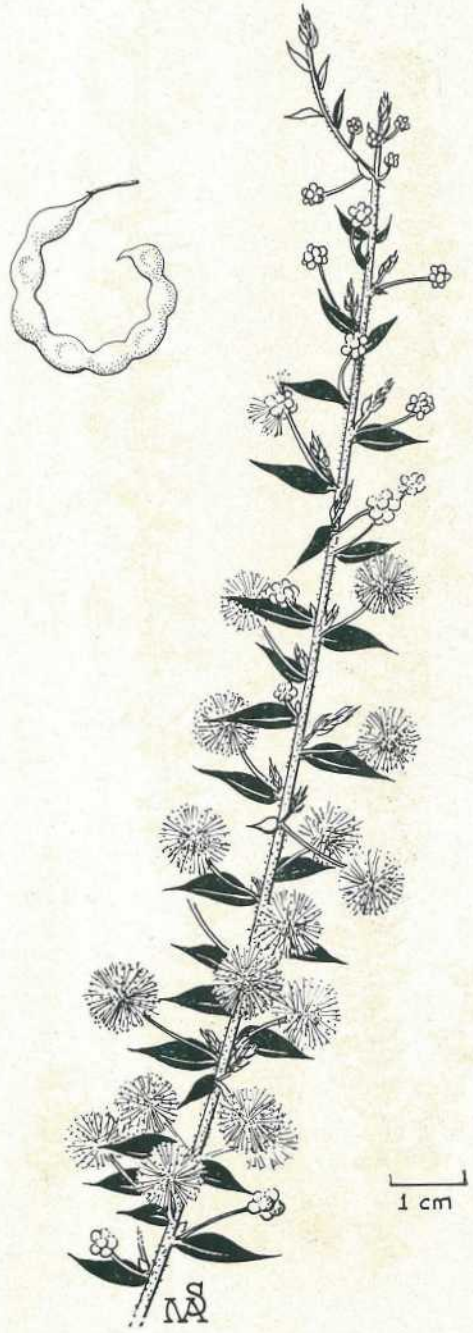
The branches are firm and terete and covered with short, spreading hairs. The phyllodes spread from the stems and are dark green. They are triangular-falcate, with an almost straight lower edge and a curved upper edge. The main vein is close to the lower edge and extends beyond the phyllode to form a slightly pungent point. The phyllodes are up to 1·2 cm long and 0·4 cm wide. About 10 to 15 flowers make up the globular heads which are on a glabrous peduncles up to 1·3 cm long. They are about 0·7 cm in diameter and are bright golden-yellow.

The pods are linear, about 7 cm long and are usually curved. The valves are raised above the seeds and slightly contracted between them.

FLOWERING TIME. It flowers in late winter and early spring.

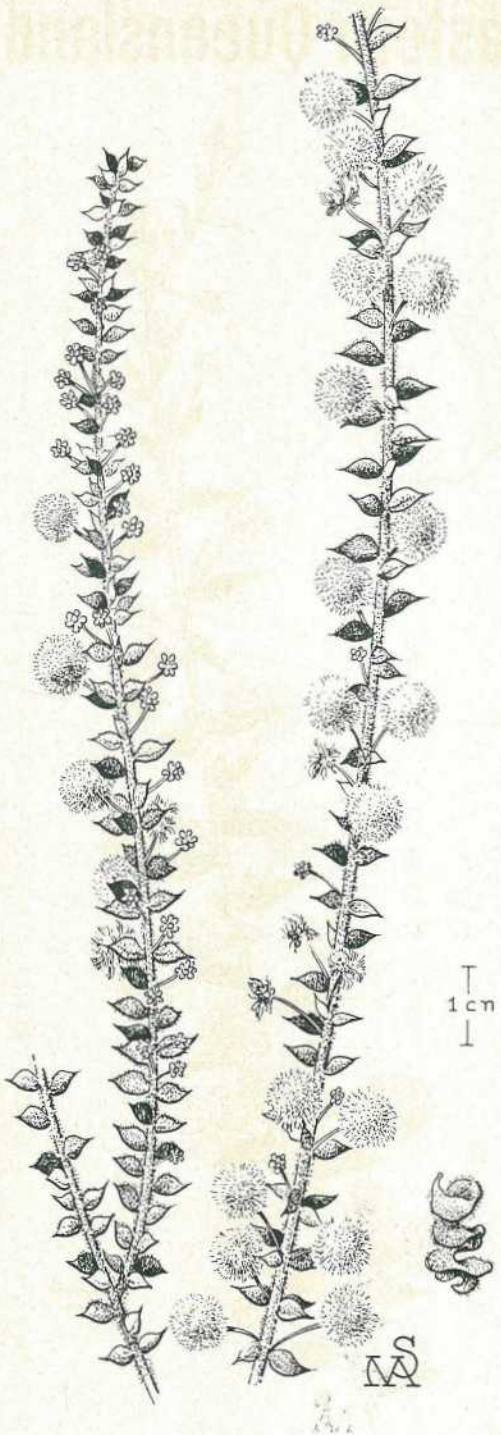
HABITAT. It grows in stony, sandy soil on ridges in open eucalypt forest.

DISTRIBUTION. It grows only in New South Wales and Queensland from as far south as the Hunter River Valley to as far north as Childers and Eidsvold. In South-eastern



Acacia amblygona

by Beryl A. Lebler, Botany Branch



Acacia pravifolia

Queensland, it is found on the sandstone hills at Plunkett, at Flagstone Creek and at Moggill, Brisbane.

Acacia pravifolia

The Latin adjective *pravus* means crooked, irregular or misshapen and combined with the Latin word for leaf forms the specific epithet describing the appearance of the phyllodes.

Until 1966, whenever this wattle was collected from the Darling Downs, it was thought to be a peculiar form of *A. amblygona*. Critical examination proved it to be *A. pravifolia*. This was originally found in the Flinders Ranges in South Australia.

DESCRIPTION. This wattle is a rigid shrub to about 30 cm high with ascending, arching branches which can spread to a diameter of 1·5 to 2 m. Dense, spreading hairs cover the stems. The phyllodes are more or less triangular in shape, up to 0·8 cm long and 0·4 cm wide, about as long as broad with a sparse covering of spreading, white hairs on the veins and on the margins. The vein closest to the lower margin is produced into a pungent point.

The heads of flowers are 0·8 cm in diameter and are bright yellow and slightly perfumed. They are on peduncles as long as or much longer than the phyllode.

The pod is linear and much twisted and about 0·5 cm wide. It is covered by white, spreading hairs.

FLOWERING TIME. This wattle flowers late in winter.

HABITAT. It grows on ridges in gravelly soil.

DISTRIBUTION. It has been found in South Australia, New South Wales and Queensland. In south-eastern Queensland, it grows only in the Upper Flagstone Creek area but is more common on the Darling Downs in the Pittsworth and Goondiwindi areas.

Acacia binervata

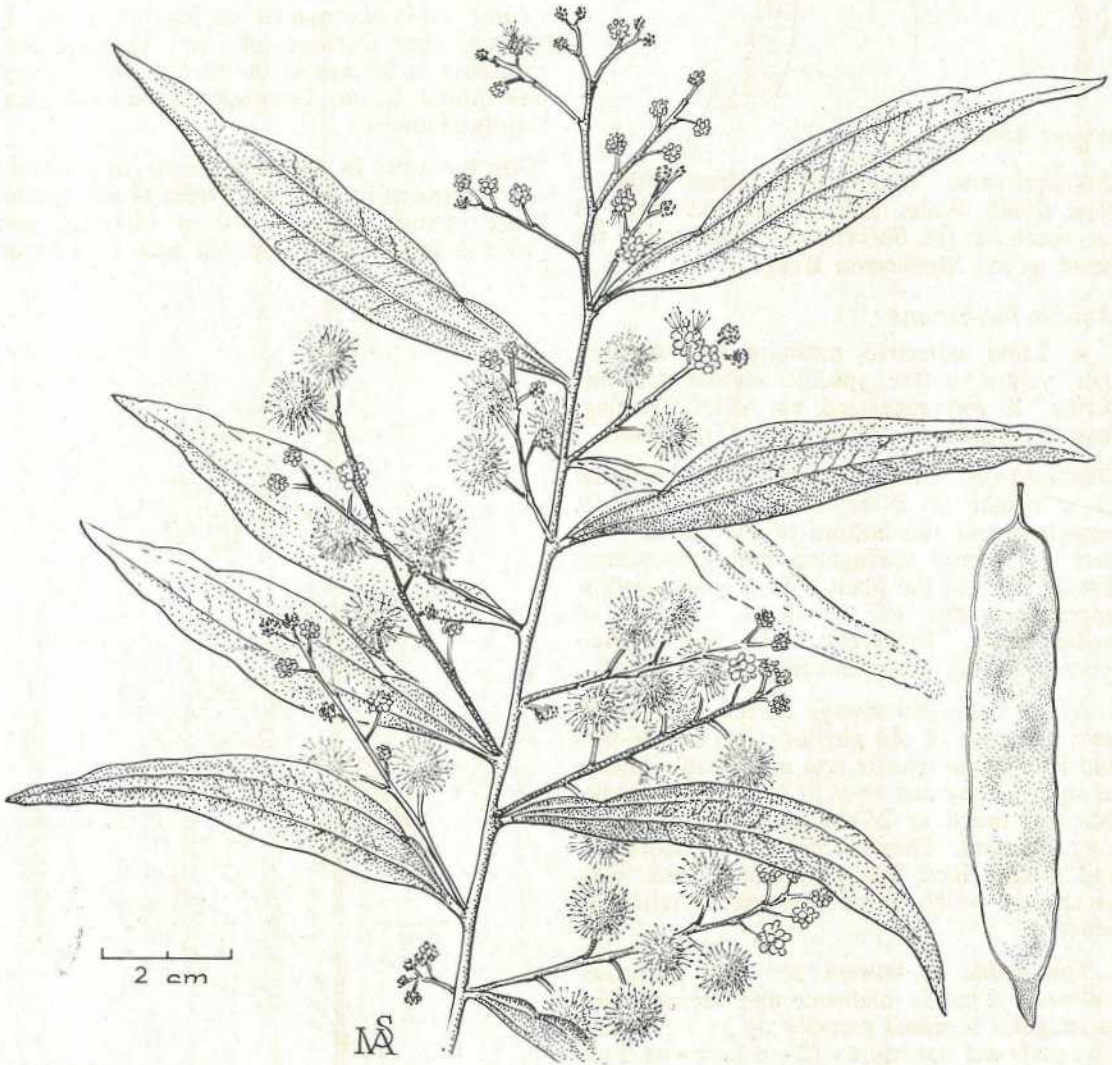
A Latin word meaning with two nerves is the specific epithet for this wattle.

DESCRIPTION. This wattle is a glabrous plant which can grow to a bushy tree 6 to 8 m high with spreading branches tending to droop at the tips. The phyllodes are dark green, thin in texture and falcate, oblong or lanceolate, narrowed at both ends and mostly 7·5 to 10 cm long. Two prominent longitudinal veins show as slightly yellow raised lines. They are connected by a coarse network of thin veins. The upper margin curves in towards the upper longitudinal vein about 2 or 3 cm from the base and at this point there is a conspicuous marginal gland.

