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POLAND, the sixth largest buyer of Australian wool, featured colourful wool garments in the Australian Wool Corporation's fashion parades at Royal National Exhibitions around Australia.

Each year, the Australian Wool Corporation which organizes the fashion show asks the International Wool Secretariat to invite a 'guest nation' prepared to provide a series of garments and a top-class model to participate in the show. This year the guest nation was Poland and the model was Agnieszka Perepeczko, an actress turned model who works at the 'KOMEDIA' theatre in Warsaw. Mrs. Perepeczko is featured on the cover of this issue wearing one of the garments designed for the parade.

The Polish participation at the Royal Shows took the form of showing a collection of ladies garments in pure new wool. The collection of garments was created by 'Moda Polska' —a state-owned fashion house and ready-to-wear clothing manufacturer located in Warsaw.

The Polish wool textile industry is receiving technical assistance and help with the introduction of new manufacturing processes from the International Wool Secretariat. For example, Poland is the first country where the I.W.S.—developed process for dyeing wool at low temperatures was introduced and put into operation on a large industrial scale.

The country is presently undergoing dynamic expansion and modernization of industrial capacity. The wool textile industry has a labour force of over 350 000, and the continuing installation of the most up-to-date machinery and equipment and the implementation of the latest technologies enable a high quality of production to be attained. Accompanying this increase in manufacturing capacity has come a steady rise in raw wool imports—the chief source being Australia.

Big customer

In 1974-75, Poland was the sixth largest market for Australian wool; ranking behind Japan, the U.S.S.R., France, Italy and West Germany. Imports totalled just under 120 000 bales or around 12 000 tons. It was the second largest importer from Eastern Europe after the U.S.S.R. Purchases in the 1975-76 season indicate that imports will rise further. This is in line with the general plans for increasing wool usage in the industry for both the domestic and foreign markets. With a population of just over 34 million and a gross national product expanding by around 8% annually in real terms, there is a considerable home demand to be met. One of the primary goals in the present Five Year Plan is the continuance of the rapid rise in living standards which has taken place since 1970. Substantial improvements in the quantity and quality of clothing form an essential element of this.

In the programme of co-operation between I.W.S. and the Polish wool textile industry, the especially valued assistance is that given in the fields of design and styling and technological developments.

The Woolmark symbol was introduced into Poland seven years ago and has become the most recognized and understood trade mark in Poland. Garments, fabrics, carpets, blankets and hand-knitting yarns are labelled with the Woolmark. This leading position in consumer recognition and understanding has been attained through an active programme of promotion and advertising of the Woolmark and labelled products by means of television, the press and other media.

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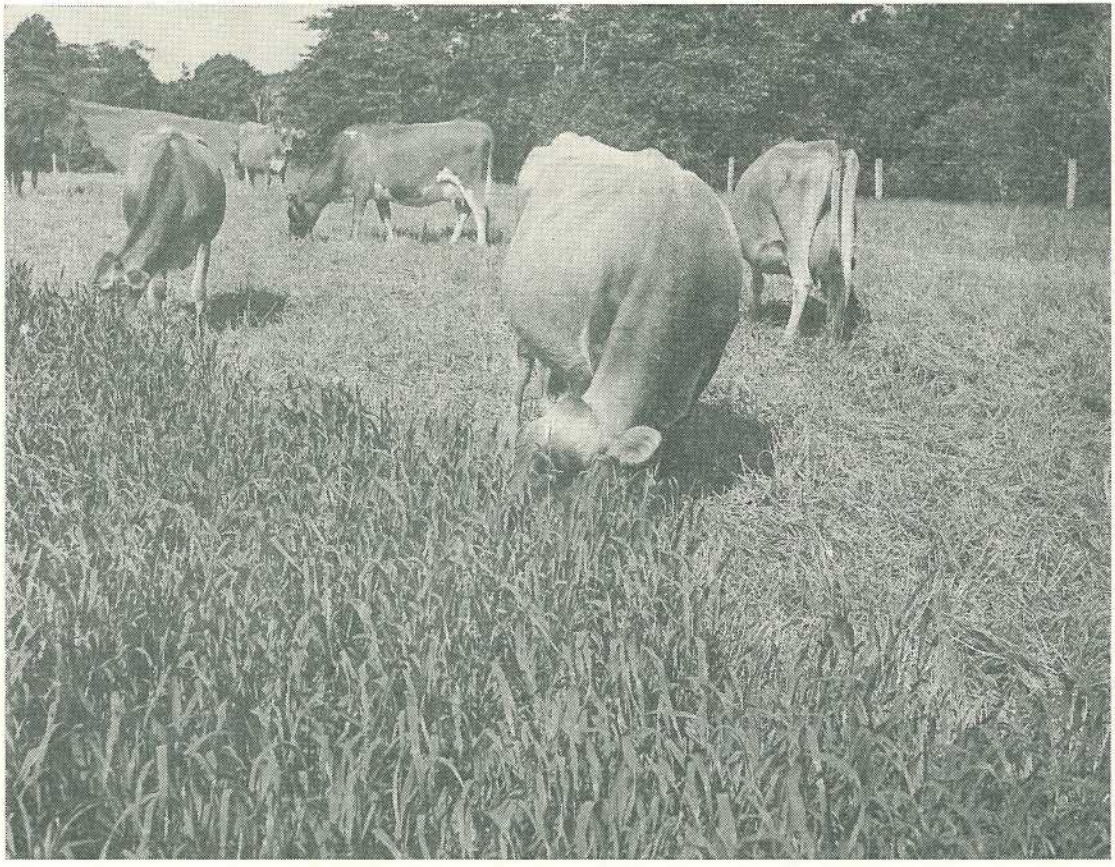
QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Temperate pastures for dairying



Strip grazing using an electric fence reduces wastage and gives better utilization of feed.

in south-east Queensland

by S. L. STILLMAN and H. OSTROWSKI,
Agriculture Branch.

THERE are two ways of overcoming winter feed deficiencies in dairying in south-east Queensland:

- using hay and concentrates
- growing special winter pastures based on temperate species.

Research has established that irrigated temperate pastures are capable of high forage yields in the cool season when summer growing species are dormant. They can fill the feed gap by providing high quality fodder that is relatively cheap to produce compared with purchased feedstuffs.

Climate and pastures

The area covered by this article extends from the New South Wales border northwards to Maryborough, and westwards to the Great Dividing Range. It does not include the Darling Downs.

Average annual rainfall ranges from 2 500 mm at Springbrook down to 1 150 mm at Gympie and 750 mm in the west. The rain falls mostly in summer and is lowest in winter and early spring (see Table 1).

TABLE 1

AVERAGE SEASONAL AND ANNUAL RAINFALL (mm) FOR SOME MAJOR CENTRES IN SOUTH-EAST QUEENSLAND
(Averages are for all years of record)

	Summer (Dec–Feb)	Autumn (Mar–May)	Winter (Jun–Aug)	Spring (Sep–Nov)	Annual
Caboolture	563	386	173	219	1 341
Cooroy	670	490	215	253	1 628
Gatton (P.O.)	328	173	108	173	782
Gympie	477	307	156	211	1 151
Kingaroy	323	163	110	177	773
Maryborough	489	334	166	203	1 192
Maleny	811	633	250	302	1 996

Source: Bureau of Meteorology, unpublished data

Frosts can occur from May to September. Three to five frosts can be expected in most coastal areas in a normal winter with up to 10 in a severe winter. In inland areas, the number of frosts can reach 20 in the West Moreton and 40 in the South Burnett; as well, they are more severe than on the coast.

Tropical pastures in south-east Queensland perform poorly during the cool season. Standover growth is often damaged by frost, and spring regrowth is slow. This means both quality and quantity are deficient for a period depending on the severity of the winter. This cool season feed gap is important with dairy cattle, especially in a fresh milk enterprise.

Temperate pasture species are frost tolerant and, except for a short period in midwinter, their growth is not restricted by low temperatures. The main factor limiting their growth in south-east Queensland is low and unreliable winter-spring rainfall. In a few favoured areas and sites, available moisture is enough for useful growth in a reasonable number of years; for high and reliable production, however, irrigation is necessary to ensure adequate moisture.

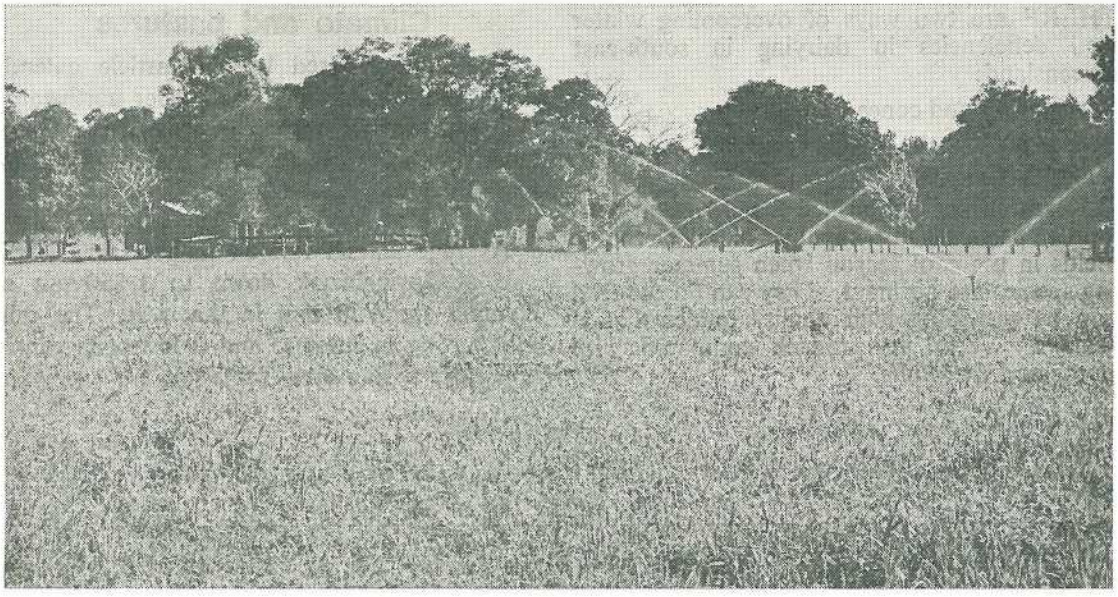
Since perennial temperate species are vulnerable to hot dry spells in summer, irrigation is also needed to stop loss of pasture components during this period.

Recommended temperate species

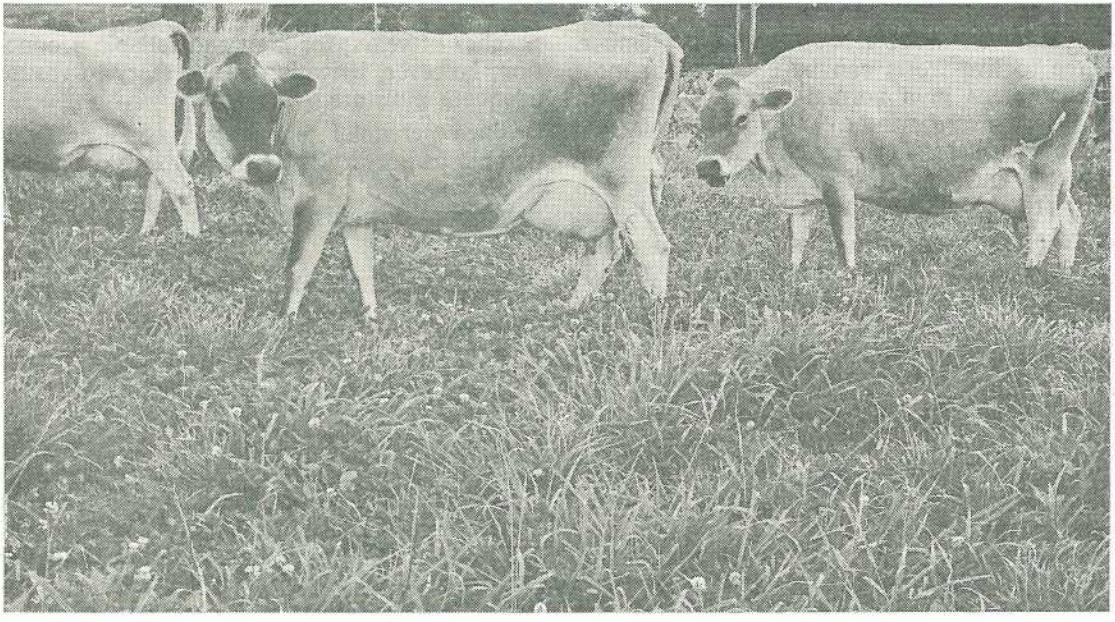
Grasses

RYEGRASSES

Ryegrasses are the most widely used temperate grasses in south-east Queensland and can produce abundant yields of high quality feed. They all need fertile, moist conditions and low temperatures for optimum growth. The ryegrasses are very responsive to nitrogenous fertilizer, tolerate flooding better than oats, and vary widely in their susceptibility to rust infection. Under rain-grown conditions or where quick feed is wanted, oats should be planted.



For high and reliable production from temperate pastures, irrigation is essential.



Irrigated temperate pastures containing white clover and ryegrass can carry five milking cows per hectare during the cool season and produce high milk yields.

Ryegrasses can be grouped as annual (plants not living beyond the first year) or perennial (plants living for two or more years). In Queensland it is rare for the perennial types to persist longer than two years. The cultivars are listed in order of popularity.

Kangaroo Valley (*Lolium perenne*) is the highest yielding and most reliable cultivar for dryland and irrigated pastures. It will produce as much feed as annuals in winter, and spring production is much higher with the peak being reached in October-November. Flowering starts in September but this does not affect digestibility.

Kangaroo Valley will persist strongly into the second season provided summer grass competition is reduced. It tolerates hot weather better than most ryegrasses, making quick growth after rain or irrigation, and has very minor susceptibility to rust.

Grasslands Manawa (*L. perenne* x *L. multiflorum*), originally Short Rotation or H1 ryegrass, is a hybrid which grows vigorously in spring. Winter production is similar to that of the perennials in this region and it is less susceptible to rust than Grasslands Paroa and Grasslands Tama. Grasslands Manawa persists weakly and is generally restricted to annual pastures.

Wimmera ryegrass (*L. rigidum*) is a fast growing annual making most of its growth from April to September. It has only moderate rust resistance and must be grazed frequently, particularly in the first few months after sowing. Under dry conditions Wimmera may seed early and complete its life cycle in August. Regeneration in the following year is poor.

Grasslands Paroa (*L. multiflorum*) or Italian ryegrass establishes rapidly but persists poorly and has only fair rust resistance. Winter and spring production are similar to that of Grasslands Manawa. When grown with clover it must be grazed regularly to avoid smothering of the legume.

Grasslands Ariki (*L. perenne* x (*L. perenne* x *L. muliflorum*)) is a cross between perennial ryegrass and Grasslands Manawa. In south-east Queensland Ariki has a similar growth pattern to Kangaroo Valley but produces less autumn feed. Field trials have shown it to be less persistent under dry conditions than Kangaroo Valley. It has very minor susceptibility to rust.

Grasslands Tama (*L. multiflorum*), bred in New Zealand, is a broad leaved, thick stemmed form of Italian. It has a similar production pattern to Grasslands Paroa, making substantially more spring than winter growth. Because of a higher moisture content it tends to be lower yielding than most other ryegrasses. It is a strict annual and highly susceptible to rust.