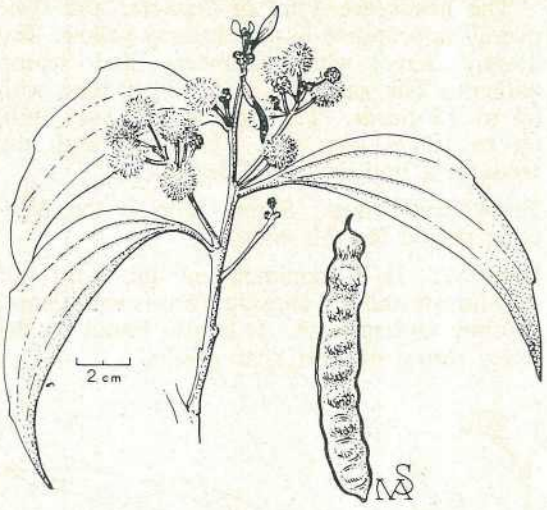
The heads are 1 cm in diameter and their overall appearance is pale creamy-yellow. The flowers have white filaments and lemon anthers. The raceme can be 7 cm long with up to 12 heads. The pod is flat, very thin, up to 12 cm long and 1 cm wide with the seeds in a line down the centre.

FLOWERING TIME. Spring time is the flowering period for this wattle.

HABITAT. It is common on the edges of rain-forests and tall eucalypt forests with dense, shrubby undergrowth. It is also found on the lower slopes of hills near creeks.



Acacia binervata



Acacia flavescens

DISTRIBUTION. This wattle grows only in New South Wales and Queensland from as far south as the Shoalhaven River to as far north as the McPherson Range.

Acacia flavescens

A Latin adjective meaning yellowish or pale yellow is the specific epithet for this wattle. It was suggested by Allan Cunningham to describe the young parts of the plant.

DESCRIPTION. This is a tree which can grow to a height of 8 to 10 m. Sometimes it branches near the bottom of the trunk. The bark is slightly corrugated and grey-brown. Young parts of the plant have a golden-yellow appearance due to the dense covering of stellate hairs. These can make mature phyllodes look very dusty, but they soon wear off.

A few hairs can always be found scattered near the base of old phyllodes which are firm and leathery in texture and are broadly falcate in shape. They can be 9 to 10 cm long, sometimes as much as 24 cm, and three times as long as broad. They are dark green in colour and usually have three prominent veins connected by widely-spaced transverse reticulate venation.

The heads of flowers are pale primrose-yellow, 1·2 cm in diameter and are arranged in irregular terminal panicles up to 7 cm long. The pods are flat, up to 12 cm long and 2 cm wide and the seeds are transverse.

FLOWERING TIME. This wattle begins to flower before the middle of Autumn.

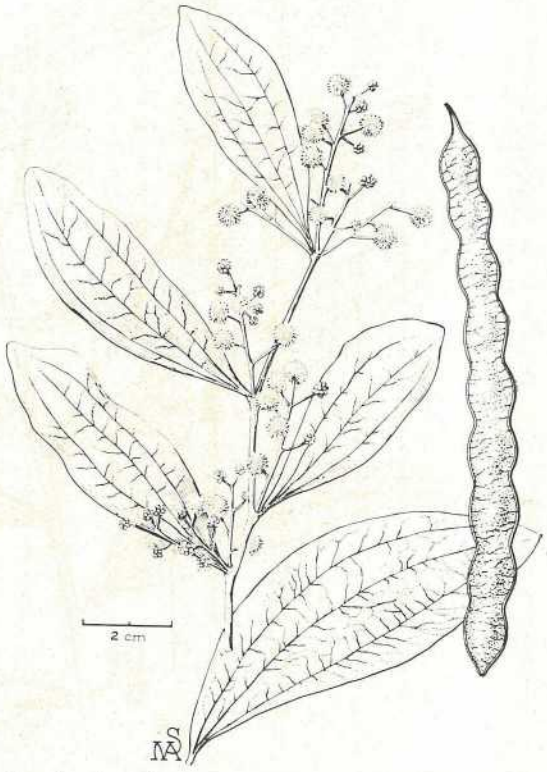
HABITAT. It grows in sandy soil in open forests near beaches, on forested high dunes, near swamps in mixed forest and in wet sclerophyll forest.

DISTRIBUTION. It is found only in Queensland from as far south as Mt. Coolum to Cape York Peninsula and as far west as the Isla Gorge and the Blackdown Tableland.

Marble wood (*Acacia bakeri*)

This wattle was first found near Mullumbimby and was named in honour of R. T. Baker, the Curator of the Technological Museum in Sydney at the turn of the century. He found it on Tengoggin Mountain, near Mullumbimby.

DESCRIPTION. In the rain-forests that existed at the time of its discovery, trees of this species were recorded 'up to 140 to 160 feet' and 'over 3 feet in diameter' but now it is found



Acacia bakeri

Acacia ixiophylla

usually in remnants of scrub along creek banks and rarely exceeds 8 m. The twigs are pendulous, and the phyllodes are dark green and slightly glossy. They are broadly lanceolate, narrowed to each end, up to 13 cm long and 6 cm wide.

The phyllodes are twisted towards the base and the slightly thickened margins are undulate. Three veins are easily seen as lighter green lines and are connected to each other by a network of veins. In texture, the phyllodes are thin but slightly leathery. There is an inconspicuous gland near the base of the phyllode on the upper margin, sometimes with a short subsidiary vein running into the gland.

A cluster of three to ten heads on slender peduncles is in each axillary raceme, each head being about 0·5 cm in diameter, and pale creamy-yellow in colour. The pod is very thin in texture, up to 12 cm long and more than 1 cm wide and is flat and very slightly constricted between the seeds. The pods usually ripen and fall during the wettest part of the year. This is an unusual wattle as the seeds begin to germinate in the pods before they fall from the trees. This fact was observed when the tree was first discovered.

FLOWERING TIME. Flowers are produced in the middle of spring.

HABITAT. It is found only in rain-forest or on the margins of rain-forest in loamy soil.

DISTRIBUTION. This wattle grows only in Northern New South Wales to as far south as the Brunswick River and in the coastal scrubs of Queensland to as far north as the Burrum River.

Acacia ixiophylla

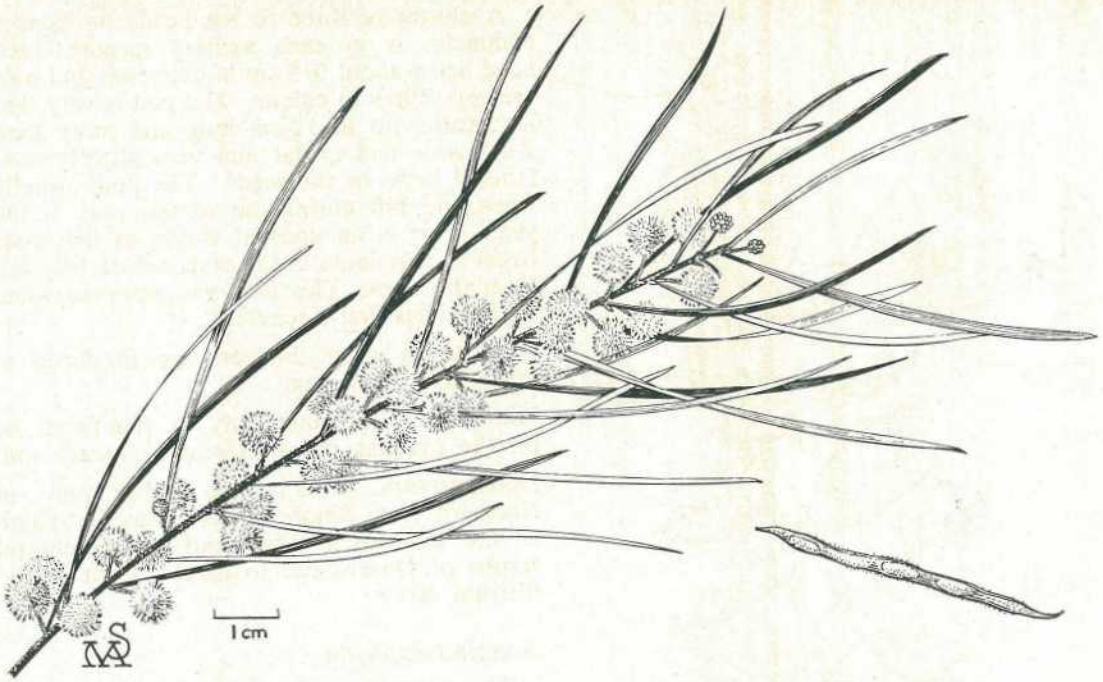
This wattle was found by Allan Cunningham in the Liverpool Plains area and the name he suggested for it is derived from the Greek word *ixos* which means sticky. It describes the phyllodes which are often glutinous or viscous.

DESCRIPTION. This wattle is a dense flat-topped shrub to 3 m in height, with oblong or lanceolate phyllodes which can be hairy or glabrous. They are leathery in texture and are covered with a glutinous layer which is slightly sticky. Their length varies from 1·7 to 5 cm and the tips are blunt. With magnification, fine anastomosing veins can be seen as dark lines.

The flowers are deep lemon-yellow in colour and the heads are 0·6 cm in diameter, with the styles projecting beyond the flowers. In the axils of the phyllodes there are two heads, each on peduncles 0·2 cm long at the end of a longer common peduncle. The flowers have little perfume but the plant is very floriferous. The glutinous pod is linear, about 5 cm long and may be curved or coiled.

FLOWERING TIME. The short flowering period is in late winter to early spring.

HABITAT. It is found on sandy soil in open forest, on stony ridges and undulating plains.



Acacia viscidula

DISTRIBUTION. This wattle grows in Queensland, New South Wales and Western Australia. In Queensland, it has a fairly widespread but patchy distribution to as far north as Alpha. In South-eastern Queensland, it has been found only at Flagstone Creek and Heifer Creek. It is widespread on the Darling Downs.

GENERAL REMARKS. This wattle has been used for median strip plantings on highways in dense plantings which diminish headlight glare.

Acacia viscidula

This wattle was first found on the banks of the Lachlan River in New South Wales. The specific epithet means somewhat sticky and describes the young growing tips.

DESCRIPTION. It can vary in habit but is usually a slender, erect shrub to 3 m with numerous ascending slender branches and ascending twigs. These have yellowish longitudinal ribs and minute, erect, white hairs are scattered over the stems and peduncles and are sparsely scattered over the phyllodes.

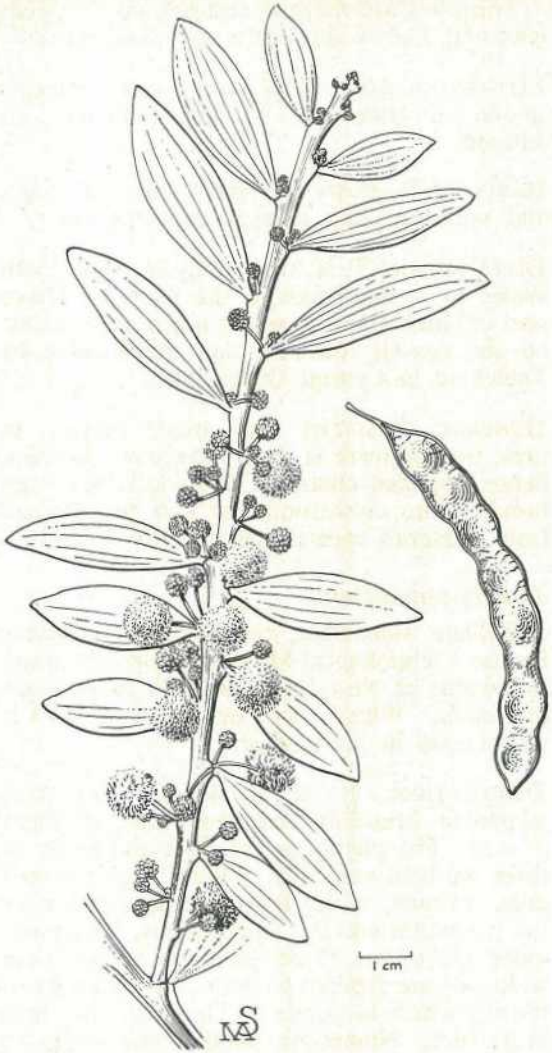
Magnification shows the young growing tips and the young phyllodes have an appearance like wet varnish and they are very sticky to the touch. The phyllodes are narrow linear and are either perfectly straight or slightly curved towards the tip. They are bright to dark green, up to 8 cm or more in length and 0·2 cm wide. Four to seven prominent veins can be seen as longitudinal lines of a different colour when held against the light under magnification.

The heads of flowers are on hairy peduncles in the axils of the upper phyllodes, usually in pairs, with one held on either side of the phyllode. They are dense, about 0·7 cm in diameter and all parts of the flower are lemon-yellow.

The pods are linear and straight, up to 4·5 cm long and 0·2 cm wide. They are slightly hairy and sticky and have longitudinal seeds.

FLOWERING TIME. This is a spring-flowering wattle.

HABITAT. It grows in alluvial soil along creek banks, on the margins of eucalypt forests, on the lower slopes of mountains, and in crevices and shallow pockets of soil on bare crags.



Acacia complanata

Acacia complanata

Allan Cunningham first found this plant and gave it the name *complanata* which means flattened. This describes the twigs which are flattened and bordered by two narrow wings.

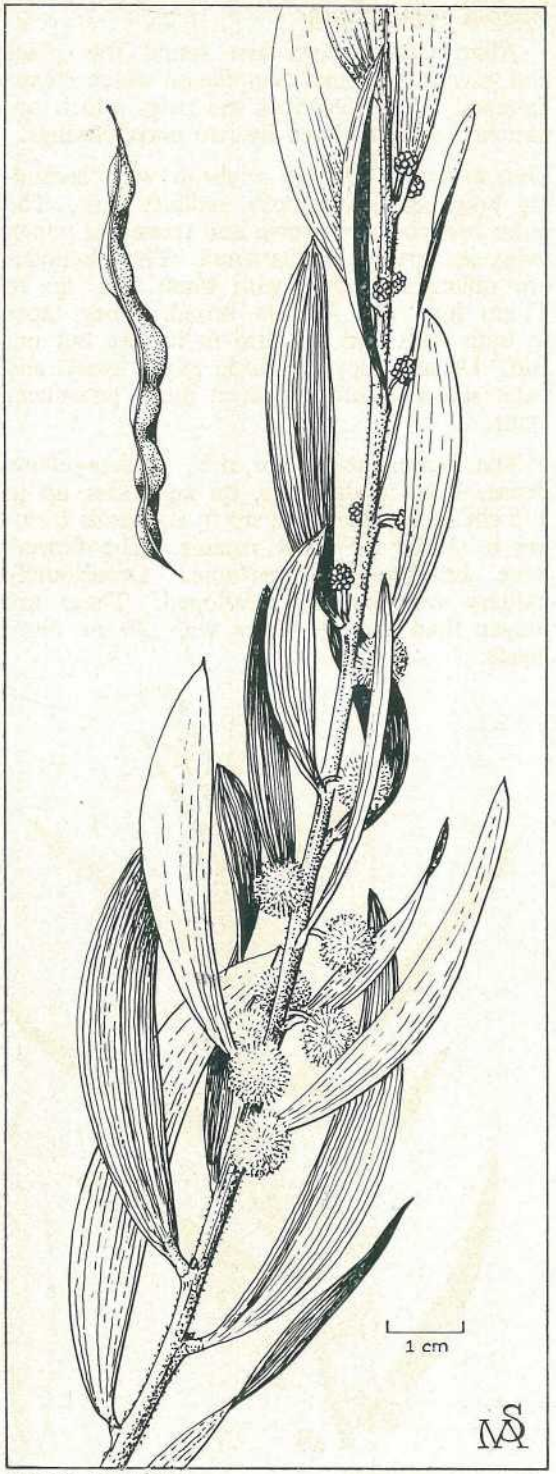
DESCRIPTION. This is a shrub with ascending branches and smooth, reddish bark. The older branches are brown and terete but young twigs are green and flattened. The phyllodes are oblong or ovate with blunt tips, up to 11 cm long and 4·5 cm broad. They taper to both ends and are firm in texture but not stiff. Usually they are dark, glossy green and have seven to nine or even more prominent veins.

The flower heads are rich, golden-yellow, dense, 1 cm in diameter, on peduncles up to 1·5 cm long, often with up to six heads forming a cluster or short raceme. The flowers have little or no perfume. Occasionally axillary racemes are developed. These are longer than the phyllodes with 20 or more heads.

DISTRIBUTION. It is found only in Queensland and New South Wales from as far south as the Lachlan River to as far north as the Glasshouse Mountains on the coastal plain and Crow's Nest further inland. It also grows on the Darling Downs in the Stanthorpe area.

GENERAL REMARKS. Plants from the mountain peaks have phyllodes which are only 4 to 5 cm long.

Acacia baeuerlenii



Acacia venulosa

The pods are flat and straight, up to 15 cm long and 1 cm wide with longitudinal seeds.

FLOWERING TIME. This wattle can be found in bloom from late in spring to late in autumn.

HABITAT. It grows in sandy soil, on ridges and sandstone hills in open eucalypt forest.

DISTRIBUTION. It is found only in New South Wales to as far south as the Clarence River and in Queensland to as far north as Rosedale on the coastal lowlands and the Blackdown Tableland in Central Queensland.

GENERAL REMARKS. In areas subject to fires, the regrowth is most attractive—forming dense, rounded clumps. This wattle has been brought into cultivation and can be obtained from nurseries specialising in native plants.

Acacia baeuerlenii

William Baeuerlen, the botanical collector for the Technological Museum in Sydney found this wattle at New Italy about 40 miles south of Ballina. When it was described in 1895 it was named in his honour.

DESCRIPTION. It is a slender tree with ascending branches and can reach a height of 4 m. The phyllodes are rigid and many of them are held vertically. Young twigs are reddish. Minute, white hairs are scattered over the peduncles and the young stems. The phyllodes are up to 15 cm long and about 1 cm wide and are tapered to both ends, more so to the tip which is pointed. They are very firm in texture. Numerous parallel veins can be seen on both surfaces and anastomosing is frequent. A very obscure gland is present on the upper margin of the phyllode just above the junction with the pulvinus.

Usually two peduncles are in the axils of the phyllodes. They are 1 cm long, reddish and bear a dense head about 1·2 cm in diameter with 30 or more flowers. The outer surface of the sepals are flushed with red and the corolla lobes are spotted with red on the outer surfaces giving a pink tinge to the centre of the head. This can be seen only with high magnification. The petals and the inner surfaces of the sepals are creamy-white, the filaments white and the anthers lemon-yellow

giving the heads an overall white colour. The flowers are faintly perfumed and the pod is flat, about 8 cm long, and 1 cm wide. The margins are white, thickened and nerve-like.

FLOWERING TIME. This wattle blooms from late autumn to mid winter.

HABITAT. It is always found on sandstone hills and ridges.

DISTRIBUTION. It grows only in New South Wales and Queensland from as far south as the Richmond River to the stony hills north of Helidon. It is known in South-eastern Queensland from only two localities—Helidon and Plunkett.

GENERAL REMARKS. It is an attractive shrub which is cultivated to a limited extent.

Acacia venulosa

Allan Cunningham was the first person to collect this wattle. It was found in New South Wales at Liverpool Plains. The specific epithet he suggested means full of veins or prominently veined and alludes to the network of veins connecting the three main veins in the phyllodes.

DESCRIPTION. This is a slender, erect, little-branched shrub to about 2 m in height. The phyllodes are slightly falcate to crescentic; and narrowed at each end. They are about 6 to 9 cm long and 1 cm wide and point towards the end of the twig. The twigs themselves curve up towards the stem giving a characteristic appearance to the plant. The phyllodes are firm and leathery in texture, grey-green in colour and rough to the touch.

The flowers are lemon-yellow and the axillary heads are either solitary or in pairs. They are on peduncles about 0·3 cm long. Occasionally two to eight heads are in a raceme up to 2·5 cm long. The pods are linear, straight or curved, thin and about 7 cm wide.

FLOWERING TIME. It flowers from mid winter to mid spring.

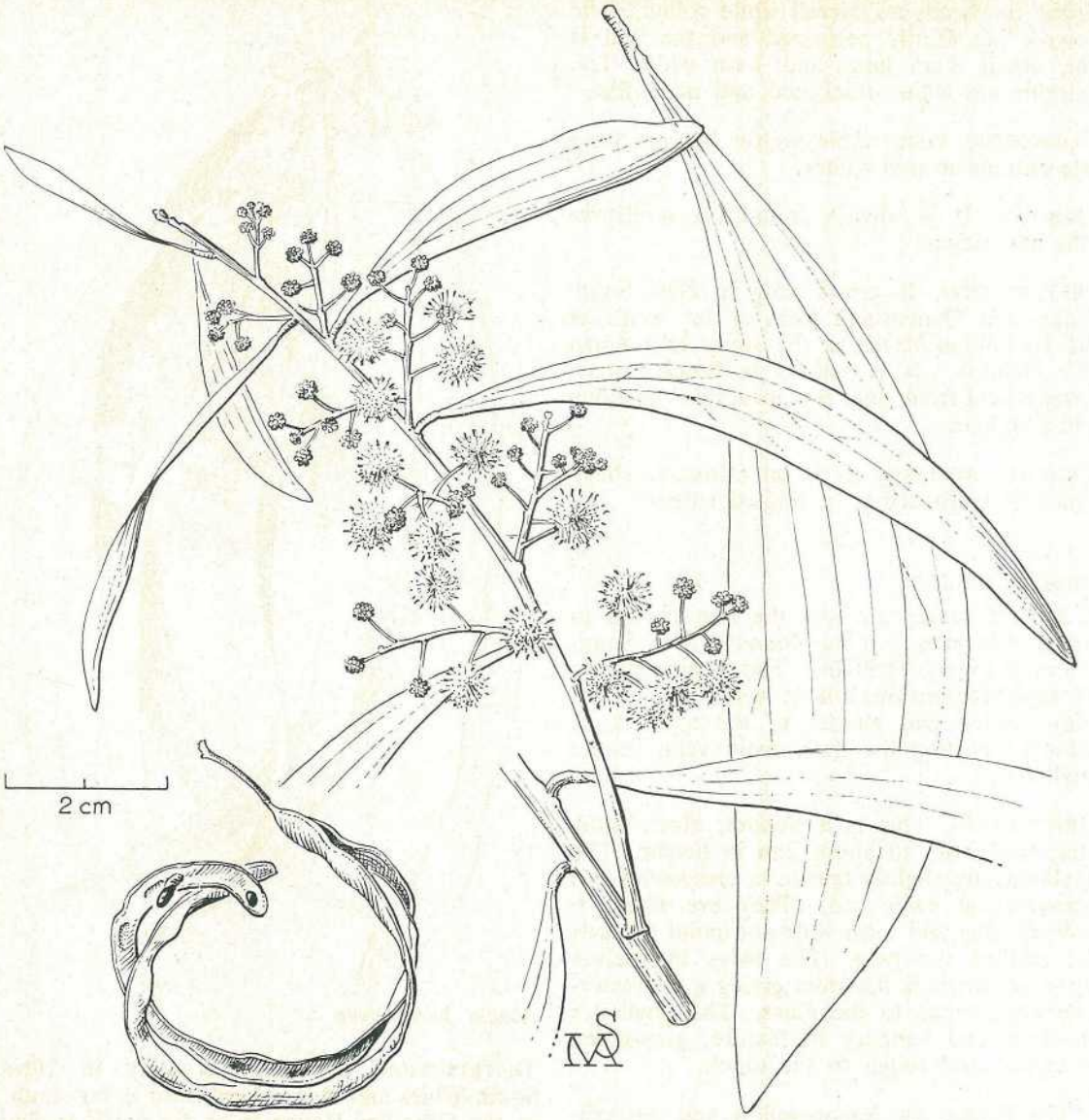
HABITAT. It grows on shallow soil among granite rocks in open eucalypt forest or among granite boulders and outcrops.