Victorian perennial ryegrass (*L. perenne*), selectively developed by the Victorian Department of Agriculture, grows a little more slowly than Kangaroo Valley and is slightly lower yielding with peak production in spring. Field trials in south-east Queensland have shown it can withstand periods of moisture stress and has minor rust susceptibility.

Prairie Grass (*Bromus unioloides*)

Priebe perennial prairie, a local selection from the Darling Downs, has better persistence under subtropical conditions than other strains. It needs well-drained soils and ample irrigation. Prairie grass will not stand heavy grazing and is unsuitable for intensive annual pastures. Grazing should be reduced at seeding time and again when the seedlings appear in autumn.

Phalaris (*Phalaris aquatica*)

Australian phalaris is a deep-rooted, clumped perennial, leafy and succulent in the young stage but stemmy when the seed heads appear in late spring. Phalaris is cold tolerant but survives hot, dry summers better than most temperate grasses. Under rain-grown conditions, it is the most persistent temperate grass. The seedlings are weak and subject to competition from other species. Establishment is slow with little growth in the first season.

Sirocco phalaris, a later release, has shown good adaptability and has been the highest producing temperate grass under irrigation at Gatton Research Station over the last 3 years. It has also persisted for 4 years under rotational grazing and irrigation at Gatton College.

Sirosa, bred from Australian phalaris and some recent introductions, has improved seedling vigour, greater seed retention and better

cool season growth. Its larger and more robust seedlings also produce more tillers. It is still under test in south-east Queensland.

FESCUE (*Festuca arundinacea*)

Fescue is generally slower to establish than ryegrasses and is not suited to annual pastures. It is useful in permanent sowings and the cultivar Demeter is superior to prairie grass on heavy soils at the Queensland Agricultural College. Summer-autumn production is higher and winter production lower than that of ryegrasses.

Alta fescue, a new introduction, has shown promise in trial plantings.

OATS (*Avena spp.*)

Oats is widely grown for winter grazing in south-east Queensland, both irrigated and rain-grown. It will grow on poorer soils and under drier conditions than ryegrass. Detailed recommendations on varieties and planting rates are given in the January–February issue of this journal each year. Quick growing varieties such as Saia, Bentland and Minhafer can be oversown in temperate pastures to provide early feed.

Legumes

LUCERNE (*Medicago sativa*)

In coastal areas lucerne suffers from waterloggging, acid soils, and high humidity in summer. Consequently, its successful use is restricted to deep, well drained soils in the drier subcoastal zone. Nearly all sowings are of Hunter River. The newer Siro Peruvian is less persistent but has better early production, winter vigour and regrowth after grazing or cutting, and is valuable in short term plantings. Both cultivars are intolerant of continuous heavy grazing.

In recent years, many stands of lucerne have suffered from various types of crown and root rot. To minimise the effect of these diseases, long rotations using other plants are needed between each lucerne crop.

In sub-coastal areas, lucerne can be a valuable component of irrigated pastures on deep soils.

Oats oversown in irrigated ryegrass-clover pasture provides valuable early feed and allows the clover to build up feed for winter.

WHITE CLOVER (*Trifolium repens*)

White clover is a perennial widely naturalized in the better rainfall areas. Its palatability, high nutritive value and ability to improve the yield and quality of associated grass are well known. Under irrigation it is highly productive with a long growing season; under rain-grown conditions its growth is erratic and mainly confined to spring. White clover is less demanding as to soil depth and drainage than lucerne.

The cultivar Ladino is widely used and forms the basis of most irrigated pastures in Queensland and northern New South Wales. Leaves and stems are larger than in the other cultivars and stolons are thick with long internodes that root down readily. Ladino has a tall, erect, open growth habit and recovers faster after long, dry periods than other cultivars. Its main fault is that it is less persistent under grazing as the fleshy stolons are readily eaten. A lighter seeder than other white clovers, its natural regeneration is poor.

Louisiana, bred in the U.S.A., has a similar growth form to Ladino. It is more productive than the other cultivars in winter but less productive than Ladino in summer. Its recovery after summer drought is good and it seeds freely.

Grasslands Huia, or New Zealand white clover, was developed for longevity and high production from local types in New Zealand permanent pastures. A perennial, adapted to moist temperate climates and medium to high fertility soils, Grasslands Huia has high spring production and persistence under grazing, but yields less in winter than Louisiana and less in summer than Ladino. It is denser and more stoloniferous, recovers quickly after grazing, and is widely used in the coastal areas.

Haifa, a new cultivar from Israel, has performed well at Grafton, New South Wales, and in south-east Queensland. It is more stoloniferous and denser in growth than Ladino, has good seeding ability, and better autumn-winter growth.

KENYA WHITE CLOVER (*T. semipilosum* cv. Safari)

Kenya white clover is a subtropical legume. It is less frost tolerant and more heat and drought resistant than common white clovers, and better adapted to climates with a low winter and high summer rainfall.

Sod-seeding ryegrass, clover and oats into a mat grass sward after rotary-hoeing.

Establishment is usually slow and may take up to 2 or even 3 years. New plantings are severely affected by rugose leaf curl disease; once the stand recovers, however, reinfection is confined to new seedlings. When established, Safari is hardier and more productive than white clover. Because of its more erect growth it combines better with the tall growing grasses. The highest production from Safari is usually in summer. It spreads well and withstands heavy grazing. Safari needs a very specific rhizobium for successful nodulation.

Red Clover (*T. pratense*)

Grasslands Hamua (New Zealand cowgrass) is the only cultivar available and does not persist beyond the second year. It provides limited feed over the critical winter period but is highly productive over spring and summer. It is sown to some extent in the Mary Valley and Beaudesert areas to provide spring and summer legume growth during the first year or two while white clover is building up. Red clover is also sown with oats around Beaudesert to improve the late spring grazing. It is highly susceptible to rugose leaf curl disease.

Strawberry Clover (*T. fragiferum*)

Strawberry clover (cv. Palestine) is tolerant of repeated flooding and is used in wet, acid, sandy soils and low-lying, wet areas where other clovers will not persist. It is suitable for irrigated pastures on low-lying areas which become waterlogged.

Annual Medics (*Medicago spp.*)

Annual medics are restricted to the West Moreton and South Burnett where they are naturalized on the better soils. There is a trend towards including them with raingrown oats in these areas. Jemalong is the most productive cultivar.

Greater Lotus (*Lotus uliginosus*)

Greater lotus is an underrated legume for use on shallow soils with poor internal drainage. It has fair frost tolerance, growing well

in acid situations where white clover fails. It is not recommended for intensively-irrigated pastures but can be a useful component in tropical mixtures or for planting in natural pastures such as mat grass.

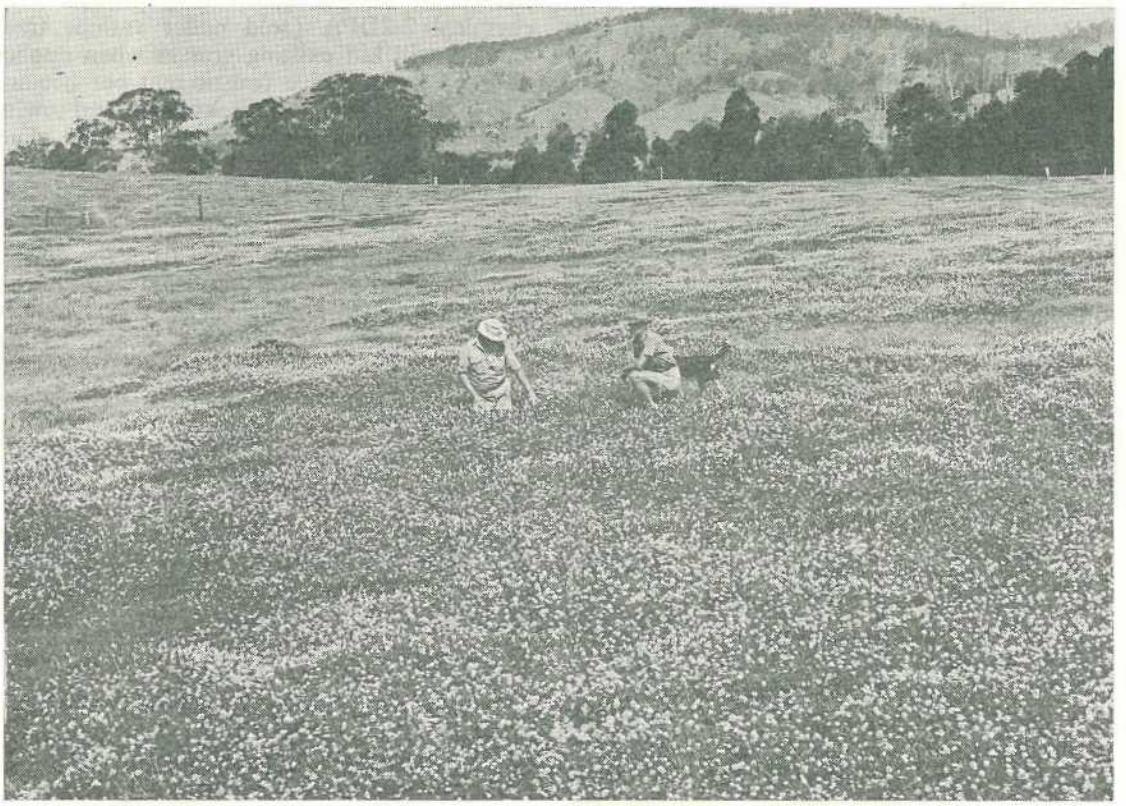
Types of temperate pastures

Temperate pastures can be annual or perennial and can consist of either pure stands of ryegrass, oats or lucerne, or grass-legume mixtures.

Where adequate irrigation and labour are available perennial pastures consisting of grass-legume mixtures are the most suitable. The actual components are chosen to provide maximum production and persistence under local conditions. Two grasses and two legumes are usually sufficient.

Perennial grass/legume pastures are exacting in their management requirements, in summer as well as winter. For less ideal situations, other types of temperate pasture are used:

- In coastal areas, clover sometimes fails to persist beyond the first year because of summer weed competition and/or inadequate irrigation. Annual oversowing of the clover may be necessary.
- For the period of most acute feed shortage (mid June to mid August), small areas (0·1 ha per cow) of intensively irrigated ryegrass or oats fertilized with nitrogen are useful.
- Pure grass pastures of kikuyu, paspalum, Rhodes or even natural grass, may be lightly ripped or disced and oversown with ryegrass at 30–40 kg/ha or oats at 60–80



Spring growth of white clover that had been originally sod-seeded into a paspalum pasture. Heavy autumn grazing and topdressing with superphosphate ensures a good crop of clover.

kg/ha in autumn Abundant irrigation and applications of 50 kg/ha of nitrogen at least three or four times during the growing season are essential.

In the west Moreton and South Burnett regions, irrigated perennial pastures of prairie, fescue, Kangaroo Valley ryegrass, white clover and lucerne are more persistent and productive than in coastal regions; consequently annual pastures have limited value in the former areas.

Choosing soils and sites

The main requirements of soils and sites for temperate pastures are:—reasonable depth and friability, good moisture-holding capacity, good drainage, both surface and internal, suitability for cultivation and irrigation (spray) including proximity to a source of irrigation water, and freedom from frequent flooding. Soils that are extremely infertile and/or strongly acid require high rates of fertiliser and/or lime.

Deep alluvial soils with sandy loam to clay loam textures are ideal. The red loams of the Springbrook, Tamborine, Beechmont and Maleny plateaus are not suitable because of excessive internal drainage. However, being in high rainfall areas they can support some growth of temperate pasture without irrigation.

Frost incidence does not bar a site for temperate pastures. Indeed it makes sense to use the frosty flats for temperates and the warmer ridges for tropicals.

Establishing temperate pastures

The type of temperate pasture will determine the method of establishment. In general, the best seedbeds give the best pastures, and where grass-legume swards are sown, a well prepared seedbed is essential.

Fully prepared seedbeds involve repeated cultivation until all vegetation is killed. Initial preparation includes slashing of the grass followed by discing or ripping crosswise, or ploughing with a mouldboard and harrowing. Where heavy grass is present the ground should then be fallowed for 2 to 3 months until the plant material has decomposed. Subsequent workings should be shallow and frequent enough to check weed growth. Light harrowing before planting will remove small weeds and break any soil crusts.

A phase of fodder cropping with lablab bean or cowpeas before sowing permanent pasture helps to get the soil in good working order, improves the soil nitrogen level, and eradicates weeds.

Clover, ryegrass or oats can be successfully introduced into an existing summer pasture by oversowing in the autumn. Heavy grazing or slashing will be necessary to remove the overburden of pasture before the seed is drilled or broadcast. Establishment by this method is slow unless good rainfall is received after sowing, or irrigation is available. Pastures consisting of tufted grasses and/or tropical legumes cannot withstand such drastic treatment. Kikuyu or pangola grass swards may be oversown after one or two rotary hoeings or discings. With pangola, narrow strips are left unhoed to facilitate recolonization by the grass runners in spring.

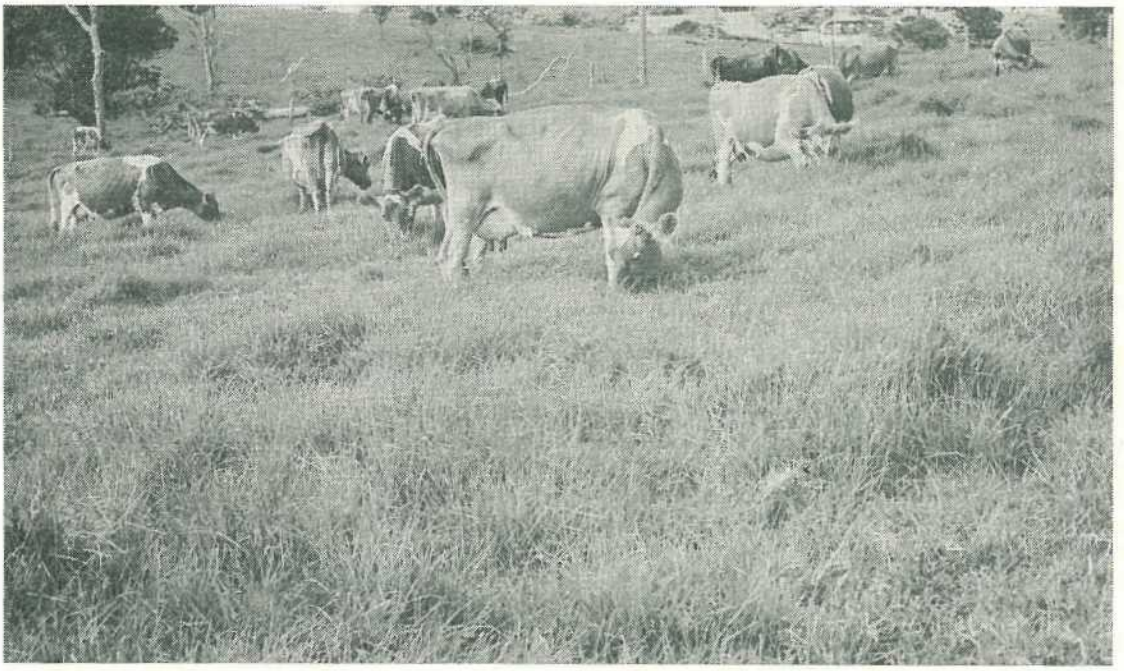
Summer grass pastures can be chemically treated to remove competitive growth. The chemical 2,2DPA (sold under various trade names) will kill existing grasses when applied at 6–11 kg of active constitutent per hectare. The grasses take 4 to 6 weeks to die and sowing should not begin sooner as the residual effect of the chemical can harm the emerging seedlings.