Acacia harpophylla

DISTRIBUTION. It is found only in New South Wales and Queensland from as far south as the Gibraltar Range to as far north as the Blackdown Tableland. In South-eastern Queensland, it has been found only at Crow's Nest, but is more common on the Darling Downs in the Stanthorpe area.

Brigalow (*Acacia harpophylla*)

The Greek word *harpe* means sickle and *phyllon* means a leaf and the combination of these two words means with sickle-shaped leaves. It describes the distinctive shape of the phyllodes.



Acacia implexa

DESCRIPTION. This wattle is a tree of variable size and shape. Tall, mature trees are usually up to 25 m high with a straight trunk which is branched in the upper part and has a rounded crown. The bark is furrowed and dark grey or black.

The phyllodes are grey-green, grey, or silvery-grey and are curved into a narrow sickle shape and are tapered to each end. They can be up to 20 or 30 cm long, and 2·5 cm wide and are leathery in texture, with several conspicuous veins with many finer veins between them with no anastomosing.

The peduncles are slender, usually about 2 cm long, and about 18 heads are clustered in the axils or crowded on a very short raceme. The heads are almost 1 cm in diameter, straw-yellow in colour with little or no perfume.

Acacia melanoxylon

The pods are flattened but rather thick, with thickened margins, usually up to 20 cm long and 1 cm broad and are somewhat constricted between the seeds.

FLOWERING TIME. Brigalow flowers spasmodically throughout the year but the main flowering period is mid winter to early spring.

HABITAT. It is found in the rainfall zone at 500 to 650 mm and used to be a very common inland species forming large scrubs.

DISTRIBUTION. It is found only in New South Wales and Queensland and in the past formed a continuous belt from the Coonabarabran area to as far north as Collinsville. Originally brigalow and allied communities covered more than 9 200 000 ha in Queensland. In South-eastern Queensland, it is now found in the area from Boonah to Lowood.

GENERAL REMARKS. In Queensland, most brigalow scrub has been cleared to provide land for beef and cattle production.

Lightwood (*Acacia implexa*)

Allan Cunningham was also the first person to find this wattle. It was growing in the ravines of the Shoalhaven River in New South Wales. The Latin adjective *implexa* means twisted or contorted and describes the fruit.

DESCRIPTION. This is a spreading tree to about 8 m high with dark, rough bark which is fissured and unevenly tessellated. The branches are often pendulous and the phyllodes drooping. They are rather thin in texture, dark green in colour and very narrowed to the base. The twigs are terete and glaucous with a bloom that can be rubbed off. Three veins are prominent and are easily seen as differently-coloured longitudinal lines which are connected by widely-spaced anastomosing veins.

A gland is usually present at the base of the phyllode, just above the pluvinus. The phyllodes have a blunt tip and can be about 20 cm long and 2·5 cm wide.

The sweetly perfumed flowers are in dense heads about 0·7 cm in diameter on peduncles up to 1 cm long. Magnification shows the corolla is pale creamy-yellow, the filaments are white and the anthers lemon-yellow. This gives the heads an overall pale creamy-yellow colour. Also, the white styles are often noticeably longer than the stamens.

The pale brown pods are narrow-linear, about 0·4 cm wide and raised over the seeds. They are coiled and twisted.

FLOWERING TIME. This wattle blooms in summer but flowers can sometimes be found at other times of the year.

HABITAT. It grows on various soil types and is found in open eucalypt forests.

DISTRIBUTION. It is found in all the eastern mainland States to as far north as Herberton.

Blackwood (*Acacia melanoxylon*)

Robert Brown, the famous British botanist, first found this wattle in Tasmania, and, because the timber was dark in colour gave it a specific epithet which means having black wood.

DESCRIPTION. This is a shapely, bushy-headed tree to 15 m high with an almost smooth, light grey bark which cracks sometimes vertically and sometimes horizontally. The foliage is dense and the angular twigs are covered by a fuzz of short, white hairs. The phyllodes are falcate-oblong or almost lanceolate. On the upper margin, an inconspicuous gland is just above the base. The phyllodes are rather membranous and not leathery and are broadest at or above the middle. Several longitudinal veins with numerous, widely-spaced anastomoses are easily seen in the dull-green phyllodes.

Pale creamy-yellow flowers are in dense heads about 1 cm in diameter. The peduncles are 1·5 cm long, axillary and either a few together in clusters or in a short raceme of about five heads.

The pod is up to 10 cm long, with rather thick valves and is coiled or very twisted. Many flowers in each head produce pods and this results in a very characteristic appearance of this wattle in the fruiting stage.

FLOWERING TIME. Flowering seems to occur throughout the year but the main period is summer.

HABITAT. It is found in open eucalypt forest, on the margins of rain-forest, and is often found on creek banks.

DISTRIBUTION. This wattle grows in Tasmania, South Australia and all the eastern mainland States.

Pineapple scale

SINCE it was found in Brisbane in 1928, pineapple scale (*Diaspis bromeliae* Kerner) has become widely distributed on pineapples in South-eastern Queensland.

It now occurs in several pineapple growing areas south of Nambour and was recently discovered in the Mary Valley. Scale is not known to occur in the Yeppoon district.

Although it is not a major pest of pineapples, its control measures do represent an extra cost which growers can well do without.

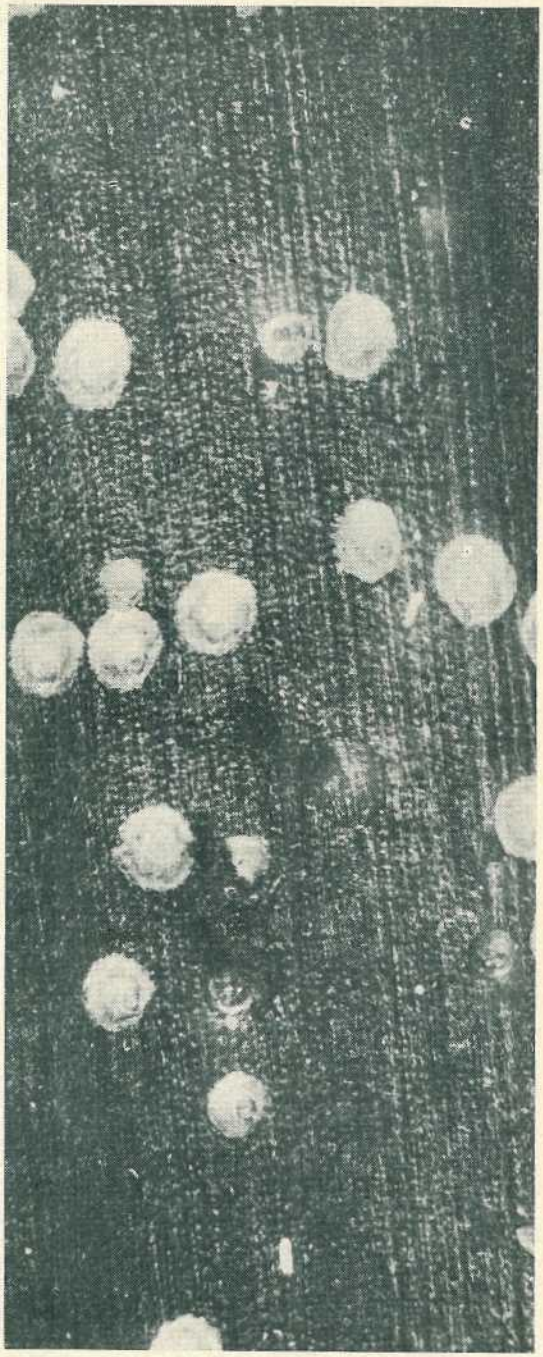
Detection and damage

Most new infestations of pineapple scale are not detected until some time during the ratoon crop cycle when isolated plants or groups of plants are found to be heavily infested. Leaves and sometimes fruit of these plants become covered in scale. This gives them a light grey, scurf-like appearance. The most obvious damage, however, is in the form of chlorotic spots on the leaves where scales feed. Heavily infested plants may become weak and stunted, show conspicuous dying back of the foliage and produce undersized, pinched-looking fruit.

Scale is not easily detected where low scale numbers are present in a planting. In such situations, the insect may be revealed by peeling off and closely examining the basal leaves of plants.

The pest

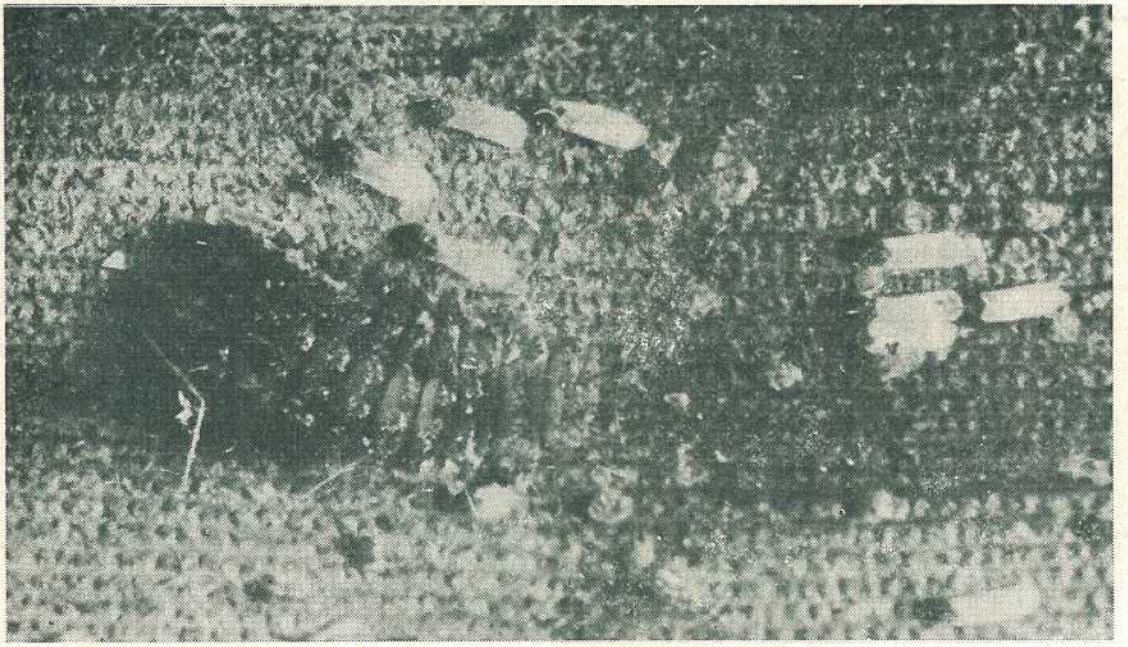
The adult female is covered by a hard, circular scale about 2 mm across. She lays small, yellowish eggs which hatch in about



Circular female scales on a pineapple leaf.

by D. A. H. Murray, Entomology Branch

Circular female scales with smaller, elongate male scales.



Larva of the scale-eating ladybird, an important predator of pineapple scale.

7 days. Tiny crawlers emerge from these eggs and seek suitable feeding sites. Once these start to feed they remain in the same place until they become mature adults. Development from egg to adult takes about 2 months in the summer. Egg-laying occurs in all months of the year, with peaks in summer and early winter.

The adult male is a fragile, two-winged insect which emerges from its white, rectangular scale, mates and then dies.

Pineapple scale occurs principally in ratoon fields and then mainly on suckers and fruit which are shaded by foliage. Heaviest infestations are usually found on ground suckers in the centres of rows where the growth is dense and light penetration is poor.