In the better rainfall areas, clover seed may be aerially sown or broadcast from the ground on uncultivated natural pastures, or following burns. On rough terrain, aerial sowing may be the only feasible method of planting and this usually coincides with the autumn application or superphosphate. In this operation, inoculated seed should be lime pelleted to protect the rhizobium from the sun and direct contact with fertilizer. Above normal sowing rates are necessary to obtain a good population. Establishment is usually slow and less successful than with other methods, and is strongly influenced by moisture and temperature conditions prevailing after planting.

Time of sowing

Sowing by any one of these methods can be carried out from late March until early June. Sowing temperate species earlier than late March is risky because of high temperatures.

Good soil moisture at sowing, either from rain or irrigation, is essential.



Nitrogen fertilized kikuyu provides valuable standover feed for autumn. This practice allows temperate pastures to bulk up for winter feed.

Sowing rates

Sowing rates are shown in Table 2.

Depth of sowing

Generally seed should be sown at a depth of 1–3 cm depending on size of seed and type of soil. Large seeds (prairie grass) in a very light soil can be sown up to 7 cm deep while very small seeds (white clover) should be barely covered or only pressed firmly into the ground. On most soils, rolling after planting will improve germination and help to prevent plants being pulled out of the ground at first grazing.

Fertiliser requirements

For establishment

Many soils in south-east Queensland are deficient in nitrogen, phosphorus and molybdenum, with deficiencies of copper and zinc also occurring on the coastal lowlands. Potassium deficiency generally occurs on old cultiva-

TABLE 2

SOWING RATES FOR TEMPERATE SPECIES (kg/ha)

Species	Drilled Into Well Prepared Seedbed		Drilled or Broadcast into Poorly Prepared Seedbed		Broadcast with no land Preparation	
	Pure Sward	Grass-Legume Mixture	Pure Sward	Grass-Legume Mixture	Pure Sward	Grass-Legume Mixture
Ryegrasses	8–12	4–5	30–40	20–30	N.R.	N.R.
Oats*	50–60	15–20	60–80	30–40	N.R.	N.R.
Prairie	12–16	8–10	20–30	10–15	N.R.	N.R.
Phalaris	3–4	2–3	N.R.	N.R.	N.R.	N.R.
Fescue	3–4	2–3	N.R.	N.R.	N.R.	N.R.
Clovers	N.R.†	2–4	N.R.	4–6	N.R.	6–8
Lucerne	10–14	6–8	N.R.	10–14	N.R.	N.R.
Annual medics	N.R.	2–5	N.R.	6–10	N.R.	N.R.

* Where the variety Saia is sown the rate should be at the lower end of the range

† Not recommended

tions, very old pasture land and sandy soils. Sulphur deficiency can occur on some soils but may not show up in the first year.

Temperate species, especially the legumes, prefer soils of neutral reaction. Extremely acid soils such as swampy peat wallum, may require from 2 500 to 5 000 kg/ha of lime or dolomite to be worked into the soil at least 10 days before planting. On soils that are only slightly acid, lime-pelleting of seed is sufficient to ensure nodulation of legumes.

Depending on available soil phosphorus levels, a rate of from 250 to 700 kg/ha of superphosphate may be required for new pastures. This will also correct a possible deficiency of sulphur. If the area has not received molybdenum during the previous 3–4 years, Mo12 superphosphate containing copper wallum soils, superphosphate containing copper, zinc and molybdenum is recommended.

On potassium deficient soils muriate of potash at 50–150 kg/ha should be applied.

Oats and pure grass pastures should receive nitrogen at 50–100 kg N/ha at planting. If land preparation included a fallow of at least 3 months and/or precropping with a legume, the available soil nitrogen is often adequate for establishing grass/legume pastures. Where the land preparation has been less than ideal, or, on extremely deficient soils, a starter application of 20 kg N/ha is advisable.

Seed and fertiliser are best applied separately. If this is not convenient they may be mixed *immediately before sowing*; in such cases, inoculated legume seed should be lime-pelleted to protect the rhizobium from the fertiliser.

For maintenance

Maintenance requirements for superphosphate can range from 200 to 400 kg/ha and this is best applied in autumn. On acid to neutral soils, molybdenised superphosphate should be used every 3 to 4 years.

Muriate of potash at the rate of 50–100 kg per hectare may also be necessary; because of the high cost, the likelihood of potash deficiency in the pasture should be checked first.

Deficiency of various elements can be established by particular deficiency symptoms, soil tests, plant tissue analyses, fertilizer test strips and general observation of the pasture vigour.

Well-balanced grass-legume pasture usually does not need any maintenance nitrogen (N) fertilizer, but small amounts of N (20–30 kg/ha) can be helpful to stimulate grass growth during the winter, when clover growth is slow. It should be realised that indiscriminate use of nitrogen is detrimental to the growth of legumes.

Pure grass pastures under irrigation require 200 to 300 kg/ha of N during the growing season in a number of split applications, preferably after each grazing. Nitrogen may be applied through irrigation pipes (as urea) or broadcast directly on the pasture. A heavy bulk of high quality feed can be obtained but, because of the costs involved, efficient utilization is imperative. The amount of nitrogen required by raingrown pastures will depend on prevailing soil moisture conditions.

Pasture management

Newly sown pasture

The first grazing of a new pasture should not be too early. Plants should be well developed before cattle are allowed entry.

Weeds may be troublesome in the early stage of the pasture but usually disappear after a few grazings and occasional slashings. If weed infestation is very severe, the overall spraying of a new pasture with 2,4–DB at 1–2 kg/ha of active ingredient should eliminate them. This should be carried out only when the legumes are at their first to eighth leaf stage. Pure grass pastures may be sprayed safely with 2,4–D (a different herbicide) to control broad leaved weeds such as turnip weed (*Brassica tournefortii*).

Established pasture

The aim in managing an established grass-legume pasture is to maintain adequate plant cover and an even balance of grass and legume. The key factors are the use of correct species, systematic rotational grazing, adequate maintenance fertilizer and regular irrigation.

Continued close grazing reduces the vigour of the root system. To maintain a reasonable plant cover the pastures should be grazed to a height no less than 7 to 10 cm. An effective plant cover is particularly important in summer to protect the roots from the sun. Close grazing at this time is disastrous.

Grazing should be on a regular basis. The available forage should be removed quickly, preferably using an electric fence.

The interval between grazings will depend on pasture growth rate. Under irrigation it will range from 30 days in midwinter to 20 days in spring.

To maintain white clover in both temperate and summer grass pastures, the grass overburden should be removed by heavy grazing or slashing in autumn to allow clover regeneration. Where necessary, extra clover seed should be drilled in or broadcast on the surface and harrowed in. This can be combined with the yearly maintenance application of superphosphate.

Bloat

A clover or lucerne dominant pasture creates a potential danger of bloat to cattle. There are several ways of reducing this risk, such as: maintaining the legume content of the pasture below 50% of the total bulk; feeding roughages before grazing the pasture; and allowing access to dry pasture. Grazing when the pasture foliage is wet should be avoided. Various commercial anti-bloat preparations are available. These may be sprayed on the pasture, applied to the feed or drinking water, or administered as a drench.

Irrigation

For continuous growth and efficient water usage, the pasture should be irrigated *before* wilting becomes apparent. Because most pasture species are shallow rooted, regular and frequent waterings give best results. Grazing immediately after watering should be avoided as this will cause soil pugging; preferably watering should closely follow grazing. In summer, it is logical to irrigate at night or in the cooler part of the day to minimize evaporation.

The frequency of irrigation depends on soil type and weather conditions. Sandy loams require more frequent watering than heavy clay loams. In spring, the interval between watering could be 10 days for sandy loams compared to 14 days for clay loams. This could reduce to 7 and 10 days respectively in summer and increase to 14 and 21 days respectively in winter.

Sufficient water should be applied to wet the soil to the bottom of the root zone. Once this stage has been reached any further water applied will be wasted either through penetrating beyond the root zone or running off the surface. On the other hand, too little water results in only partial wetting of the root zone and the plants wilt rapidly.

The amount of irrigation water to be applied to wet any given soil to the bottom of the root zone varies with soil texture. For example, sandy loams require 20–25 mm per 30 cm of soil while clay soils require up to 50 mm. The depth of the root zone will vary with different soils and plant species. For an irrigated white clover based pasture the effective root depth would rarely exceed 60 cm.

Planning for temperate pastures

Irrigated, temperate pastures involve a major capital investment and require skilled management. Because of this they should not be regarded as a replacement for tropical pastures. Their role is to complement these during the critical winter fodder gap.

To reduce the amount of input on temperate pastures, every effort should first be made to extend the useful period of tropical pastures.

Grass-legume tropical pastures grown on less frosty sites can be stood over to provide quality feed in May. The sub-tropical grass kikuyu when fertilized with nitrogen at 100 kg/ha in mid-March can provide high quality feed until mid-June. Recent research has shown that Narok setaria similarly fertilized can provide green feed even later.

In integrating temperate pastures into a farm feed system, one has to decide which type of temperate pasture is the most feasible under the particular conditions. Are suitable sites available? Should the pasture be annual or perennial? Are there any improved or natural pastures suitable for oversowing with clover or ryegrass?

Seek appropriate advice

The recommendations provided in this article are of a general nature only. It is impossible to include specific recommendations on pasture mixtures, sowing and fertilizer rates to cover all districts and situations. Local advisory officers are in a position to provide detailed information and should be consulted before embarking on any temperate pasture enterprise.

GRAPES

Summary of Chemical Insect Control Recommendations

Prepared by Entomology Branch Officers

THE following tabulation summarises chemical insect control recommendations for grapes grown in Queensland. Compilations of this nature cannot give comprehensive detail on pest identification, application timing and cultural control. Further details when required, should be sought from Extension Officers of the Department.

Pest	Description of Pest	Damage to Crop	Control Pesticide % active constituent except where product specified	Notes
GRAPE VINE SCALE *Eulecanium persicae* (Fabricius)	Large dark brown oval scale (7 mm long, 4 mm wide) with a hard convex exterior protecting the sap sucking scale. The fully grown scales form clusters along the canes which later become coated with a black, sooty mould which grows on the scales' secretions. Scales overwinter as immature females on canes and under bark. They mature in spring and each lays several hundred eggs	The scales weaken vines and in severe cases can cause death. When they move to the fruit their presence and the growth of sooty mould on the bunches makes the fruit unmarketable	1 *l* superior dormant oil (product) + 100 g 50% azinphos-methyl product/ 100 *l* water	Do not mix superior dormant oil and azinphos-methyl with lime sulphur. Spot spraying of infested vines is usually sufficient
BUD MITE *Eriophyes vitis* (Pagenstecher) (Bud form)	The adults are microscopic in size being 0·16 to 0·20 mm long and about 0·04 mm in diameter. They are elongate and translucent with two pairs of short legs at the anterior end	Mites feed on the young leaves within the buds and in severe cases cause many bud failures. Affected buds give rise to thick canes with short internodes and short scraggly bunches	Carbaryl 0·1%	Found mainly on the variety Waltham Cross. If it is found to be active 3 applications of carbaryl should be applied during the growing season. The timing of the first spray, just before bud movement, is very important

GRAPE LEAF BLISTER MITE *Eriophyes vitis* (Pagenstecher) (gall form)	The adults are microscopic in size being 0·16 to 0·20 mm long and about 0·04 mm in diameter. They are elongate and translucent with two pairs of short legs at the anterior end	Mites feeding on leaves produce leaf malformations resembling galls. The concavity of the galls on the lower surface of the leaf is densely lined with abnormal plant hairs. The surface of the leaf is wart-like in appearance. In severe infestations reduction in quality and yield can occur, with premature leaf fall affecting the following year's crop	Lime sulphur 5 *l* product/ 100 *l*; Carbaryl 0·1% during growing season	The variety Muscat Hamburg is the one most often showing symptoms. Sprays of lime sulphur to be applied just before bud movement and carbaryl sprays when shoots are 15–20 cm long, just before flowering and if necessary after harvest
GRAPE LEAF RUST MITE *Calepitrimerus vitis* (Nalepa)	Too small to be seen with the naked eye but under magnification they appear cream coloured and worm-like. They are broad at the front tapering off to a pointed posterior. They bear two pairs of short legs at the anterior end	They feed by puncturing the leaf cells and sucking out the juices. Affected leaves show discolouration along the main veins which eventually spreads over the leaf surface. In severe cases they may cause premature leaf fall	Lime sulphur 5 *l* product/ 100 *l*	Usually a problem in hot, dry seasons. Sprays of sulphur against powdery mildew will also control the mites. Apply lime sulphur just before bud movement
BUNCH MITE *Brevilpalpus californicus* (Banks)	Microscopic, somewhat squarish in shape, transparent pink in colour, found associated with scarred berry stalks	Causes scarring of the berry stalk and in severe cases the removal of sap by their feeding can cause berry drop with subsequent yield reductions	Lime sulphur 5 *l* product/ 100 *l*	Not a problem in the Granite Belt but may cause damage in grapes in warm, dry regions of the State. If a problem, a lime sulphur spray at late bud swell in addition to sulphur sprays for powdery mildew in summer will control this pest
GRAPE VINE MOTH *Phalaenoides glycine* Lewin	Newly hatched larvae are pale and transparent but later develop yellow, black and red markings. The larvae is mainly black with numerous yellow lines criss-crossing the body to form a rectangular patch-work. Fully grown, they reach 5 cm in length. The adult moth has a wingspan of 5 cm with mainly black wings with white and yellow markings. A tuft of reddish hairs occurs at the tip of the abodomen	Larvae defoliate vines and are particularly troublesome towards the end of the season	Azinphos-methyl 0·05% OR Carbaryl 0·1%	Only a minor pest, rarely important from an economic point of view. Natural parasites and predators as well as sprays for mites will normally keep it in check

Pest	Description of Pest	Damage to Crop	Control Pesticide % active constituent except where product specified	Notes
LIGHT BROWN APPLE MOTH *Epiphyas postvittana* (Walker)	The light green larvae which grow up to 25 mm long are recognized by their fast wriggling movements and their habit of parachuting on a strand of silk when disturbed. Adults have a wingspan of about 20 mm. The basal half of the fore-wings is light brown while the remainder is dark brown; the hindwings are uniform and light brown	Larvae chew and web leaves and build silken galleries inside the bunches. Bunch damage may be serious because it increases susceptibility to grey mould rot	Azinphos-methyl 0·05% OR Carbaryl 0·1%	Specific control measures should be applied 3–4 weeks after flowering and later as required. Usually sprays applied to control other pests will control light brown apple moth also
CALIFORNIAN MEALYBUG *Pseudococcus obscurus* Essig.	The flightless female mealy-bugs are about 5 mm long, and covered in a uniform white mealy powder. The young bugs resemble the adults in shape. They move slowly and are found on the under surface of leaves near the midrib or at the base of petioles. Numerous oval eggs are laid in loose cottony masses. The males are small, insignificant flying insects rarely seen unless specifically searched for	The damage produced is on the grape bunches. The honey-dew produced by the adult females is an ideal medium for the growth of sooty mould. This mould in conjunction with the honeydew renders a bunch of choice grapes into a black sticky un-sightly mess	Parathion 0·025%	Not a widespread problem, but is more prevalent on the warmer and wetter coastal areas of grape production
BLACK PLAGUE THRIPS *Haplothrips froggatti* (Hood)	Mature adult thrips are small (about 1·5 mm long) elongate winged insects. Immature thirps are cream and wingless while adults are dark grey to black. They are very active and may be observed in most grape blossoms	Generally do not cause damage but in years of high infestation they may be the cause of poor setting	Endosulfan 0·07%	Control measures may be required just before flowering only when thrips numbers are unusually high
QUEENSLAND FRUIT FLY (*Dacus tryoni*) (Froggatt)	The adults are slender brown wasp-like flies with yellow markings on the thorax and abdomen and are about 8 mm long. The adult females may be observed walking over berries with their wings extended. The maggots are pale cream in colour and grow to about 13 mm long	Attack on the fruit just before colouring is evident by an irregular brown dis-colouration under the skin. The ovipositing female ruptures the skin providing an entry site for rot organisms	Dimethoate 0·03% OR Fenthion 0·04%	This pest is rarely a problem on the Granite Belt but in the warmer and more humid coastal areas protective sprays may be required. If required sprays are applied 4 weeks before harvest

GRAPE VINE HAWK MOTH *Hippotion celerio* (Linnaeus)	The larvae is grey-green and grows to 7–8 cm in length and is recognized by a curved posterior horn. The adult has a wingspan of 8 cm with a stout, pointed abdomen. The body and forewings are light brown with white and black lines while the small hind wings are deep pink with black markings	The larvae defoliate vines	Azinphos-methyl 0·05%	Spray should be applied only if larvae are found to cause damage

Material (Common Name)	Percentage Concentration Active Constituent	Strength of Product	Quantity per 100 *l*	Quantity per 100 gals	Withholding Period (days)
Azinphos-methyl	0·05	500 g/kg (80%) wettable powder	100 g	1 lb	*P14
Carbaryl	0·1	800 g/kg (80%) wettable powder	125 g	1·25 lb	3
Dimethoate	0·03	300 g/*l* (30%) emulsion	100 ml	16 fl oz	7
Endosulfan	0·07	350 g/*l* (35%) emulsion	190 ml	30 fl oz	P14
Fenthion	0·04	550 g/*l* (55%) emulsion	72 ml	11·5 fl oz	P7
Lime sulphur	1·0	200 g polysulphide sulphur/*l*	5 *l*	5 gal	..
Parathion	0·02	500 g/*l* (50%) emulsion	50 ml	8 fl oz	14
Superior dormant oil	1	..	1 *l*	1 gal	1

* P = provisional

Of particular interest

Items of news recently released by the Minister for Primary Industries, the Hon. V. B. Sullivan, M.L.A.

Looking for less expensive wool harvesting methods

(*Statement by the Hon. V. B. Sullivan, M.L.A., Minister for Primary Industries*)

CONCERN is mounting in the sheep industry over the ever-increasing costs of shearing.

This has triggered extensive investigations in Australia, and throughout wool-producing countries overseas, into developing less expensive methods of harvesting.

Some research organisations are attacking the problem along orthodox shearing lines, but modifying catching and holding techniques to ensure less physical exertion for the shearer.

They also are looking into such aspects as improving the hand piece and placing less importance on correct positioning of the sheep during shearing.

The biology of wool growth is being studied so that completely new methods of harvesting might be developed.

Chemicals known to stop, or slow down, cell growth to cause a break, or weakness, in the wool fibre and so allow easy harvesting are under intensive scrutiny.

My Department's Toorak Sheep Field Research Station, at Julia Creek, is concentrating on this approach but a lot of problems have yet to be solved.

A number of chemicals had been tried and work was proceeding with the most effective of these.

Early work at Toorak showed that, when a complete break was made and the fleece came off a few weeks after treatment, sunburn was a major problem in that area.

In cold weather, the de-fleeced sheep are likely to die from exposure.

Current investigations at Toorak are designed to control the action of the effective chemical to allow de-fleecing at more precise times so that a uniform harvesting time can be achieved.

This involves the reaction of sheep to rates of dosage of the chemical used and much work remained to be done in this field.

Should chemical shearing be perfected, investigations into mechanical de-fleecing will be expanded.

At present, mechanical de-fleecing of chemically-treated sheep is carried out with a vacuum cleaner type of machine.

No mechanical de-fleecing without prior treatment with chemicals is being attempted at this time.

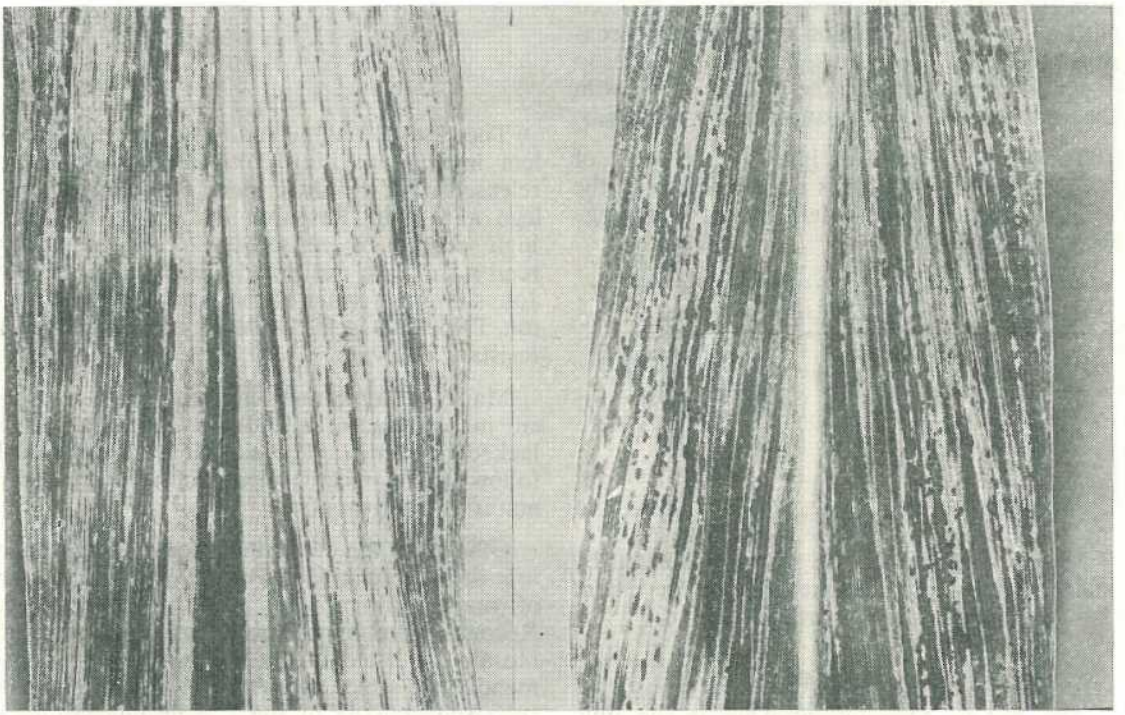
Maize Dwarf Mosaic Disease

by D. M. PERSLEY, Plant Pathology Branch.

MAIZE crops in southern Queensland can be seriously affected by maize dwarf mosaic disease.

Symptoms

Characteristic symptoms are mosaic and ringspot patterns on the leaves. Mosaic symptoms consist of light green-dark green patches, usually in the form of broken lines between the veins. Extensive areas of leaf chlorosis (lack of normal green colour) develop on infected plants of highly susceptible cultivars. The type and severity of symptoms depend on the cultivar and time of infection. Early infection, for example, generally results in extensive leaf symptoms and marked stunting of plants. Colour illustrations of the mosaic and ringspot patterns appeared in the July 1974 issue of the *Queensland Agricultural Journal.*



Mosaic, ringspotting and chlorosis symptoms of maize dwarf mosaic disease.

Cause

The causal agent, sugarcane mosaic virus, has a wide host range among grasses including cultivated grain sorghums and millets (*Panicum, Setaria* and *Echinochloa* species). The virus survives between seasons in its chief perennial host, Johnson grass (*Sorghum halepense*), or in standover forage sorghum crops. A number of strains are associated with other grass species but only the Johnson grass strain is important on maize and sweet corn.

Spread

The virus is spread from plant to plant by several species of aphids with the corn aphid (*Rhopalosiphum maidis*) being the most prevalent carrier (vector) species found in maize crops. Winged aphids from outside the crop play an important role in spreading the virus. As these insects generally feed for only short periods, insecticides are of little value in disease control.

Importance

In crops of susceptible cultivars it is common for 40% to 50% of plants to be infected with up to 100% infection occurring on occasions. The level of virus infection in a crop depends on the cultivar, the sources of virus in the area and the number and activity of aphids.

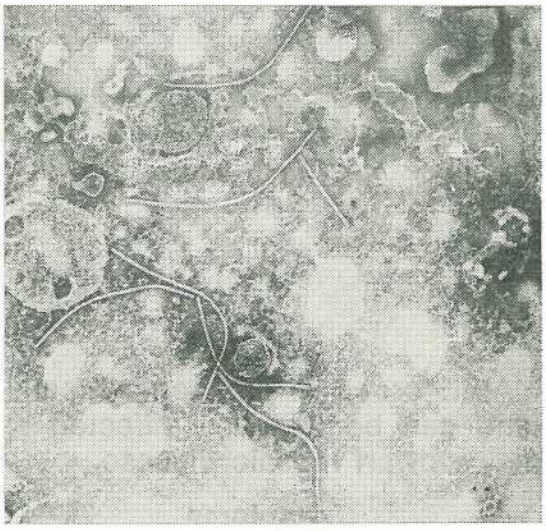
The effect of time of infection on yield of two susceptible hybrids is demonstrated in the following results from a field trial at Hermitage Research Station.

Cultivar	% Reduction in Cob Weight	
	Early Infection (Up to 5 weeks after planting)	Late Infection (5–11 weeks after planting)
1	47	19
2	46	12

Sweet corn can also be severely affected by maize dwarf mosaic, sometimes to the extent that harvesting is not worthwhile.

Control

The use of resistant cultivars is the only effective means of control.



Minute flexuous threadlike particles of sugarcane mosaic virus in sap from an infected maize leaf and viewed under an electron microscope. The particles are less than 0·001 mm in length.

The disease has generally not been a problem in late maturing cultivars because those released from the Queensland Agricultural College and Kairi Research Station have had a high degree of resistance. An important reason for the restricted distribution of the Johnson grass strain of the virus on the Atherton Tableland is the widespread use of highly resistant cultivars.

Maize dwarf mosaic has been more important in early maturing cultivars, most of which lacked resistance. The situation has improved following the recent release of resistant early maturing cultivars.

Officers of the Plant Pathology Branch have assessed the relative resistance of a wide range of maize cultivars to maize dwarf mosaic. Recommended hybrids resistant to maize dwarf mosaic are listed in the maize varietal recommendations which is published annually in the July-August issue of the *Queensland Agricultural Journal*.

Fire Danger and Burning Meters . . . and their uses

by R. P. HEALY, Secretary, Rural Fires Board.

THERE are many factors which have a bearing on the intensity of a fire. Some of them are particularly localised and therefore cannot be specifically "built-in" to any general formula for assessment of fire behaviour. Other factors can be evaluated more generally and their combined effects determined.

The approach to the production of a fire danger or burning meter has been aimed at establishing the degree of intensity of a fire by the measurement of those parameters which are capable of pre-determination, and applying the result with variations appropriate to the conditions prevailing at the particular fire.

Factors which have a major effect on fire behaviour and which can be fairly simply predetermined for general application are: Temperature, humidity, wind velocity, and degree of curing of fuel. To these can be added where data is available, rainfall figures and a consideration of the drought factor which is used only in the forest fire danger meter.

Local factors which must be considered when lighting or fighting a fire are—

- Density and distribution of fuel.
- Slope.
- Wind direction and gusting.
- Climatic conditions, i.e. cloudy, clear, etc.
- Adjoining areas.
- Control measures available (personnel, equipment, etc.).
- Actual size of area.

There are also more remote factors which, while affecting behaviour are not capable of simple assessment. Their effects need not be taken into account when designing a burning meter. Naturally, a meter must be capable of simple and speedy operation at the time it is needed.

Meters are now available for use in grasslands, forest lands, brigalow scrub and sugar cane, all based on the same principles, but with variations for the specific fuels. The meters, correctly used, give an accurate picture of the anticipated fire behaviour and provide fire fighters with a forward picture of the fire or, when used in a planned burning operation, enable the achievement of the object of the exercise within the acceptable limits of safety.

The grassland meter

The four factors previously mentioned (degree of curing, temperature, wind velocity and humidity) are used to determine a figure known as the fire danger index. In all meters 0 is taken as a figure where burning is a practical impossibility and 100 as representing "wild fire" conditions completely beyond control. Standard terms are used and the categories are—Low < 3, Moderate 3–7, High 8–20, Very High 20–50, Extreme 50 +. The Meteorological Bureau uses this same standard terminology and a forecast of high, very high or other category fire weather means that the fire danger index lies between the limits listed herein.

The intensity of a fire and its difficulty of control are affected by the quantity of grass in the pasture. Naturally, fires burn faster in heavy than in light pastures. Figures for rate

of spread which are directly related to intensity and ranging from 0·2 to 13 in km/hr are listed in the meter and apply to annual and perennial pastures carrying a continuous body of fuel and occurring on level to undulating ground. Spread rates will vary according to quantity of pasture and topographical features.

The following table is used with the fire danger index.

TABLE 1

Fire Danger Index	Rate of Spread (km/h)	Difficulty of Suppression	Maximum Area at Various Times from Start (hectares)*				Average Final Size of Fire (hectares)	Flame Height (m) in		
			½ h	1 h	2 h	4 h		Sparse Pasture	Average Pasture	Heavy Pasture
2	0·3	Low. Headfire stopped by roads and tracks	3	20	80	320	3	0·3	1·0	3·0
5	0·6	Moderate. Head attack easy with water	6	40	160	640	16	0·6	2·0	3·5
10	1·3	High. Head attack generally successful with water	15	90	360	1 440	65	1·0	3·0	5·5
20	2·6	Very High. Head attack will generally succeed at this index	35	210	840	3 360	450	2·0	3·5	7·0
40	5·2	Very High. Head attack may fail except in favourable circumstances and close back burning to the head may be necessary	80	480	2 000	8 000	2 400	2·5	5·0	9·0
50	6·4	Extreme. Direct attack will generally fail. Back burn	105	530	2 500	10 000	4 000	..	5·5	10·0
70	9·0	from a good secure line with adequate manpower and	170	1 000	4 000	16 000	10 000	..	6·0	11·0
100	12·8	equipment. Flanks must be held at all costs	300	1 800	7 000	28 000	32 000	..	7·0	13·0

NOTE.—* This assumes that the head fire burns unchecked. Suppression action which is only partially successful will reduce these areas.