Natural spread of pineapple scale is slow. It is, however, easily spread by the movement of infested planting material. Crawlers can be dispersed on clothing and by wind. In addition to pineapples, scale has been recorded on certain species of *Agave, Billbergia* and *Bromelia,* so these plants are also possible sources of new infestations.

Natural enemies

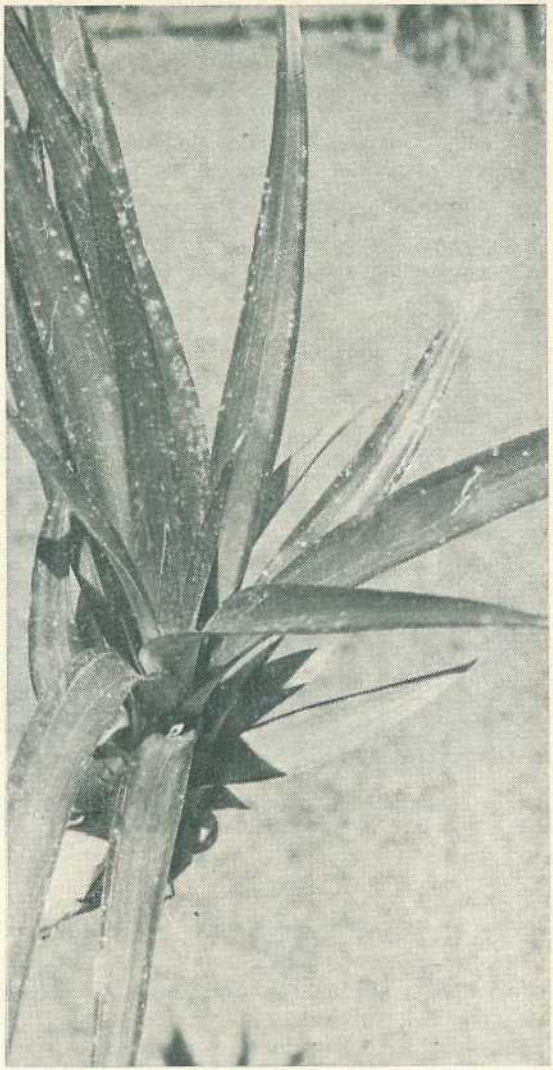
In Queensland, two small wasp parasites and a ladybird predator are important natural enemies of pineapple scale. They make an important contribution to the regulation of scale.

The use of diazinon for scale control may upset the delicate balance established between these natural enemies and the scale. This disruption may cause a resurgence of the pest problem following spraying.

Control

Use clean planting material

Prevention is better than cure. At present, many farms and districts are free from infestation. Growers in such situations should do everything possible to prevent establishment on their farms. As infested planting material is the source of virtually all new outbreaks, growers should make sure that they do not introduce this pest with plant material.

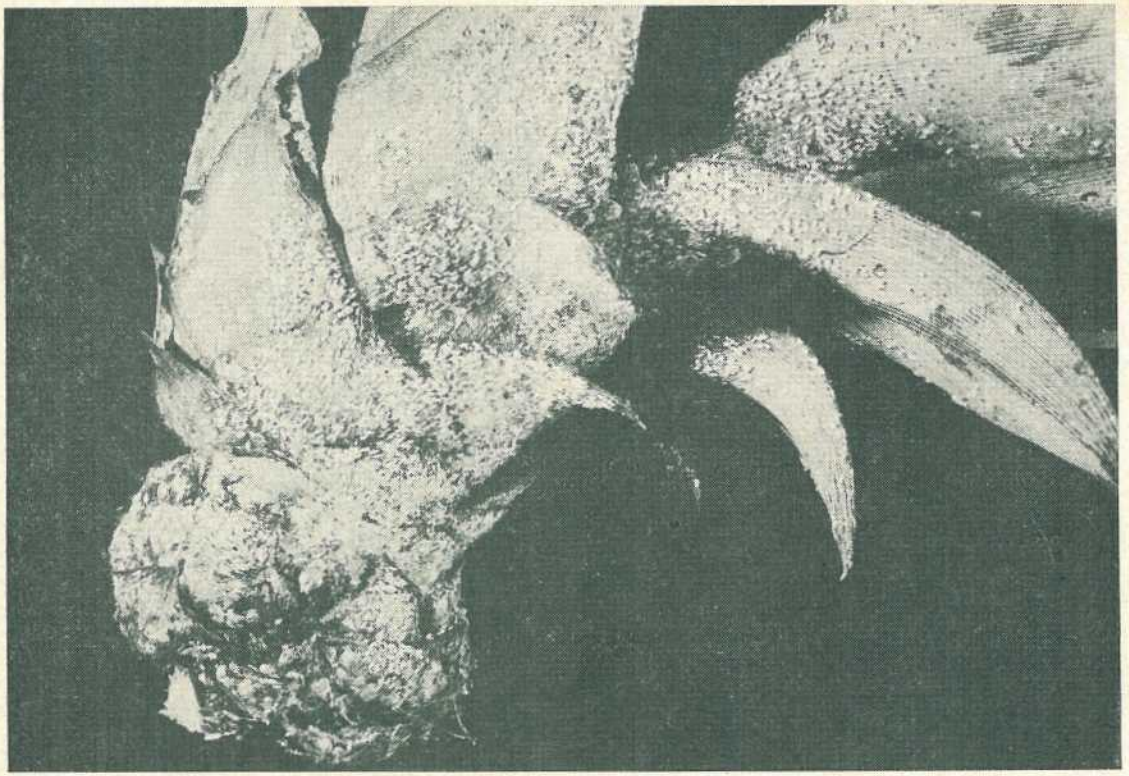


Leaf spotting caused by scale feeding on a pineapple sucker.

Fumigate

Recent trials showed that fumigation with methyl bromide at 46 g per cubic metre for 2 hours at 20°C eliminated all living scale, and also pineapple mealybug, from planting material. This treatment would be useful if it was absolutely necessary to plant scale-infested material on a hitherto 'scale-free' farm.

Since methyl bromide is hazardous, fumigation should be conducted under supervision of experienced personnel. Plant damage may



Heavy scale infestation on the base of a pineapple slip. Note the number of male scales.

occur at higher rates or when the time of exposure is more than 2 hours. Formulations of methyl bromide containing the warning gas, chloropicrin, are not suitable for use as the chloropicrin is extremely phytotoxic. Additionally, fumigation should not be done in direct sunlight.

Control in new plantings

Where scale infestations are discovered in new plantings, suppression can be obtained by applying a diazinon spray as soon as possible with a follow up application 4 to 6 weeks later. Plant size will determine the actual spray volume used. As a general rule, a mature plant crop will require 1·3 to 2 L of diazinon (Gesapon 80) in 2 000 to 3 000 L water per hectare. Eradication using chemicals is most unlikely to occur as it is almost impossible to obtain total cover.

Control in established plantings

High volume sprays of diazinon at the above rates will provide satisfactory control of scale in established plant crops. Control is more difficult in ratooned crops, however, because of their dense growth and resultant poor spray penetration.

Burn old patches

Old scale-infested patches are a source of infestation for new plantings. As soon as fruit is harvested and necessary planting material removed (if no alternative source is available), patches should be destroyed by burning. Plants may be sprayed first with a dessicant such as an arsenical weedkiller. When they have dried off they are burned. Dousing with kerosene or diesel fuel will provide a better burn.

Wheat varieties for Queensland-1980

compiled by S. R. Walsh, Agriculture Branch

EIGHT wheat varieties are recommended in Queensland by the Department of Primary Industries for 1980.

The recommendations are based on agronomic, disease resistance and quality characteristics. The varieties are listed in order of maturity, and their main features described. The varieties Kite, Banks, Cook, Shortim are recommended for irrigation. It is advisable to grow a number of varieties to reduce risk.

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

Shortim

Slow maturity; suited to early and main season planting; heavy tillering; very short straw; should be sown on good subsoil moisture and rough ground avoided; medium to high yield potential; awned heads; resistant to stem rust and crown rot; moderately susceptible to leaf rust; PH grain quality with medium protein; released by University of Sydney in 1977.

Oxley

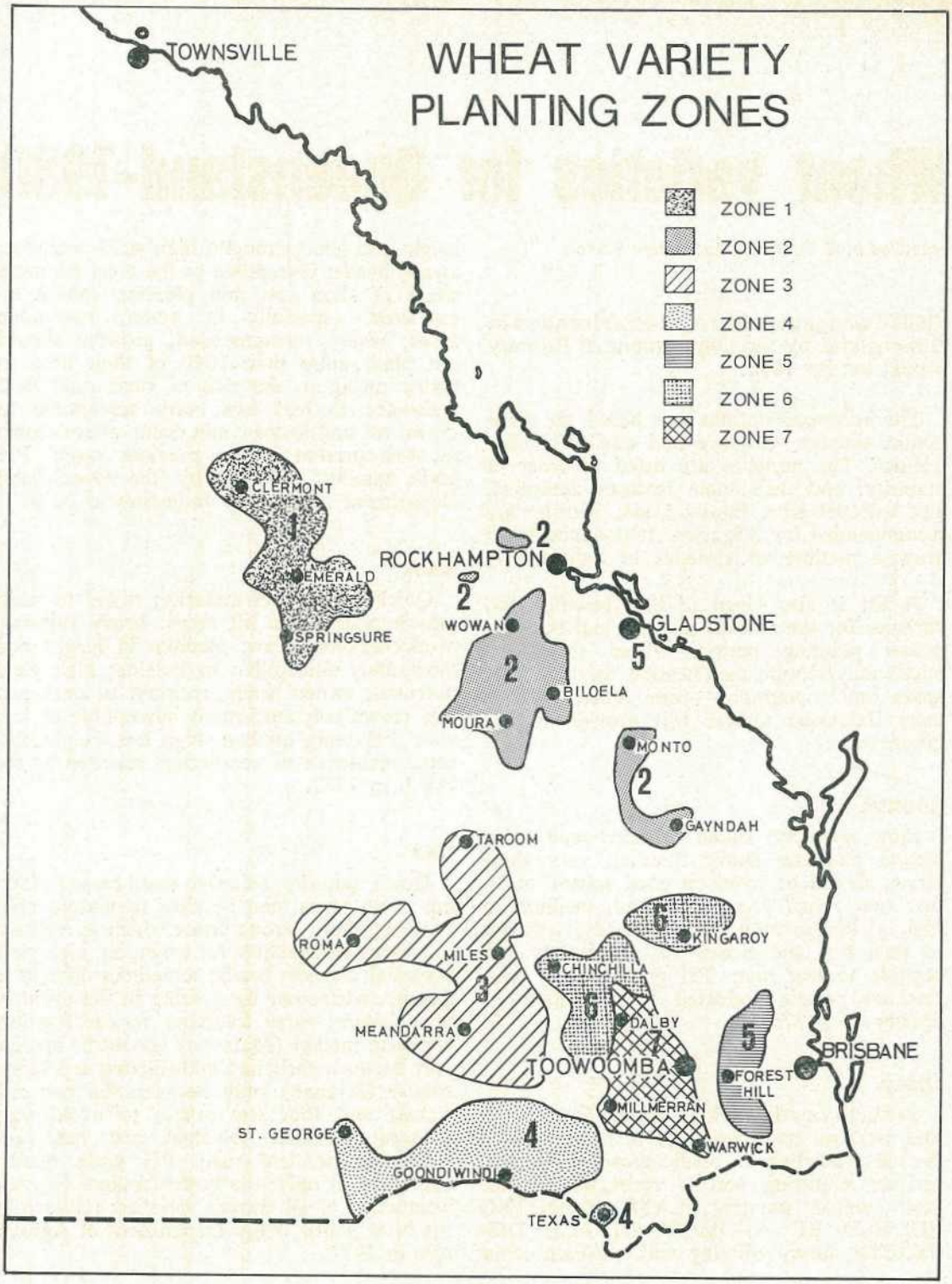
Medium maturity in Central Queensland and western areas where it is recommended for early planting; in colder areas, it becomes quicker maturing and is recommended for main season planting; LATE PLANTING SHOULD BE AVOIDED IN ALL DISTRICTS; heavy tillering with medium straw height and good strength; high yield potential; awned heads; susceptible to the most common strain of stem rust and planting should be restricted, especially in wetter, rust-liable areas; where recommended, growers should not plant more than 10% of their area to Oxley owing to the risk of stem rust; field resistance to leaf rust; very susceptible to crown rot and losses could occur where crown rot was present in the previous crop; PH grain quality; released by the Queensland Department of Primary Industries in 1974.