Effect of slope

Over short distances the effect of slope is very pronounced. Forward rate of spread will double up to 10° slope and will be four times greater in a 20° slope. The rate of spread will correspondingly decrease on downslope with the proviso that in very severe conditions massive fire whirlwinds may develop.

Perimeter increase

A figure of 2·5 times the forward spread is accepted as a practical figure for perimeter spread.

Area increase

The area of fire increases as the square of burning time, i.e. the area four hours from the start will be 16 times the area covered at 1 hour. This emphasises the need for quick initial attack.

Grassland burning meters are available to fire wardens throughout the State and a limited distribution is available from the Rural Fires Board to other interested parties.

Brigalow burning meter

As the meter was designed specifically for use in burning operations for a defined area and specific fuels it differs slightly from the grasslands meter. For example, no rate of spread is shown on the index.

Although most of the brigalow lands have now been converted to pasture or cultivation, there is still a significant area in private hands yet to be treated. In addition, the brigalow meter can be used for similar types of scrub burning (i.e. gidyea) and is the simplest of all the burning guides.

Rain effects

Recent rain will reduce the burning index considerably in a felled area and allowance should be made for this effect. Two or three days may be required to dry out the felled scrub if more than 12 mm of rain falls.

The intensity of burn and its difficulty of control are related to the amount of fuel present on the area to be burnt. As the quantity of felled brigalow and other tree species is relatively constant, the main variation in fire intensity results from the amount of grass present in the felled scrub. The table provides the range of indices to produce ideal results for varying conditions and objectives.

TABLE 2

Management Objective	Range of Burning Indices								
	Heavy Grass			Average Grass			Sparse Grass		
	Poor	Optimum	Dangerous	Poor	Optimum	Dangerous	Poor	Optimum	Dangerous
1. Removal of Unpalatable Grass	1–2	3–6	7–10	2–4	5–8	9–12	4–7	8–12	13–16
2. Cultivation	1–4	5–10	11–16	5–9	10–15	16–24	5–11	12–20	21–24
3. Pasture Establishment ..	1–3	4–7	8–12	2–6	7–10	11–15	6–14	15–20	21–30
4. Sucker Control	1–4	5–10	11–16	3–6	7–12	13–16	5–9	10–16	17–24

Grass classifications

In respect to burning a brigalow block grass can be classified as—Heavy–Dense, continuous cover of tall (1 metre +) grass ungrazed for at least a year; or

Average—Moderately tall grass (30–100 cm) with occasional bare areas; or

Sparse—a low discontinuous patchy grass cover in which fire would progress with difficulty.

Because the meter is primarily for persons burning off, lighting techniques are important.

- Area—not too large—250 hectares maximum.
- Light up quickly—have efficient lighting equipment.
- The lee side can be used to test fire, but as the main consideration is to get the fire to travel through the area, light up in centre then windward side and quickly round the perimeter.
- Light thick edge using 2 or 3 lighters. Single lighting of edge is far too slow and results in a poor burn.

NOTE: Unless there is a heavy body of grass a brigalow burn will initially move slowly. Brigalow (Acacia Harpophylla) is, however a hot burning timber and under intense burning conditions will "explode".

Brigalow burning meters are also obtainable from the Rural Fires Board.

Cane burning meters

The preharvest burning of cane is a long established practice in the industry and because of the specific requirements of such burn, and the associated danger to adjoining cane, this type of burning is usually carried out in a period when the fire danger index is not greater than "upper" moderate.

The main sufferer from cane fires which have escaped is seldom other cane, but frequently vacant land usually forested and in hilly country adjoining cane farms. Investigations into cane burning have resulted in the production of the burning meter. In this meter, the temperature, humidity and wind factors remain, but the category "degree of curing" has been altered to "condition of cane", described as follows:—

FULLY CURED. Tops brown to the stage of near death (normally associated with very dry seasons—uncommon in north Queensland).

LATE SEASON CONDITION. Tops yellow brown and dying—cane arrowed. A normal condition in south Queensland in mid-spring to early summer.

EARLY SEASON CONDITION. Tops in early stage of drying; some yellow-brown. Occurs early in dry areas later in wetter districts.

GREEN CANE. Typical of high rainfall in north Queensland areas, particularly in early season.

In respect to wind speed the meter is calculated on wind speed in the open. If the wind speed is measured in a paddock of cane, add 3 km/hr.

The cane guide to be used with the meter is printed below—

TABLE 3

Cane burning index	Minimum down-wind break (m)	Minimum no. of men	Recommended Cane Burning Operations
1	..	2	Minimum burning conditions—suitable for opening canefields when winds less than 8 km/h (5 mph)
1–2·5	20	3	Suitable conditions for burning standing cane, poor results in lodged cane
2·5–5	40	4	Optimum burning conditions
5–7·5	60	6	Isolated blocks, badly lodged or silt affected cane. Upper limit for burning standing cane
7·5–10	60	..	Cane burning not recommended. Trash burning of harvested cane tops
10	..	..	Trash burning not recommended
20	..	..	All open fire in canelands prohibited

Avoid burning any but isolated blocks under conditions where sudden wind changes are likely to occur:—

1. Under unstable atmospheric conditions prior to the onset of the sea breeze.
2. In advance of a thunderstorm, particularly when rain can be seen falling from a thunder head within 8 km (5 miles) of the burn.

Rainfall

After rain allow 2 hours of sunny drying conditions before calculating the cane burning index.

Forest fire danger meter

In addition to the factors used in the other three meters, the forest fire danger meter adds "rainfall to 9 a.m.", "no. of days since rain" and "drought factors". This information is not readily available to the average landholder, and as the burning in forest areas is mostly the concern of the Department of Forestry, it is not proposed to deal here with this meter. Information on its use is available from the Department or from the Rural Fires Board.

In an age when the use of the results of research are constantly being made available to and are welcomed by the general body of landholders, it should not be too much to hope that the use of fire danger meters will become a standard procedure for those who are using fire as a proper tool of land management. Whatever experience the user has had with fire, it is very unlikely that his acquaintance with fires extends to the number that have been investigated and measured to provide the data for the production of these aids. It can be stated with some degree of confidence that with intelligent use and the provision of reasonably correct data, the meters will predicate, with considerable accuracy, the behaviour of fire in a variety of fuels and circumstances.

The Rural Fires Board makes the meters available on request in the interests of the better use and control of fire.

Profit and loss in dehorning grown cattle

BRUISING costs cattlemen an estimated $22·5 million each year.

Horned cattle are the major cause of this loss. Poor handling and bad yard design also affect profits.

by A. E. HOLMES, Beef Cattle Husbandry Branch.

The significance of horns as a cause of bruising has been revealed in studies undertaken by the Australian Meat Board in conjunction with CSIRO and the Queensland Department of Primary Industries.

Advantages

Widely recognized advantages of hornless cattle include:—

- **Increased safety** for men and horses working cattle both in the yards and in the paddock.
- **Transport is simpler,** and it is sometimes possible to carry an additional animal per truck.
- **Less bullying** when either drought feeding or supplementary feeding. Animal behaviour studies have shown that horned cattle are much more aggressive around feeding troughs. This results in an uneven distribution of food throughout the herd.
- **Feedlot** operators prefer hornless cattle and may be prepared to pay a premium for them in the future.

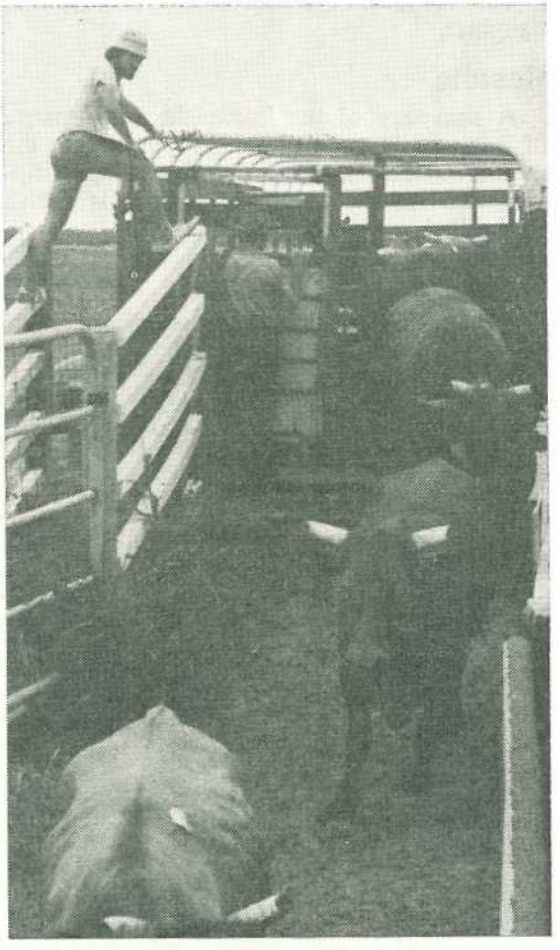
Questions

- How does dehorning affect the grown animal?
- What are the relative merits of tipping and complete dehorning?

These are important questions when considering dehorning or tipping grown cattle.

A trial recently carried out at the 'Swan's Lagoon' Cattle Field Research Station has provided some information on these important questions.

'Swan's Lagoon' is owned and staffed by the Queensland Department of Primary Industries and is typical of the spear grass area of north-east Queensland.



Heavily-tipped bullocks in Group 2 being unloaded at the meatworks.

The Trial

The trial using two drafts of cattle was conducted from December 1973 to May 1974 and from December 1974 to May 1975. In each period, horned Brahman crossbred bullocks aged 3 to 3·5 years were divided into 3 groups as follows:—

Group 1—horns left on.

Group 2—horns heavily tipped.

Group 3—completely dehorned.

The bullocks were weighed monthly during each period and were then slaughtered after being road transported 171 km to the meatworks. Each treatment group was transported separately.

The amount of bruising was recorded at slaughter.

Results

A summary of the liveweight performance of bullocks in each of the groups during the month immediately following dehorning or tipping and for the ensuing 3 months is shown in Table 1.

TABLE 1

AVERAGE LIVEWEIGHT GAIN (KG)

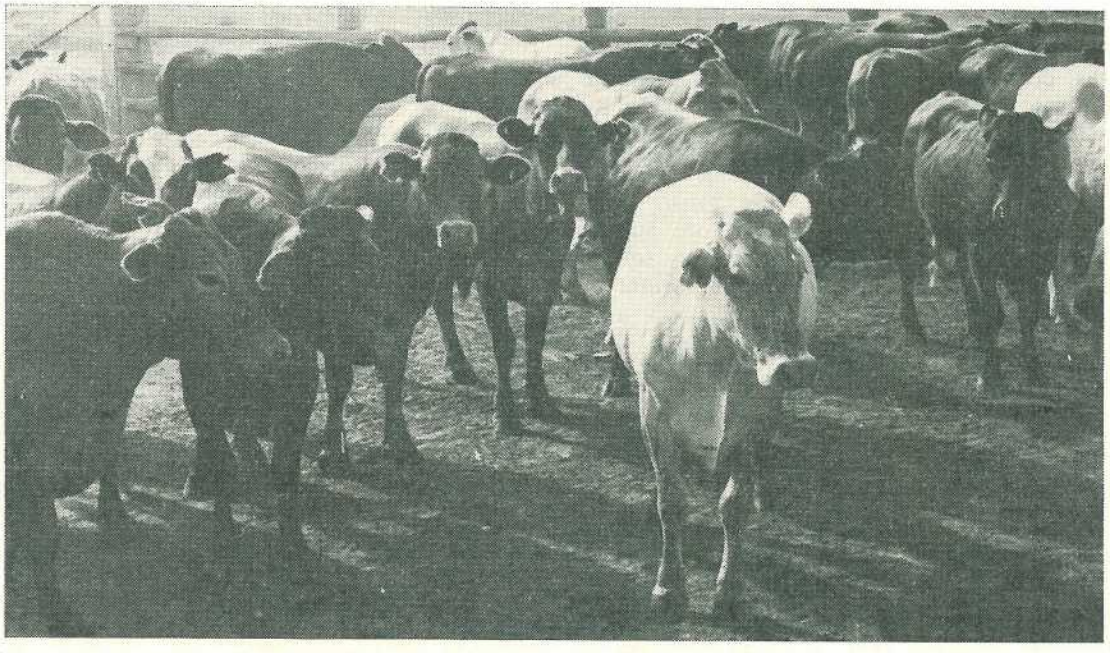
Treatment	0–1 month	1–4 months	Total Gain
1973–74—			
Horned	28·5	56·0	84·5
Tipped	20·7	55·2	75·9
Dehorned ..	16·1	58·7	74·8
1974–75—			
Horned	24·3	78·3	102·6
Tipped	16·3	79·8	96·1
Dehorned ..	6·8	82·2	89·0

These results show that both tipping and dehorning depressed performance in both years. This depression occurred in the first month following the operations and the depression was greater in dehorned than in tipped groups.

The depression in performance is in the order of 8 to 10 kg which represents 4 to 5 kg of carcass.

It is interesting to note that the depression in performance occurred only in the month following the operations and that all groups performed similarly after the first month.

These animals are representative of the horned cattle in Group 1.



The completely dehorned Group 3 bullocks prior to slaughter.

The average weight of bruise trim per carcass is shown in Table 2.

TABLE 2

BRUISING TRIM PER CARCASS (KG)

Treatment	Weight of Tissue Trimmed	
	1973–74	1974–75
Horned	1·11	0·21
Tipped	1·16	0·09
Dehorned	0·68	0·22

Figures obtained in 1973–74 indicate that there is little difference in the amount of bruising between horned and tipped animals and both have approximately twice as much bruising as dehorned animals.

The 1974–75 figures do not follow this pattern but the amount of bruise trim recorded is very low. This very low bruising figure, may in itself be responsible for the emergence of an atypical bruising pattern.

In an observation conducted in 1972 (reported *Queensland Agricultural Journal* May 1973) on a mob of Shorthorn bullocks transported from the Windorah district to Brisbane for slaughter, the average bruising trim was 1·8 kg. The Shorthorn bullocks were of a similar liveweight to the 'Swan's Lagoon' bullocks. This figure is more than 10 times the average amount of bruising recorded in the 'Swan's Lagoon' trial in 1974–75 and almost twice as much as recorded in 1973–74.

When the overall bruising level is very low, factors such as yard and transport design and handling may play an important part in the overall bruising level. The mob of cattle used in 1974–75 was abnormally quiet. They had been on 'Swan's Lagoon' for the previous 2 years and were handled frequently during that time.

Rainfall

Very heavy rain was received soon after the operations were carried out in 1973. Forty millimetres were recorded five days after the operations and 180 mm a further five days later. In contrast, the period following the 1974–75 operations was much drier with no rain being recorded for 23 days after the operations and then only 10 mm.

The very heavy rainfall recorded just after the operations were carried out in the first year was considered a significant factor in the depressed performance. However, in the second year, a majority of wounds healed before any rain was received, but similar depressions occurred.

These liveweight figures therefore suggest that rainfall in the period immediately following the operations is not as important as previously thought.

A summary of rainfall registrations appears in Table 3.

TABLE 3

RAINFALL (MM)

Month	1973–74	1974–75	Mean (39 years)
December	373	116	87
January	804	308	195
February	229	48	222
March	103	126	173
April	27	29	41
May	37	23	26

Discussion

Tipping v. dehorning

There appear to be few advantages in tipping mature Brahman crossbred bullocks.

In this trial, the liveweight performance and bruise trim of tipped and dehorned bullocks were similar.

Many of the side benefits of hornless animals do not apply to tipped animals.

Results from this trial indicate that tipping is of little benefit as a means of reducing the incidence of bruising.

Timing of operations

The time of the year when the operations were carried out may have contributed to the depressed performance of tipped and dehorned groups.

Temperatures and humidity were high and flies were quite active. Perhaps a more favourable result could have been obtained if the operations were carried out around June or July when flies are less active and conditions cooler. However, the lower nutritive value of pastures at this time may negate any benefits from these two factors.

The present departmental recommendation is to avoid the summer and autumn periods when dehorning.

The importance of age

Perhaps the most important single factor affecting performance in the period following dehorning is age. In the 'Swan's Lagoon' trial, animals which had small sinuses opened at dehorning gained 16 kg more in the month following dehorning than those animals which had large sinuses opened.

Young animals have much smaller sinuses than older cattle and therefore should suffer less setback from dehorning.

A detailed study is now in progress at 'Swan's Lagoon' to examine the effect of age on dehorning. Groups of animals in this trial will be dehorned at 6 months, 18 months and 30 months of age and subsequent liveweight performance will be measured. These groups will be dehorned in June of the year in which treatments are due.

Results of this trial will provide additional information on this factor.

To dehorn—Yes or No?

The results recorded indicate that dehorning of mature Brahman crossbred bullocks, under the conditions which prevailed in this study, is uneconomic.

This is because the amount of carcass lost through depressed liveweight performance by tipped or dehorned animals is greater than the amount of bruising trim.

This does not take into account any carcasses which may be downgraded because of severe bruising or the other factors which must be considered before arriving at a decision on dehorning. Safety, supplementary feeding, transport, possible market premiums and bruising are all areas for thought when considering the advantages of dehorning. Remember too such factors as the time of year and the age of the animal at dehorning may have important influences on growth performance.

Ticks—a warning

by M. R. E. DURAND, Beef Cattle Husbandry Branch.

AFTER prices, the cattle tick could become the burning issue among cattlemen in south-east Queensland. Unlike their counterparts in central and northern Queensland, most breeders and buyers have not yet come to terms with the idea of accepting Zebu crossbred cattle.

But because the tick has become such a threat, a meeting that could have far-reaching effects took place at the C.S.I.R.O. Meat Research Laboratories at Cannon Hill in May this year.

There, more than 40 prominent scientists, cattlemen, meatworks' executives, Queensland Department of Primary Industries and N.S.W. Department of Agriculture officers discussed the tick menace and the role of *Bos indicus* cattle in the sub-tropics.

Dr. R. H. Wharton, head of the C.S.I.R.O. cattle tick research team at the Long Pocket Laboratories gave a strong warning to those who would rely on chemicals to control ticks. He drew attention to the fact that Queensland has the worst acaricide resistance problem in the world, that our control methods over the past 30 years had produced resistance in every type of chemical used extensively to control ticks, that none of the acaricides introduced in recent years to control resistant ticks has the all-round efficiency that several organophosphorus chemicals had before resistance and that we face the prospect of having no acaricide to control some types of resistant ticks. A graphic picture of an animal covered in ticks, despite repeated 10-day dipping demonstrated what could happen.

This picture was taken in the Lamington area in May 1970, when Mt. Alford resistance first flared up. It was controlled by Spike. One day, though, there may be no new chemical to step-in when the last one fails. Chemical firms recently suspended the development of two tickicides because of the enormous cost. The short life of any chemical once it does reach the marketing stage and the limited market because resistance does not occur universally, make it difficult for them to recoup an outlay of over $10 million that may be needed for the development of one tickicide.

How long will it be before such a catastrophe strikes is impossible to say. Dr. Wharton did not suggest that tick control would break down this year, next year or even within the next 10 years, but he warned that we must expect crises ahead unless we reduce our reliance on acaricides to control ticks on herds of British breeds of cattle. No one is infallible —but can we afford to just sit tight and hope that Dr. Wharton might be wrong, when all the evidence points the other way?

Resistant ticks

The menace lies in the ability of a few ticks to have a high resistance to any chemical. The speed at which a large population of these

resistant ticks builds up depends at least partly on dipping practices. In parts of Africa, where all cattle are dipped at 10-day or weekly intervals to prevent the fatal and incurable east coast fever, resistant ticks have been slow to emerge. The very high level of tick control has kept the tick population at a very low level. Where cattle are seldom dipped, resistance is likewise slow to emerge, as the selection "pressure" is low. It is an all or nothing, or practically nothing, situation. Extremely efficient tick control or very little chemical control both delay the emergence of resistant tick populations. In Queensland, the usual dipping practice falls in between the two extremes—and is highly conducive to selecting resistant ticks.

The choice seems obvious. Either we embark on a prohibitively expensive and everlasting dipping routine (everlasting because eradication would be virtually impossible) or we cut out as much dipping as possible and rely on other means of control. The only other practical means is the use of tick resistant cattle.

Tick resistant cattle

Most Zebu cattle and most Zebu crosses have a high degree of tick resistance. On the other hand only a few individuals in a *Bos taurus* herd are resistant to ticks. It would be possible to eventually select a herd of British cattle that were highly resistant, but this would take many years, would need more than ordinary facilities for tick counting and would mean virtually dropping every other selection criterion if success were to be achieved in one man's lifetime. By comparison, changing to a crossbred herd might take about nine years to achieve a satisfactory level of tick resistance.

The choice would seem obvious if we could dispel emotion and prejudice in evaluating breeds. However, there are some real obstacles to a change from a British breed herd to a Zebu or "Taurindicus" breed. ("Taurindicus" is the term coined by Professor Francis for breeds such as the Braford, Droughtmaster, Santa Gertrudis etc., that are derived from a cross between *Bos indicus* and *Bos taurus* breeds). The main purpose of the meeting at Cannon Hill was to look at the reasons why fewer than 30% of cattle in the ticky areas of south-east Queensland have any Zebu blood.

For and against

As well as being told of the advantages of crossbreds, the meeting also heard Hereford breeders and Southern butchers say why they didn't favour them.

Mr. David Bell, of Esk, started the ball rolling by describing how he had introduced Brahman bulls into his Hereford herd and then put Santa Gertrudis bulls over the first cross heifers. He was now stabilising with Brafords as this is what the local store buyers wanted. He said that the change had brought increased production by reducing the cost of tick control, reducing the incidence of cancer eye and increasing growth rate. His stores were ready earlier, and this despite carrying more animals on the same feed. He soon learnt that store buyers didn't like brindle animals, so these were fattened and sent for slaughter.

He emphasised that he had no difficulty in selling stores or fats, provided they were good, quiet, and well-finished. He had no difficulty in handling the crossbreds and indeed he found he could get by with less labour than before. He was sure, though, that their different and sometimes difficult temperament was the main reason why others had not gone into crossbred cattle.

Mr. Ian Kennedy, who has a grazing property in the Brisbane Valley and runs the Kilcoy Meatworks, presented the other side of the story. He was successfully controlling ticks by conventional means. His Hereford herd was highly productive and produced just the type of animal he needed for the Brisbane trade. While he didn't deny that crossbreeding might lift production he felt this would take more time and attention than he could afford to give.

As a beef processor, he said the top quality crossbreds were as good as any other animals and quite acceptable. However, yearling crossbreds did not finish easily and were less suitable for the yearling trade. The 2nd grade, unfinished, crossbreds had a high fore to hindquarter ratio, which didn't please the butcher. Dark cutting and yellow fat he associated with crossbred animals with a bad temperament. In a short term feedlot they did not perform as well as Herefords—they grew rather than finished.

Mr. Neil Deignan, a prominent Brisbane butcher, said he had tried crossbreds, but found their meat often appeared to be coarser and darker in appearance and he believed it was tougher. He also found that their fat was more yellow. Nor did he like their behaviour. In strange surroundings with strange men they'd "scatter like wood-duck".

Mr. Ren Ramsay, of the Queensland Department of Primary Industries, pointed out that buyers at Cannon Hill said that crossbreds "would not grade". Animals that looked well finished had too little fat once the hide was off. It is apparent that people with Hereford experience find it difficult to judge crossbreds, and Mr. Deignan himself made the point that liveweight selling and selling on weight and grade would help break down the present buyer resistance.

Mr. Bill Granville, Manager of CQME, Rockhampton and Mr. Graham Dear, who manages Borthwicks Bowen Works, both denied that there was any real or appreciable difference in the carcasses of crossbreds and British breeds. Neither felt that crossbreds produced too many dark cutters or had yellow fat and, of course, few people from Central Queensland now believe their meat is tougher. In bone-out competitions conducted at Rockhampton, the crossbreds had performed as well, over the years, as the British breeds, and there was no unfavourable fore-hind ratio. However, Mr. Granville did say that, in lightly finished steers, the crossbred had a more uneven fat distribution but, on the other hand, they didn't come in with 2·5 to 5 mm of useless fat as did some consignments of British breed cattle. His contention that cattle best suited to the environment produced the best carcasses seemed sensible.

Speaking for the Department, I would make no bones about advocating crossbred cattle in ticky country. In view of Dr. Wharton's warning, we could not do otherwise, but it is a pity when this stance is opposed by some of the breeders of British cattle. The Brahman breeders don't urge commercial cattlemen to grade up their herds to pure Brahman—they recognise that Brahman stud breeders will always have a market for their cattle in a crossbreeding situation. The same applies to the Hereford stud breeder. Crossbreeding will not do him any harm—quite the reverse.

But while advocating introduction of Zebu blood into British breed herds, it would be foolish not to recognise the obstacles. However, the outcome of the debate at Cannon Hill was that, in fact, there is more common ground between the two sides than appears at first sight.

Temperament

The Brahman temperament is different—alert, intelligent and quick if you are a Brahman breeder—nervous, stirry and unreliable if you are a Hereford man! Many cattlemen have successfully learnt to handle them—but many of them would much prefer something a little less "alert". For even with good upbringing, the crossbreds tend to get nervous in strange surroundings.

In Southern Queensland there is definitely some buyer resistance, though good quality crossbreds will compete successfully in the fat market. There is more resistance among store buyers. This resistance will eventually disappear, as it has done in Central Queensland, but until then it remains a deterrent.

Carcass quality

The alleged poorer carcass quality is a bone of contention. Further research may help to resolve the differences of opinion. However, as more crossbred carcasses come onto the market and as their quality improves then they will, I am sure, become accepted. In the meantime, when buyers can pick and choose, one can hardly blame them for sticking to the product they know. The crossbred carcass may be just as good but why should they take a chance? Disappearance of discrimination will occur only when buyers have to start competing for cattle. Payment on a weight and classification basis will also help to reduce price differences.

Production

The higher productivity of crossbred cattle in central coastal Queensland has been demonstrated in numerous comparisons. Are these results applicable on the south-east coast? I believe they are, but there is a need to repeat the comparisons in this area. However, I suspect that most cattlemen would take as much notice of people such as David Bell as they would of Departmental research

results. Those who haven't yet introduced Zebu blood into their herd will want to know if the extra return is worth the trouble and cost of changing, the possible difficulties of handling and the possibility of buyer discrimination. This is a decision each person makes for himself. All we would like to do is give him what information is available and remind him of the risk he runs in sticking to animals that are so susceptible to ticks.

In the ticky areas of Queensland I know of no one who has introduced Zebu blood and then gone back to 100% British breeds, so one must conclude that they have overcome all the alleged difficulties, and found the change worthwhile.

One remaining question is how much Zebu blood is necessary for an "adequate" level of tick resistance? This is the hardest to answer. In general the higher the level of *Bos indicus* in a crossbreed the more likely it is to be highly tick resistant. But how much resistance is adequate? If you want to stop dipping altogether you would probably need much more than 50% Zebu. A herd with less than 50% Zebu would have a fair number of animals carrying a lot of ticks, and some dipping would almost certainly be necessary. But most existing crossbred herds are probably dipped a lot more often than is necessary. This is a hangover from the days when everyone, the Department included, was intent on complete control of ticks. Cattlemen also dislike to see ticks on their animals—even if the numbers are too few to do any harm. But to answer the question, trials are now being carried out in the south-east to measure the effects of no dipping, or greatly reduced dipping on various breeds and crosses.

Hopefully these will help producers make the right decisions.

BEEF STABILIZATION SCHEME

THE Queensland Beef Industry Committee has adopted proposals for a beef stabilization scheme to operate over an initial period of five years.

The Chairman of the Committee (Hon. V. B. Sullivan, M.L.A., Minister for Primary Industries) said the scheme now adopted was based on a study by a Working Group which had extensive discussions with various persons and organizations in other parts of Australia.

In essence, the scheme provided for a minimum price somewhat above the present market price, designed to assist producers towards meeting the cost of producing beef.

"Unless this is done", said Mr. Sullivan, "many efficient producers will be forced off the land with the inevitable result that beef will be both scarce and very dear in the future."

He added that the scheme as envisaged contains proposals for a stabilized price in the future, and this would operate to the eventual advantage of producers, consumers and all other sections of the industry.

Mr. Sullivan said the Committee had already made specific recommendations on a classification system for beef and a restructuring of the Australian Meat Board to give producer control over overseas marketing.

Some earlier recommendations on short-term measures of assistance, such as suspension of the inspection fees for export, a subsidy on the cost of acaracides and rail freight concessions on cattle came into operation last year.

Mr. Sullivan emphasized that the measures adopted were designed to support an important industry over a crisis period. In the long run, all sections of the community would benefit from a stable beef industry in Queensland.

ULV application of insecticides

DURING the 1972–75 locust plagues in Queensland, there was a big increase in the application of ULV insecticides. Large areas were sprayed effectively for control of spur-throated and migratory locusts.

The Department first recommended ULV application for insect control in 1973 when ULV maldison was found to give control of sorghum midge. Until the locust plagues the technique was not widely used in Queensland, but there are many good reasons why ULV application may be used more often in Queensland in the future.

What is ULV?

The letters ULV stand for ultra-low-volume. The term is generally applied to spraying techniques when less than 5 *l* of total volume per ha are applied; as little as 0·2 l/ha are sometimes used. In contrast when high volumes are used for insect control, in aerial spraying, volumes can reach 150 l/ha and in ground application 1 300 l/ha.

How does ULV work?

The success of insecticidal spray treatments to crops depends on the effective distribution of an adequate amount of an effective active ingredient. The main objective is to spread the active material evenly over the relevant plant surfaces so that a lethal dose is available in the target area for pick-up by the target insects. This is achieved by distributing the insecticide in droplets onto the plant surface to provide a coverage which is sufficiently dense that the insect cannot survive. In conventional aerial application the mean droplet diameter is usually 180–250 microns (1 micron = 0·001 mm). In ULV where smaller volumes are used in order to produce the same number of droplets, the droplet size must be reduced. Droplet sizes commonly used in application of ULV insecticides vary between approximately 20–150 microns.

Are special equipment and insecticides needed for ULV application?

Yes, in ULV spraying, equipment with special nozzles is used so that only small droplets are produced. The equipment also has to be capable of producing a droplet pattern with a minimum of scatter in droplet size. Conventional spraying equipment cannot produce the narrow range of small droplets required for effective ULV application.