Cook

Quick to medium maturity; suited to main season planting in all areas; heavy tillering, producing fine straw; medium in height and moderately susceptible to lodging; high yield potential; awned heads; resistant to stem rust and crown rot; moderately susceptible to leaf rust; PH grain quality; high test weight and some resistance to weathering; released by the D.P.I. in 1977.

Kite

Quick maturity; suited to main season planting in all areas; can be slow to mature after heading; short, strong straw which is resistant to lodging and suitable for irrigation; high yield potential; awnless heads; sometimes difficult to thresh; satisfactory for grazing in the event of crop failure; some tolerance to ear frosting; flamprop methyl (Mataven) should be applied only between early and mid-tillering and difenzoquat (Avenge) only between the two and a half and four leaf stages to avoid crop damage; resistant to stem rust but fully susceptible to leaf rust; PH grain quality classification only; the best resistance to grain weathering of all current varieties; released by the New South Wales Department of Agriculture in 1974.


WHEAT VARIETY
PLANTING ZONES
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ZONE 6
ZONE 7
TOWNSVILLE
CLERMONT
EMERALD
SPRINGSURE
ROCKHAMPTON
WOWAN
GLADSTONE
BILOELA
MOURA
MONTO
GAYNDAH
TAROOM
ROMA
MILES
MEANDARRA
KINGAROY
CHINCHILLA
DALBY
TOOWOOMBA
BRISBANE
FOREST HILL
MILLMERRAN
WARWICK
ST. GEORGE
GOONDIWINDI
TEXAS

Banks

Quick maturity; suited to main season plantings in most areas; straw of medium height and good strength; high yield potential except on the finer black soils of the Darling Downs where its yield may be lower than Cook and Kite; awned heads; resistant to stem rust, although a few pustules may develop above the stalk nodes late in crop growth; resistant to leaf rust; susceptible to the leaf disease yellow spot which can develop from the carryover of infected stubble; very susceptible to crown rot; more susceptible to frost damage in early growth stages so areas liable to heavy frost should be avoided; PH grain quality, but low protein; released by the D.P.I. in 1979.

Timgalen

Quick maturity; suited to main season planting in all areas; straw of medium height and a little peak; medium to low yield potential; generally performs better at lower planting rates; awned heads; resistant to stem rust; moderately susceptible to leaf rust; PH grain quality, with high protein; released by the University of Sydney in 1967.

Songlen

Very quick maturity; suited to main season plantings in all areas; straw of medium height and strength but may lodge in dry conditions when secondary roots are not developed; medium yield potential; awned heads; resistant to stem rust; now susceptible to a strain of leaf rust; more susceptible to frost damage in the early growth stages; in some seasons, may develop genetic black chaff similar to Gatcher; PH grain quality with high protein; released by the University of Sydney in 1976.

Gatcher

Very quick maturity; suited to main season and late planting, particularly in Zones 1 and 3; straw rather tall and susceptible to lodging; medium yield potential; awned heads; difenzoquat (Avenge) should be applied only between the two and a half and four leaf stages of the crop, to avoid crop damage; moderately resistant to stem rust; susceptible to leaf rust; in some seasons, may develop dark pigmentation on ear and stem (genetic black chaff); PH grain quality but medium to low protein; released by the University of Sydney in 1969.

WHEAT VARIETY CHARACTERISTICS, QUEENSLAND 1980

Variety	Agronomy						Disease			Quality			
	Maturity	Yield Potential	Height	Awns (beard) Present	Resistance to Lodging	Early Grazing Suitability	Resistance to Stem Rust	Resistance to Leaf Rust	Resistance to Crown Rot	Grade	Test Weight	Resistance to Weathering	Protein %
Shortim	Slow	Medium	V. Short	Yes	V. Good	Light	V. High	Medium	High	PH	Medium	Nil	Medium
Oxley ..	Medium	High	Medium	Yes	Good	Light	Low	High	Low	PH	Medium	Nil	Medium
Cook ..	Quick	High	Medium	Yes	Medium	No	V. High	Low	High	PH	High	Small	Medium
Kite ..	Quick	High	Short	No	V. Good	No	V. High	V. Low	Medium	IH	Medium	Medium	Medium
Banks ..	Quick	High	Medium	Yes	Good	No	High	High	Low	PH	Medium	Nil	Low
Timgalen	Quick	Medium	Medium	Yes	Poor	No	V. High	Low	Medium	PH	Medium	Nil	High
Songlen	V. Quick	Medium	Medium	Yes	Medium	No	V. High	Medium	Medium	PH	Medium	Nil	High
Gatcher	V. Quick	Medium	Tall	Yes	Poor	No	Medium	V. Low	Medium	PH	Medium	Nil	Low

To avoid crop injury, herbicides should be applied only in accordance with the recommendations on the manufacturers' labels

District Guide to Recommended Wheat Varieties and Planting Periods

Note: To be used in conjunction with the article and map

Zone	Region	Varieties in order of preference within each planting period	Planting Period (approx. weeks)															
			April				May				June				July			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Central Highlands	Oxley, Shortim		X	X	X	X	X										
		Cook, Banks, Kite, Timgalen					X	X	X	X	X	X						
		Gatcher, Songlen							X	X	X	X	X	X				
2	Dawson–Callide and North Burnett	*Oxley, Shortim			X	X	X											
		Cook, Kite, Banks, Timgalen						X	X	X	X	X						
		Songlen, Gatcher								X	X	X	X	X				
3	Western Downs and Maranoa ..	Oxley, Shortim				X	X	X	X									
		Cook, Kite, Banks, Timgalen							X	X	X	X	X	X	X			
		Gatcher, Songlen									X	X	X	X	X	X		
4	South-west	Oxley, Shortim				X	X	X	X									
		Cook, Kite, Banks, Timgalen							X	X	X	X	X	X				
		Songlen, Gatcher									X	X	X	X	X	X		
5	Sub-coastal	Shortim					X	X	X	X								
		Cook, Kite, Banks, Timgalen							X	X	X	X						
		Songlen, Gatcher								X	X	X	X	X	X			
6	Northern Darling Downs and South Burnett	Shortim, Oxley							X	X	X	X						
		Cook, Kite, Banks, Timgalen									X	X	X	X	X	X		
		Songlen, Gatcher										X	X	X	X	X	X	X
7	Central and Southern Darling Downs	Shortim								X	X	X	X					
		Cook, Kite, Banks, Timgalen									X	X	X	X	X	X		
		Songlen											X	X	X	X	X	X

* There is a high risk of stem rust damage on Oxley in this Zone.

Where there is an overlap of varieties for a certain planting period choose the variety which has given proven results in your own district.

Consult Your Shire Agricultural Extension Officer.

What is 2,4,5-T?

THE herbicide 2,4,5-T is one of the most widely used chemicals in agriculture to control trees, woody shrubs and broad-leaf weeds.

But what is 2,4,5-T, how does it get this unusual name, why does it kill plants, and how harmful is it to man and animals?

Why it is called 2,4,5-T

The common name 2,4,5-T is an abbreviation of its full chemical name 2,4,5-trichlorophenoxyacetic acid. This complicated name describes the chemical's structure.

The structure is made up of a number of smaller sections joined together, with the basis being the phenoxy group (figure 1A). (This group is also the basis for the common farm and household disinfectant, phenol.) The phenoxy group is a six-membered carbon ring with oxygen and hydrogen attached. The carbons are numbered from 1 to 6, with the oxygen attached to carbon number 1.

When each hydrogen atom on carbons 2, 4 and 5 is replaced by a chlorine atom, the result is the 2,4,5-trichlorophenoxy group (figure 1B). When acetic acid (the basis for table vinegar) is attached to the oxygen on this group, the complete herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) is formed (figure 1C).

The well-known weed killer 2,4-D has a chemical structure similar to that of 2,4,5-T, except that the hydrogen atoms on carbons 2 and 4 only are replaced by chlorine atoms (figure 2).

Commercial formulations of 2,4,5-T

Because of the low solubility of the acid form of 2,4,5-T in water and petroleum oils (diesel distillate, petrol and kerosene), the acid is modified to either an amine salt or ester. The amine salts are commonly known as 'amines' only. It is the amine and ester formulations that are available on the commercial market.

by A. N. Lee and L. C. Orr, Lands Department

The amines of 2,4,5-T are soluble in water, but not in petroleum oils. Esters are soluble in petroleum oils, but not in water. Also, some ester products which contain special detergents and oils will mix with water to form emulsions. These emulsions are milky in appearance and, in fact, milk and mayonnaise are common domestic examples of emulsions.

Mixing and methods of application

For economic reasons 2,4,5-T is sold as a concentrated liquid. The herbicide is still active on plants at low concentrations and the commercial product needs to be diluted to the rate recommended on the label of the container with either water or petroleum oils.

The amines of 2,4,5-T, being soluble in water, can be applied to the leaves of plants as an overall spray. They can also be applied to trees and woody shrubs by various stem treatments. One treatment involves the injection of the amine into cuts made around the base of the stem (stem injection). Another treatment is to cut the tree off close to ground level and apply the amine to the cut surface of the stump (cut stump method). The herbicide should be applied to the freshly cut surface before the sap dries.

Esters of 2,4,5-T can be applied to weeds by methods similar to those for amines. Overall sprays of esters are applied in either petroleum oils or oil-water emulsions, and are generally more severe on all plants than amines. This limits the ability of esters to selectively remove weeds growing among desirable plants. Esters are also effective if applied in petroleum oils to the base of trees and woody shrubs (basal bark method). Any grass obscuring the base of the stem should be cleared and the stem thoroughly sprayed for 40 to 50 cm up from ground level.

One problem with esters is that they readily evaporate into the air, and move away with prevailing wind currents. If these vapours are deposited on nearby susceptible crops such as beans, tomatoes and cotton, they will cause injury or death to these plants just as if purposely applied.