Only certain insecticides are available for ULV application. Ordinary insecticides are designed to be mixed with water and contain volatile petroleum solvents and emulsifiers. They cannot be used by ULV techniques. Conversely ULV formulations will not mix with water and cannot be applied with conventional spray equipment. Some insecticides that are available as ULV formulations in Queensland at the present time are: maldison, fenitrothion, diazinon, naled and DDT-toxophene.

Why use ULV?

The biological efficiency of a given active material when properly formulated for ULV applications has been shown to be equal to and in several cases better than when applied by conventional methods. This often makes it possible to reduce the amount of active ingredient for the same control operation. All the reasons for this increased effectiveness are not fully understood. Probably one of the main reasons is the ability of ULV techniques to provide better coverage.

The smaller droplets used in ULV application provide for a denser pattern of droplets on foliage than conventional applications. For example, when spraying with 1 l/ha, a droplet size of 267 microns gives 1 drop per cm^2 whereas a droplet of 58 microns gives 100

by B. A. FRANZMANN, Entomologist.

drops per cm^2. Droplets produced from ULV insecticides have a lower volatility than those from conventional insecticides thus less evaporation loss occurs and more droplets are likely to reach the target area. Another reason for the effectiveness of ULV applications is the ability of droplets of the size produced to penetrate foliage and to be collected and retained by plant surfaces.

With ULV spray application there is the potential for operators to apply insecticide more efficiently. Through the increase in area covered per load, the ULV technique enables the operator to treat a specific area at a reduced cost compared with conventional insecticide application methods. The saving of time in ULV spraying is obtained by the decrease in the ferrying and loading times. The gain in actual spraying time is relatively small.

What problems are there with ULV?

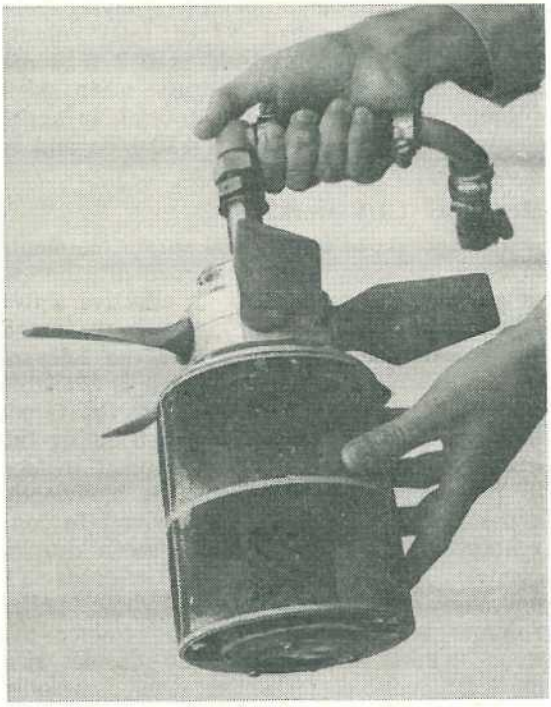
The main disadvantage is the problem of drift. The small droplets produced in ULV applications are very light. The lighter the droplets the longer they remain suspended in the air and consequently the greater the chances of them being carried away from the target by wind current. The aerial application of ULV sprays to small areas of crops, spray should only be applied when wind velocity is low to avoid excessive windrift. Wind velocity exceeding 20 km/h is unsuitable.

General considerations

ULV application of insecticides is being tested and finding acceptance in many countries for the control of insect pests in a wide variety of crops. Although the aerial application of ULV insecticides against certain pests is well developed in Australia, ground applications of ULV by vehicle mounted or hand held applicators has been utilized in only a few insect pest control situations. Much research needs to be carried out before ground application is developed. ULV techniques also find a place in herbicide application in certain situations where drift does not constitute a potential hazard. The application of fungicides by ULV techniques is not developed in Australia.

The technique of ULV application of insecticides is slowly being adopted in Queensland but due to its obvious advantages it should become more common in the future.

Two ULV insecticides on sale in Queensland.



A 'Micronair' ULV applicator. These nozzles are used on aircraft for the efficient application of ULV insecticides. The nozzle is essentially a cylindrical gauze rotating around a spindle from which the chemical is released. The liquid is thrown from the gauze in an atomised condition by centrifugal force. The mechanism is wind driven by the adjustable pitch propellor which can control the r.p.m.—the higher the r.p.m. the finer the droplet.

Evaluation of New Cattle Breeds for the Tropics

by T. H. RUDDER, Beef Cattle Husbandry Branch.

RISING costs of production and fluctuating prices for beef demand that we use "easy-care" breeds of cattle in the tropics. We need cattle that will survive, reproduce, and grow in the existing environment. Returns for beef rarely justify markedly altering the environment by the extensive use of expensive supplementary feeds, or stringent use of medicaments to control herd health.

Short term improvement in the environment for cattle is restricted to astute management practices, e.g., strategic weaning, controlled mating, herd segregation. Long term improvement will be limited to improvement of rain-grown pasture, subdivision, and provision of water points.

It follows that for the foreseeable future we will need cattle that are adapted to the existing environment.

Methods of evaluation

When one considers the number of different breeds of cattle in the world there is an infinite variety of breed combinations that could be contemplated. Since the development of artificial breeding methods many of these combinations are available to Australian cattlemen. However, we do not have the immense resources necessary to gather empirical evidence on the merits of each breed, or breed combination for the environments prevailing in the tropics.

It is possible to make informed judgements on the likely merits of a given breed, or breed combination by considering the characteristics of types of cattle in conjunction with the prevailing environmental factors known to affect performance.

There is a reservoir of information describing the effects of various environmental components on productivity of different types of cattle.

Environmental components

The components of the environment which affect productivity of beef cattle in the tropics are cattle tick and worms in the coastal and semi-coastal areas, disease, heat, and fluctuating nutrition in all areas. The effects of these factors on the various types of cattle are:—

Cattle tick

The cattle tick occurs over large areas of the tropics and sub-tropics. Control by the use of acaricides is costly in terms of chemicals and labour. It has limited efficiency due to the practical problems associated with getting complete musters, and the ability of the tick to develop resistance to acaricides.

British cattle have low levels of resistance to cattle tick, and marked decreases in production can be expected when ticks are not controlled. Limited evidence suggests that the large European breeds have similar tick susceptibility to British cattle.

Africander x British cattle have much higher tick resistance than British cattle, but the level of resistance is lower than that found in Brahman x British cattle.

Within Zebu x British cattle 80–85% of the population is highly tick resistant, thus selection to further improve resistance of a herd is feasible. Owing to the small proportion (about 10%) of highly resistant cattle in British breeds it is not practical to expect marked improvement through selection.

Worms

In the wetter areas of the tropics, it could be expected that worms are present in significantly large numbers. If uncontrolled, worms will depress the productivity of British cattle, but Brahman x British cattle are unaffected under reasonable nutritional conditions. Africander x British cattle tend to be intermediate between British and Brahman x British cattle with respect to the effect of worms.

Although there are marked breed differences in the effect of worms, faecal egg counts are similar for all breeds. This is different to the position with ticks where susceptible breeds carry more ticks than resistant breeds. At present it is not possible to suggest a practical method of selection to improve a herd's tolerance to worms.

Disease

Pink eye is endemic throughout the tropics. This disease affects a large proportion of British cattle and adversely affects productivity of affected animals. The incidence in Brahman x British cattle is low, while Africander x British cattle have moderate susceptibility.

Zebu cattle have resistance to some types of tick fever (*Babesia argentina* and *B. bovis*). However, Zebu and British cattle are susceptible to B. bigemina.

Brahman x British cattle have a better resistance to footrot than British cattle.

Heat

Brahman and Africander crosses can control body temperature under hot climatic conditions. By comparison, British cattle suffer stress at the temperatures commonly experienced in the tropics. This stress has been shown to affect weight gain. Casual field observations suggest that the large European breeds will react to high temperatures the same as British cattle.

Within British breeds, coat type is related to heat tolerance and productivity. Selection of smooth coated animals offers a way to improve heat tolerance in British cattle, but this method is slow and inefficient compared with infusion of Zebu component.

Nutrition

In the absence of ticks, worms, disease, and heat British and European cattle are more productive than Zebu cattle given that nutrition is not limiting. British and European cattle have larger appetites than Zebu cattle which results in a greater capacity to consume amounts of feed well above maintenance requirements.

While a large appetite results in high productivity when nutrition is adequate, it must be remembered that appetite and maintenance requirements are in a constant ratio. Large appetities are associated with larger maintenance requirements. When nutrition is limited the large appetite together with its accompanying large maintenance requirement becomes a liability. Cattle with a large maintenance requirement will start to lose weight earlier in the dry season than those with a smaller maintenance requirement.

When nutrition is poor, weaknesses in a breed become more apparent. Breed differences in the susceptibility to parasites are greatest under conditions of low nutrition with the susceptible British cattle being relatively more affected. Brahman, and Brahman derived breeds have a weakness in reproduction and when nutrition is low are more affected than British cattle. Overseas experience suggests that the large European breeds are not as highly fertile as British cattle.

Choice of breeds

The ideal breed of cattle for the tropics would be one resistant to ticks and disease, tolerant of worms and heat, possessing a large appetite to make best use of feed in the wet season, having a low maintenance requirement to cope with the long dry season, highly fertile,

and quiet to handle with a minimum of labour. Obviously, no one breed of cattle has all these attributes so some compromise is necessary.

All the evidence accumulated from research and practical experience shows that half Zebu is necessary to give cattle a reasonable degree of environmental adaptation. Brahman x British cattle have better environmental adaptation than Africander x British cattle, but have lower reproductive ability and a worse temperament than the Africander cross. Under extremely harsh environmental conditions, one would expect the Brahman cross to be superior, but in the drier western areas where ticks and worms are not a problem, the Africander cross may be preferable.

There is little comparative data showing the merits of other Zebu breeds. Limited information suggests that Sahiwal crosses will be about the same in productive traits as Brahman crosses.

Research results show that half British component is necessary to complement the Zebu component. From the British parent the crossbred gets a larger appetite which influences growth rate, earlier maturity in terms of puberty and deposition of fat or "finish" on the carcase.

The real question concerning cattlemen in the tropics is whether it is preferable to incorporate large European breeds as all or part of the non-Zebu component, or whether it is preferable to select within the existing Zebu x British cattle.

In the absence of empirical data comparing Zebu x British with Zebu x large European cattle we can only guess at the likely results. A logical line of reasoning would suggest:—

- The large European breeds will not enhance environmental adaptation. Resistance to ticks and disease, and tolerance to heat and worms will be about the same as British breeds.
- The large mature size of the European breeds may well prove to be a disadvantage. Large mature size is associated with a large appetite and large maintenance requirement. This large maintenance requirement is likely to be a disadvantage under the generally harsh conditions of the tropics. Animals of large mature size are suitable when nutrition is high, however, when nutrition is limited they will be slow to mature. This delay in maturity affects reproductive processes and body composition. Zebu x large European cattle may be inferior to Zebu x British cattle in terms of reproduction, survival, and marketable age in harsh conditions in the tropics and subtropics.
- Large European breeds have the capacity for high rates of gain. It may be desirable to replace half of the British component with half large European breed, i.e., have an animal which is half Zebu, a quarter British, a quarter large European.

Large European breeds should be evaluated under commercial conditions in the tropics. This evaluation should be on the basis of reproduction, growth, survival, and carcase acceptability. Until these data have been collected, my personal feeling is that the large European breeds should be treated with caution on an experimental basis.

Selection within Zebu x British Herds

Infusion of Zebu component into British herds has resulted in a dramatic improvement in the productivity of northern herds. However, within these herds there is a large variation in growth rate, reproductive ability, and tick resistance. Growth rate, and tick resistance are highly heritable, therefore, further gains can be made by astute selection within existing herds.

Selection of bulls on the basis of weight per day of age at 18–20 months, and on the basis of tick resistance would gradually improve the productivity of beef herds. Where environmentally adapted cattle are being used, it is probable that this approach will be as or more fruitful than further breed changes. It is highly unlikely that any future introduction of new breeds and a change from the existing adapted cattle will result in the dramatic improvement the change from British to Brahman x British gave.

Beef grading system modified

MODIFICATIONS made to the Queensland Department of Primary Industries voluntary, free, blue ribbon beef classification and grading scheme came into operation in Brisbane in October, 1975.

The modifications introduced two concepts new to beef carcase grading in Queensland. Yield (or cutability) is considered when assigning a grade (yield is the amount of the carcase that can be sold as saleable meat). As well fat is measured at the rib eye.

Research has shown a relationship between meat yield and fat cover. A single measurement of fat in one place on the carcase gives a reasonably accurate measure of fat on the whole carcase.

For example, the average butcher will find meat yield to be greater from a 226 kg carcase with 6 mm of fat at the rib eye than from one with 12 mm of fat.

The changes have made the system more objective (measurement) than subjective (opinion, eye appraisal). Measurement of fat eliminates the inconsistency inherent in eye appraisal.

The modified beef grading system was developed after extensive consultations with wholesale and retail butchers. These discussions with industry began after meat wholesalers had requested the Department to grade meat with less fat and less emphasis on conformation (shape).

Industry advanced the argument that excessive fat was no longer acceptable to the consumer and that in relation to conformation, yield of saleable meat should be the principal consideration in determining eligibility for a grade rather than shape.

The Department accepted the fact that flexibility was necessary to keep pace with industry and agreed to bring the grading up to date with modern practice and trade requirements. Flexibility is an essential feature of modern grading systems.

The modifications have met consumer demand without affecting consumer protection inherent in the grading system. Industries' support of the modifications has ensured continued acceptance by the trade.

Classification, grading and the modifications adopted

Since 1959 the Queensland Department of Primary Industries has provided a voluntary, free, blue ribbon beef classification and grading service at abattoirs in Brisbane, Ipswich, Toowoomba and Townsville. Queensland has been and still is the only state in Australia to classify and grade beef and so provide an element of consumer protection for the domestic meat supply.

Before October, 1975, grading had been wholly subjective in nature. Judgement had been based on a visual assessment of age, conformation, quality and finish with carcases divided into three classification classes of yearling, heifer and steer.

At first the Department proposed the modified system of grading would be done on cold quarters. It was intended that the grader would measure the fat at the exposed rib eye muscle in the quartering position. Generally this meant between the 11th and 12th rib since it is trade practice to quarter beef in this position.

Modifications made to the grading system included:

1. Grading done on cold quarters where possible.
2. Specifications of grades changed to define limits of acceptability of fat by measurement with an upper limit of 12 mm.

   Fat limits would be lower than had been accepted under previous grading requirements. The fat measurements and grading categories are set out below:

Grading Category	Range of Fat Measurement	Symbol
Steer and heifer	2 – 5 mm	circle
	6 – 12 mm	diamond
Yearling ..	1 – 3 mm	circle Y
	4 – 12 mm	diamond Y

Detailed specifications of grades are shown in Appendix 1 and classifications in Appendix 2.

3. Words and brands to be replaced with symbols and distinction made between the lightly finished carcases (previously "choice") and moderately finished (previously "prime").
4. Cutability (i.e. yield of saleable meat) to be considered more so than conformation.