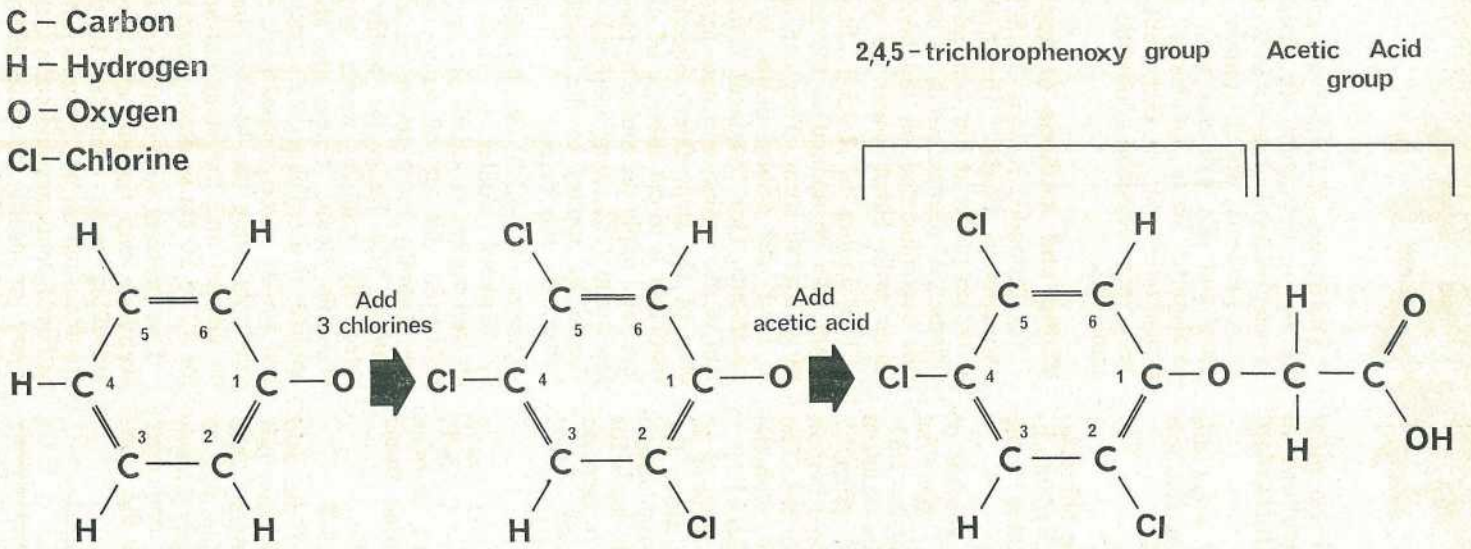


Figure 1a

Figure 1b

Figure 1c

Figure 1a—the phenoxy group.

Figure 1b—the 2,4,5-trichlorophenoxy group. Note the hydrogens on 2,4,5 of the phenoxy group are replaced by chlorines.

Figure 1c—the complete structure of 2,4,5-trichlorophenoxyacetic (2,4,5-T).

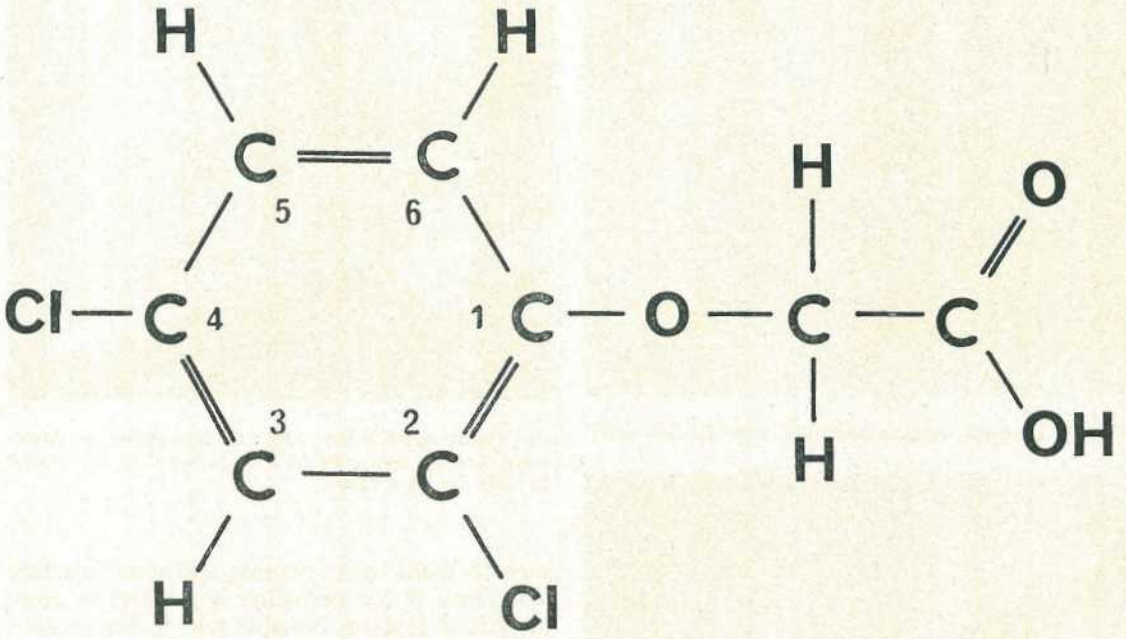


Figure 2—the structure of 2,4-dichlorophenoxyacetic acid (2,4-D).

Vaporization of esters increase with increasing atmospheric temperature and is highest in the middle of a hot summer's day. In Queensland, the Agricultural Chemicals Distribution Control Act (ACDC), restricts the use of ester formulations in agricultural areas of the near north coast from Brisbane and the Darling Downs.

Penetration and movement of 2,4,5-T in plants

When 2,4,5-T is applied to the leaves of plants as an overall spray, the herbicide is absorbed into the leaf through the waxy cuticle. Penetration is relatively slow, taking up to 24 hours to complete. Rainfall within this period can result in a poor kill as the herbicide is washed off the leaves. For best penetration, the herbicide should remain as a liquid for as long as possible on the leaves. Hence, spraying should be carried out in the cooler periods of early morning or late afternoon.

Basal bark treatments with 2,4,5-T ester can penetrate the stem only if applied in an oil solvent. The corky nature of bark resists penetration of water, therefore water-borne basal sprays are ineffective.

After penetration, 2,4,5-T moves with the sap stream throughout the plant. The preferred direction of herbicide movement to

Overall spraying Acacia *regrowth with 2,4,5-T ester.*

Cut stump application. The tree was felled by downward sloping axe cuts to form a 'well' in the stump to hold the herbicide.

Stem injection of 2,4,5-T amine into cuts around the stem.

achieve best control is downwards towards the roots. The actual direction of movement is dependent on a number of influencing factors. Some of these are the position of treatment on the plant, time of year of treatment and the availability of water and nutrients to the plant.

Generally, overall spraying of weeds with 2,4,5-T is most effective if carried out when the plant is young, or when a mature plant is in a stage of lush growth. Stem treatments such as basal bark spraying and stem injection work best if the herbicide is applied as close to ground level as possible and if treatment is carried out during the periods of late summer to early autumn after a good wet season.

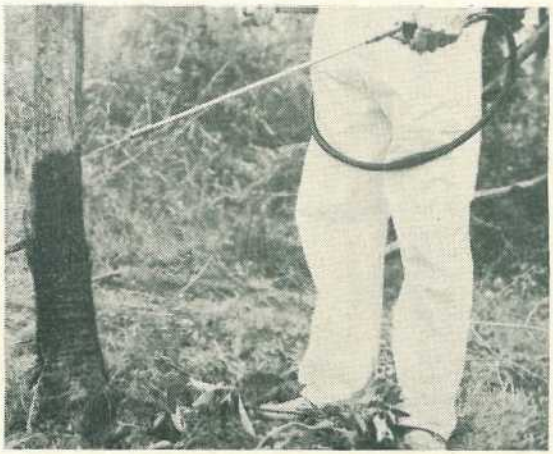
How plants are killed

The first noticeable effect of 2,4,5-T on plants is the curling and twisting of leaves and stems. This is followed by browning of leaf tips and swelling and splitting of bark. Death finally results from a number of causes including rapid and disorganized growth, and prevention of sap flow by complete blockage of the vital transport pathways of the plant. Plants may take several weeks, months or even years to die.

Weeds controlled by 2,4,5-T

The amines of 2,4,5-T will control clover, creeping oxalis and other broad-leaf weeds in lawns when applied as an overall spray. The amine will also control trees and woody shrubs if applied by stem injection, cut stump or overall spray. Susceptible trees include spotted gum, white stringy bark, poplar box, white and red mahogany, scribbly gum, narrow-leaf ironbark, bull oak, firebush, flooded gum, Moreton Bay ash and blackbutt.

For basal bark application of 2,4,5-T ester in petroleum oils, the stem should be sprayed for 40 to 50 cm up from ground level.



For successful basal bark application, any grass obscuring the base of the stem should be cleared and the lower part of the stem thoroughly sprayed, as shown.

The esters of 2,4,5-T are used as overall sprays to control brigalow, giant sensitive plant, bracken fern, devil's fig, blackberry and brambles. Trees controlled by 2,4,5-T ester using basal-bark, stem injection and cut-stump methods are wattle, some species of Eucalypts, tea trees, Banksias, sandalwood, pepper tree, poplars, elms and willows. Other woody brush controlled includes African boxthorn, blackberry, brigalow, gooseberry, gorse, green cestrum, groundsel bush, hickory, honeysuckle, lantana, lime bush, native raspberry, poison ivy, prickly acacia and sweet briar.

Loss of 2,4,5-T in the environment

Once 2,4,5-T is released in the environment, it immediately begins to disperse and break down. This process is influenced by a number of factors such as the rate of evaporation of the herbicide, its downward movement through soils and its breakdown by micro-organisms in the soil and by sunlight.

The rate of vaporization of 2,4,5-T will depend on whether it is formulated as an ester or an amine. Most esters will readily evaporate and move off into the atmosphere. The vaporization of the amines is very low and their movement in the atmosphere is negligible.

Soils with a high clay and organic matter content will tend to bind 2,4,5-T and restrict its downward movement; soils with a low content of clay and organic-matter (for example, some sandy soils) will not bind 2,4,5-T which is then more easily leached downwards. The amines are more soluble in water than esters and therefore are more easily leached through the soil.

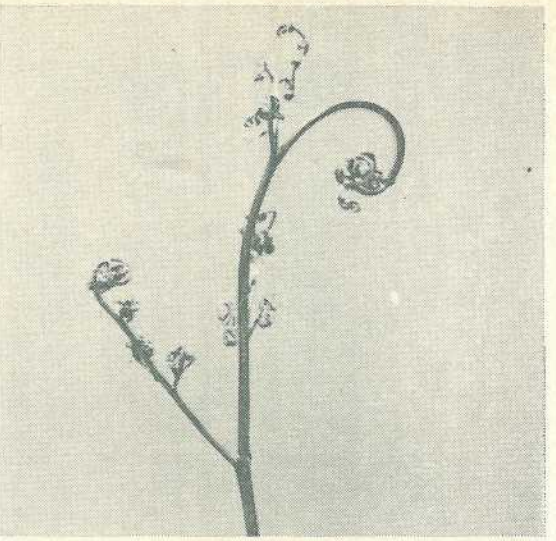
A significant breakdown of 2,4,5-T is caused by soil bacteria and micro-organisms. This process is aided by warm, moist conditions and the addition of organic matter to the soil. Some breakdown of 2,4,5-T occurs through the action of sunlight, though this is of minor importance.

Overall, the average persistence of 2,4,5-T in warm, moist soil is from 1 to 4 weeks. Thus, the herbicide does not build up in the soil and can be used without accumulation.

Toxicity of 2,4,5-T to man and animals

All substances produced by man and nature are dangerous to life if taken in a large enough dose. The dose required to kill 50% of test

A healthy frond of bracken fern.



Twisting and curling of bracken fern frond after overall spraying with 2,4,5-T ester as an emulsion.

animals in a trial is called the lethal dose (LD_{50}). This is measured by scientific feeding trials on a variety of laboratory animals including rats, mice, monkeys, fish and birds.

The lethal dose is measured in milligrams of chemical per kilogram of body weight of the test animal and is specified by how the chemical enters the body—by inhalation, absorption through the skin, or swallowed by mouth. A comparison of the toxicities of 2,4,5-T with the active ingredient in some common farm and household chemicals is shown in table 1.

If the manufacture of 2,4,5-T is not controlled under strict temperature and pressure conditions, a dangerous by-product TCDD (dioxin) can be formed. This chemical, which is very toxic to man and animals (see table 1),

TABLE 1

TOXICITY LEVELS OF THE ACTIVE INGREDIENT IN SOME COMMON FARM AND HOUSEHOLD CHEMICALS

Active Ingredient	Some Common Trade Names	Use	Toxicity Level of the Active Ingredient (Acute oral, LD_{50}–mg/kg for rats)
TCDD (dioxin)	(for comparison)		0·0021–3
Strychnine	Various Brands	Animal Pest control	1–30
Warfarin	Ratsack	Rat poison	5
Dieldrin	Various Brands	Insecticide	46
Propoxur	Baygon	Insecticide	100
Endosulfan	Endogrub	Lawn grub killer	110
DDT	Various Brands	Insecticide	115
Paraquat	Gramoxone	Herbicide	155–200
Arsenic Trioxide	White Arsenic	Herbicide	180–200
2, 4–D	Various Brands	Herbicide	375
2, 4, 5–T	Various Brands	Herbicide	500
Aspirin	(for comparison)	Pain killer	1240
Table Salt	(for comparison)	Flavouring	3320
Captan	Various Brands	Fungicide	9000

then becomes an impurity in the final commercial product. When concern is expressed about the use of 2,4,5-T as a weed killer, the reason should not be because of the 2,4,5-T itself but because it might be contaminated with TCDD. In Australia, legislation restricts the level of TCDD in 2,4,5-T to 0·1 parts per million—the level recommended by the World Health Organization of the United Nations. It should be noted that TCDD is not formed during the manufacture of 2,4-D.

Allegations have sometimes been made that a relationship exists between 2,4,5-T and birth deformities in man and animals. The level of chemical necessary to adversely affect the foetus is found by research trials on laboratory animals. It has been established that administration of a chemical (for example, 2,4,5-T) to a test animal will cause no observable biological effect below a certain dose level. (Doses above this point will cause adverse biological effects on the test animal). This level is known as the no-affect-level.

If these laboratory results are extrapolated to the food intake of a pregnant woman, then it has been accepted in the U.S.A. that the no-effect-level on the foetus for 2,4,5-T is 20 mg per kg of mothers body weight per day, and for TCDD is 0.00003 mg per kg per day. However, the most misunderstood concept in this field is that with the normal agricultural usage of 2,4,5-T, it is virtually impossible to reach these levels.

Ingestion of 2,4,5-T would be expected to occur by eating or drinking contaminated foodstuffs. However, trials have shown that after normal application of commercial 2,4,5-T ester to control blackberries, a pregnant woman would need to consume 60 kg of the unwashed blackberry fruit for several successive days during the critical period of pregnancy to reach the no-effect-level. For TCDD she would need to consume 900 kg of unwashed blackberry fruit each day. Alternatively she could drink daily, 200 L of water collected in a 10 000 L tank from a roof accidentally sprayed with 2,4,5-T from the air at the rate of 4 kg per ha, or drink 12 000 litres of milk, or eat 6 000 kg of meat (about 12 bullocks) from animals fed 2,4,5-T at higher levels than would be expected to occur on normally treated pastures.

Over the years, there have been many extensive and detailed investigations into 2,4,5-T as well as over 40 000 scientific papers published on it. Normal agricultural use of 2,4,5-T has never been shown to cause birth abnormalities in domestic animals, nor is there any evidence to connect its use with human deformities.

Cattle tuberculosis protected area expanded

THE Bovine Tuberculosis Protected Area in Queensland has been expanded to include the Boulia and Bulloo Shires and the city of Mt. Isa.

The continued progress in the control and eradication of this disease in Queensland herds had been recognised at the national level and approval had been given for further extensions of the declared protected area.

This means that these areas will be brought in to the compulsory TB eradication programme operating in this State.

Only the lower Diamantina Shire and parts of the Barcoo and Quilpie Shires remained as infected areas outside the compulsory eradication programme.

It is anticipated they will be included in 1981.

Winter cereals . . .

chemical control of wild oats and paradoxa grass

by B. J. Wilson, Queensland Wheat Research Institute.

THIS chart is a guide to the chemical control of wild oats and paradoxa grass in winter cereal crops. Chemical herbicides have a valuable part to play in supplementing other weed control measures.

Each year, the number of chemicals commercially available increases. The successful use of these chemicals depends on a number of factors. These include the choice of the most efficient chemical, the correct timing of the spraying and the rate and methods of application. Careful attention should also be given to applying the chemical at the correct stage of crop growth so that the possibility of injury to the crop is minimized.

It is important that the weed should be correctly identified before selecting the chemical to be used. The weeds listed in the guide are those that occur most frequently in winter cereal crops in Queensland.

The explanatory notes are most important and should be read in conjunction with this guide.

When applying herbicides, producers should take care to avoid spray drift.

Further information on weed control may be obtained from your local agricultural extension officer.

Herbicide Rates in Millilitres per Hectare

Herbicide/crop	Weed controlled		Stage to apply (of the weed)	Rate	Cost per ha (chemical only) (4)
	Wild oats	Paradoxa grass			
Wheat					$
Avadex BW (3)	Yes	No	Up to 3 weeks before or at sowing	2100	12.90
Avenge (2, 4)	Yes	No	2½ leaf to end of tillering, preferably 3 to 5 leaf	One pack/8 ha	21.90
Hoegrass (2, 5)	Yes	No	2 to 4 leaf	1500 to 2000 + wetting agent	26.25 to 35.00
Neoban (2, 6)	Yes	No	1 to 2½ leaf	500 to 700 (ground) 400 to 500 (aerial)	7.32 to 12.80
Mataven (2, 7)	Yes	No	3 leaf to end of tillering ..	4500 to 6000	28.35 to 37.80
Barley					
Avadex BW (3)	Yes	No	Up to 3 weeks before or at sowing	2100	12.90
Stampede (3)	Yes	Yes	From 1 to 3 weeks before sowing	2100	10.86
Trifluralin (3)	Partial	Yes	From 1 to 4 weeks before sowing	1000	4.45
Avenge (2, 4)	Yes	No	2½ leaf to end of tillering, preferably 3 to 5 leaf	One pack/8 ha	21.90

Herbicide Rates in Millilitres per Hectare—continued

Herbicide/crop	Weed controlled		Stage to apply (of the weed)	Rate	Cost per ha (chemical only) (8)
	Wild oats	Paradoxa grass			
Linseed					$
Avadex (3)	Yes	No	Up to 3 weeks before or at sowing	2100	10.15
Hoegrass (2, 5)	Yes	No	2 to 4 leaf	1500 to 2000 + wetting agent	26.25 to 35.00
Safflower					
Avadex (3)	Yes	No	Up to 3 weeks before or at sowing	2100	10.15
Trifluralin (3)	Partial	Yes	From 4 weeks to just before sowing	1400–1800 (light-med soils) 1800–2100 (med–heavy soils)	6.23 to 9.35
Canary					
no herbicides registered	..	..	..	..	..
Lupins					
no herbicides registered	..	..	..	..	..
Chickpeas					
no herbicides registered	..	..	..	..	..

Notes

1. Pre-sowing control of wild oats—use Roundup at 500 mL per ha (seedling stage), 750 mL per ha (early tillering) or 1 000 mL per ha (boot-head stage) OR use Gramoxone at 700 mL per ha (wild oats must be beyond 2 leaf stage).

2. The best results are obtained from post-emergence wild oat spray if both the crop and wild oats are growing vigorously. Subsequent crop competition is important for control. Avoid spray drift to non-registered (susceptible) crops.

3. Avadex BW, Stampede, trifluralin—Apply only with ground boom spray; must be incorporated immediately (see details on label).

4. Avenge—Do not mix with other herbicides and do not apply within 24 hours of spraying phenoxy-type herbicides. Gatcher, Kite and Eagle should not be sprayed after the 4 leaf stage; other varieties should not be sprayed after full tillering stage. Can be applied by boom spray at 100 to 125 L per ha or 50 to 60 L per ha (use half the wetting agent) or by air at 30 L per ha. Should not be applied if rainfall is likely within 12 hours.

5. Hoegrass—Can be mixed with linuron, bromoxynil or bromoxynil plus MCPA; do not apply within 10 days of spraying phenoxy-type herbicides. Add wetting agent at 0·25% a.i. to water in vat. Can be applied by boom spray at 80 to 150 L per ha or by air at 20 to 30 L per ha. Do not apply if rainfall is likely within 2 hours. Use the higher rate if most of the wild oats are in the 3 to 4 leaf stage or if spraying has been delayed to 5 to 6 weeks after sowing.

6. Neoban—Do not mix with other herbicides. Wheat must be sprayed before the 4 leaf stage. Can be applied by boom spray at 50 to 150 L per ha (at a minimum pressure of 280 kPa) or by air at not less than 35 L per ha. Use the higher rate for dense infestations.

7. Matavan—Do not mix with other herbicides and do not apply within 10 days of spraying phenoxy-type herbicides. Kite and Eagle should not be sprayed after mid-tillering; other varieties should not be sprayed after the start of jointing. Can be applied by boom spray at 30 to 100 L per ha or by air at 20 to 30 L per ha. Do not apply if rainfall is likely within 4 hours. Use the higher rate at the 3 leaf to early tillering stage especially if the crop has a higher than average yield potential. Do not apply to crops that have been grazed.

8. Costs are as at January, 1980.

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Watch for the Giant African Snail

by D. Currey, Horticulture Branch.

IN 1977, a breeding population of the Giant African Snail (*Achatina fulica* Bowditch) was found in Australia for the first time at Gordonvale near Cairns.

An eradication campaign was conducted and no living snails have been found for over 2 years.

Damage

The snails are voracious feeders and will attack a wide range of plants including crops such as crucifers, curcurbits and legumes. Seedlings of all crops appear to be preferred. Overseas experience indicates that the snail could become a major problem if introduced to Australia.

The nuisance potential of the Giant African Snail is probably even worse. As they move, they leave slime trails and excreta behind them and after death produce rank odours.

Description

A number of different colour forms are recognized, but the usual colour is brown with intermittent, paler, longitudinal streaks on the whorls. These streaks range in colour from yellowish-brown to almost white.

Adults have shells usually 8 to 10 cm long, but specimens up to 20 cm have been recorded. When the head and foot are extended the overall body length may double.

Distribution

Originally confined to East Africa, this snail has spread widely and now covers the area indicated on Map 1.

In 1945, it reached Papua New Guinea and is now widespread in that country.

Interception

Quarantine Inspectors at Australian ports regularly intercept this snail on imported cargo. Its ability to withdraw into its shell and survive for long periods without food increases the threat of introduction, and as the snail may be found on a wide range of cargoes, the inspector's job is all the more difficult.

As with all pest outbreaks, the key to control lies in rapid detection. It is important for people to be aware of this problem and to immediately report suspected Giant African Snails to Plant Quarantine Inspectors or any Department of Primary Industries' office.

Map 1. Distribution of the Giant African Snail.

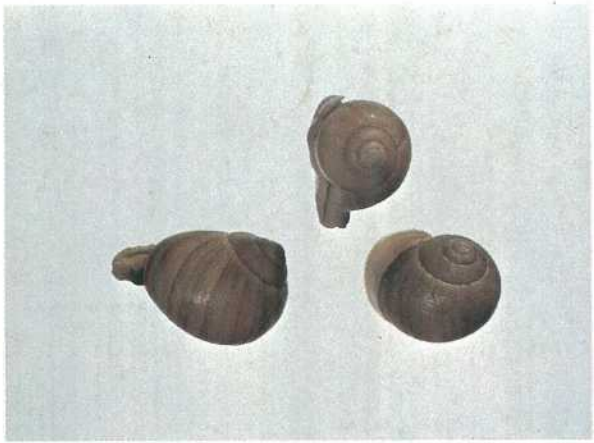
Some snail species

Achatina fulica Bowdich—the Giant African Snail.

Thirsites richmondiana Reeve.

Hedleyella falconeri Gray.

Sphaerospira fraseri Griffith and Pidgeon.



Xanthomelon pachystylum Pfeiffer.

Pedinogyra sp.