The principal change in the system from subjective to objective judgement involves the measurement of fat. This presents no problem where quarters are on a "dead" rail. It was found to be impracticable on conveyor chains due to the speed at which the quarters were handled.

Following this, a successful trial on the slaughter floor at the Metropolitan Public Abattoir, Cannon Hill, confirmed the practicability of measuring fat hot, in the intact side.

Cutting and measuring technique

The method is simple. The grader, a skilled knife man, makes a small incision in the fat which is then measured with a clear plastic ruler.

A horizontal incision, 25 mm to 32 mm in length is made over the eye muscle between the 11th and 12th rib. The grader commences the incision approximately 12 mm from the lateral edge of the eye muscle at the same time gripping the 13th rib firmly with the other hand to steady the moving side.

The left side of each carcase was selected for cutting and measuring.

The length of the cut varies according to fat thickness. The fatter the carcase, the longer the incision. When air bubbles and retained water is encountered in the fat at the site of the incision, the back of the knife is used in a scraping motion to flatten out the fat.

Knife size is a matter of individual preference. The grader in this particular case preferred a small knife with a blade length of 88 mm.

The skill of the knife man is best illustrated by the fact that the fat was incised without cutting the underlying eye muscle.

Measuring was performed by the assistant grader using a clear plastic ruler, 17 mm long, 12 mm wide and 2 mm thick. The assistant grader also affixed tags and recorded measurements.

Clear plastic was essential to enable the lower cut surface of the fat to be measured against the black lines on the ruler. Care was taken to ensure that pressure on the ruler did not distort the fat.

Where the fat had a tendency to sag after incision, the thumb was placed at one end of the cut to hold the fat taut while measuring.

The method requires two graders, one cutting the other measuring.

While it is possible for one grader using a knife fitted with a small ruler to cut and measure in the one operation it is not possible to cut and measure sides of beef on each successive finger of a slaughter chain over a sustained period and maintain a high level of accuracy.

The trial

The trial was conducted on 500 carcases of beef over a period of 14 days and demonstrated that it is possible, by the use of a knife and a clear plastic ruler, to accurately cut and measure fat thickness of hot unquartered beef sides on a moving slaughter chain.

Check measurements of the 500 carcases, after chilling and quartering, showed that 87·2% of the hot measurements were within 1 millimetre (44% being exactly the same) and 98·2% within 2 millimetres of the cold measurement.

Hot fat measurements were taken by inspectors carrying out normal classifications and grading duties. The slaughter chain moved at average slaughter floor dressing speed.

Accuracy of measurement was evaluated by comparing the measurements of hot and cold carcases. For comparison cold fat measurements were checked in the wholesale meat markets on dead rails after the sides had been chilled and quartered.

Both the measurements were taken in the Australian Beef Carcase Appraisal System (A.B.C.A.S.) position approximately 25 mm from the lateral edge of the eye muscle between the 11th and 12th rib.

To eliminate bias in the results, three different inspectors were used for check measuring.

In recording the results of the trial, the cold fat measurement has been accepted as accurate.

This method of measuring hot fat is particularly applicable in any grading or classification situation where broad groupings rather than precise measurements are required.

The accuracy of the method depends on the individual knife skill of the grader for position and depth of cutting and the assistant grader's proficiency in measuring moving sides of beef carcases. The method is compatible with normal slaughter floor operations.

Its simplicity and reliability could make this technique of measurement useful for inclusion in the Australian Meat Board's proposed beef classification scheme. It could have particular application in abattoirs with small throughputs where the cost of expensive measuring equipment might prove prohibitive.

DETAILED SPECIFICATIONS OF GRADES

Lightly Finished
Circle Symbol

1. AGE

This grade shall include only carcasses or quarters thereof of yearlings, steers and heifers not more than 3½ years of age.

Carcasses showing visible evidence of well developed islands of ossification within the cartilaginous extensions on the spines of any of the last five thoracic vertebrae shall be accepted as evidence of age exceeding 3½ years and consequently shall not qualify for this grade.

2. CUTABILITY

Carcasses with a gradeable fat cover as defined under finish will generally be of reasonable cutability, and will need to have only such conformation as is consistent with a reasonable degree of muscling. Thus graded beef carcasses shall be reasonably muscled throughout.

It should be noted that cutability is not related to breed nor compactness.

3. QUALITY

Muscle colour may range from a pale red to a deep blood red or slightly dark red but shall be uniform and bright. Dark red to black muscle colour (dark cutters) shall be excluded.

Carcass fat shall be fairly firm and brittle. Fat colour shall be white to creamy white. Carcasses with yellow fat shall be excluded.

4. FINISH

Rib Eye Measurement

(a) yearling—distinguished by letter "Y" within the symbol. Not less than 1 mm and not greater than 3 mm of fat and adequate to protect muscle colour from blackening during chilling and storage.

(b) steer and heifer—not less than 2 mm and not greater than 5 mm of fat and adequate to protect muscle colour from blackening during chilling and storage.

Moderately Finished
Diamond Symbol

1. AGE

This grade shall include only carcasses or quarters thereof of yearlings, steers and heifers not more than 3½ years of age.

Carcasses showing visible evidence of well developed islands of ossification within the cartilaginous extensions on the spines of any of the last five thoracic vertebrae shall be accepted as evidence of age exceeding 3½ years and consequently shall not qualify for this grade.

2. CUTABILITY

Carcasses with a gradeable fat cover as defined under finish will generally be of reasonable cutability and will need to have only such conformation as is consistent with a reasonable degree of muscling. Thus graded beef carcasses shall be reasonably muscled throughout.

It should be noted that cutability is not related to breed nor compactness.

3. QUALITY

Muscle colour may range from a pale red to a deep blood red or slightly dark red but shall be uniform and bright. Dark red to black muscle colour (dark cutters) shall be excluded.

Carcass fat shall be fairly firm and brittle. Fat colour shall be white to creamy white. Carcasses with yellow fat shall be excluded.

4. FINISH

Rib Eye Measurement

(a) yearling—distinguished by letter "Y" within the symbol. Greater than 3 mm and not greater than 12 mm of fat.

(b) steer and heifer—greater than 5 mm and not greater than 12 mm of fat.

SPECIFICATIONS OF BEEF CLASSIFICATION

(i) Beef means the carcass or portion thereof of a steer, heifer, cow, stag or bull of the bovine species, that has been skinned and dressed in accordance with standard practice, but does not include veal.

(ii) Cow beef is defined as being beef from the carcass of a female bovine two years of age and over and which shows evidence of having had a calf as judged by pelvic and udder characteristics and which does not come within the specifications of heifer beef.

(iii) Heifer beef is defined as beef derived from the carcass of a female bovine whose age does not exceed three and one-half years.

(iv) Yearling beef is the beef derived from steers or heifers under two years of age and within the weight range of 91 kg to 226 kg (hot dressed weight).

(v) Bull beef is beef derived from a mature uncastarated male bovine or from a carcass showing stag characteristics.

Sweet potato growing in Queensland

I. J. L. WOOD,
District Adviser in Agriculture.

SWEET potato yields in Queensland are up to world standards. At present, the industry is expanding to meet the increasing demand created by the release of the attractive, orange-fleshed varieties such as Centennial.

In Queensland, the sweet potato is much under rated as a table vegetable. In the past, sweet potatoes were grown as stock feed as well as for the table. In many cases they were only considered as a substitute for English potatoes when prices of that vegetable were high.

In recent years, the sweet potato has developed into a comparatively high priced luxury vegetable; its price being mainly influenced by its availability.

Primitive people in the Central Americas and numerous tropical islands in the Pacific were using sweet potatoes long before historical records came into existence. Some authorities are of the opinion that it evolved in the tropical South Pacific islands, others believe it evolved in Central America while there is another body of opinion which believes it evolved in China. Wherever it originated, it has spread widely throughout the tropics and sub-tropics and is of major importance in the food supplies and economies of many countries. The sweet potato has been a major item in the diet of our near neighbours in New Zealand and in Papua New Guinea for many centuries. It is known as Kumura in New Zealand and Kau-kau in Papua New Guinea.

The principal regions now growing the sweet potato are Africa, S.E. Asia, Latin America, North America and Oceania.

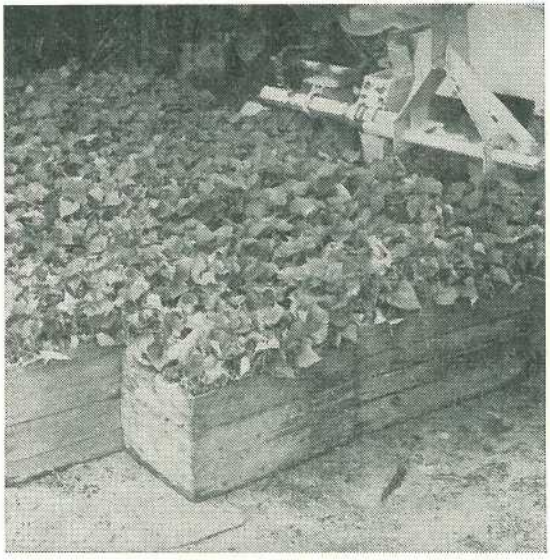
The average annual area grown to sweet potatoes in Queensland over the past 10 years is only 150 ha with an average yield of just under 9 t/ha. The 1972–73 area was 160 ha compared with 250 ha in 1952–53. The main growing areas are the south east Queensland coastal Shires, the Lockyer Valley and the Atherton Tableland.

Sweet potato growing is less mechanized than most other farm crops. This high labour requirement has resulted in reduced areas despite the higher prices being received for the crop. The most urgent need is better harvesting machinery—machinery that will not only avoid skinning and bruising but will reduce significantly the hand labour required to recover the roots.

Uses

The nutritive value of the sweet potato is high and it should not be just considered as another starch food. Whilst still a basic food in many countries, the sweet potato presented in many forms is an extremely popular food in the homes and restaurants of the western world.

It is rich in nutrients, containing as much vitamin C as tomatoes and considerable quantities of B vitamins and mineral salts. The roots of the new orange fleshed varieties are an excellent source of food energy since about 98% of the starches and sugars of the flesh are easily digested. They are also an excellent source of carotene or provitamin A. Australian baby food manufacturers should welcome their availability for inclusion in prepared vegetable baby foods.

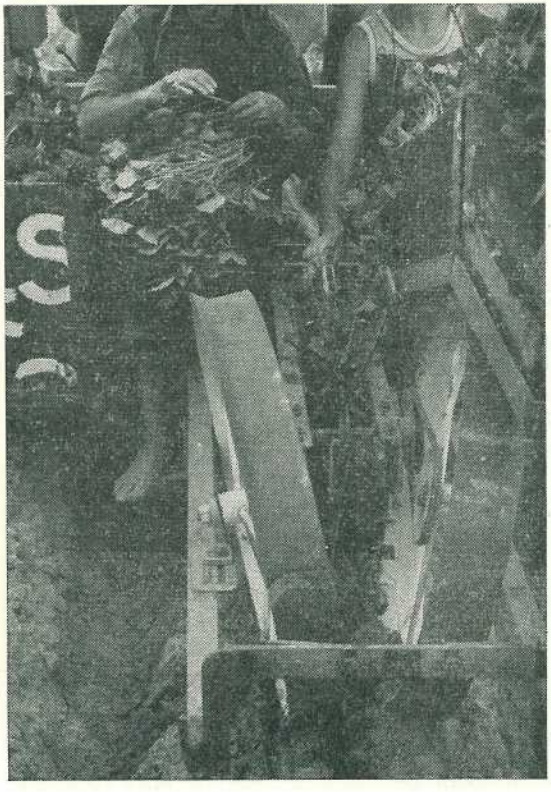


Sweet potato cuttings stored ready for planting. Each box holds approximately 300 cuttings packed vertically. They must be kept in the shade and watered periodically, before planting. They can be held up to four days.

At present, Queensland grown sweet potatoes are used solely as a fresh vegetable with a high percentage of production being marketed in southern capital cities.

In some countries and in particular the U.S.A., an increasingly larger proportion of the sweet potato crop is being prepared commercially in various canned, frozen or dehydrated forms. They have a much wider use there than in Australia being also prepared for pie fillings, candied and in various forms for dessert dishes.

Canning and flake investigational trials have been carried out by the Food Preservation Laboratory of the Queensland Department of Primary Industries, using the orange fleshed varieties. Processing techniques have been perfected to the point that commercial processing can now begin.



Above and right—planting using a transplanter on well-formed hills at Deception Bay. Cuttings are placed in moist soil and well-firmed by press wheel. Plant rate averages 2 500 plants/hour.

Starch can be manufactured from certain white fleshed varieties which yield up to 75 t/ha with a 25% starch content.

In Japan, the sweet potato is a basic stock used in the fermentation industry to produce industrial alcohol and associated by-products.

Botany

The sweet potato (*Ipomoea batatas* (L) Lam) is a member of the *Convolvulaceae* family which includes various weeds common in Queensland such as the morning glories, bindweeds etc. It is treated as an annual in cropping though it has a perennial growth pattern.

It is an herbaceous plant and the most common varieties have trailing long slender stems with fairly widely spaced leaves. Leaf shape, size, colour and pigmentation vary considerably and these characteristics are useful for varietal identification.

The edible sweet potato is a fleshy, tuberous root but not a true tuber and this characteristic causes problems in harvesting as these roots do not readily release themselves from the vine crown.

There is a great range of skin colours varying from pure white through off-white, yellow, orange, pink, red to very dark purple. Similarly, flesh colours vary and range from white through cream, yellow and light and dark orange.

Flowers are more common in the tropics than the subtropics and are similar to morning glory flowers. Growing sweet potatoes in glasshouses promotes flowering in the subtropics and enables breeding programmes to be carried out.

Commercial propagation is by vegetative means using transplants and vine cuttings. The standard practice in Queensland is to use vine cuttings, both terminal and base.

Varieties

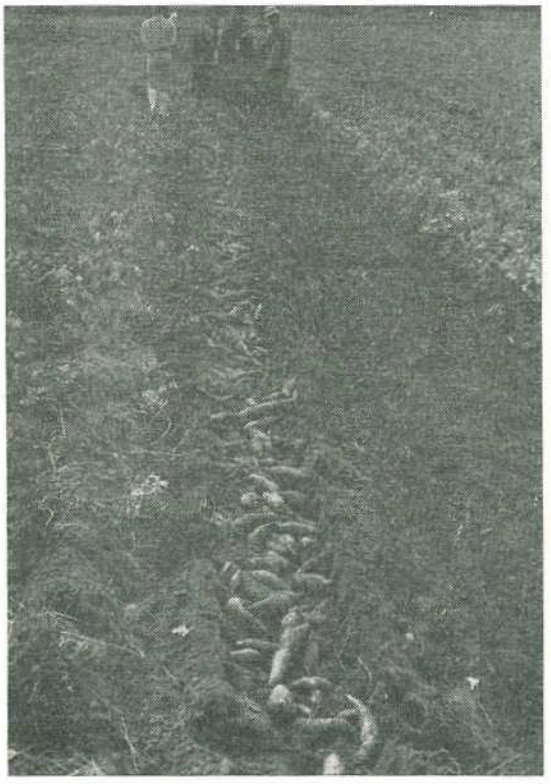
In 1923 Mr. G. B. Brooks, a Departmental Instructor in Agriculture classified 41 types of which only three are currently being grown commercially.

A well built up area at Deception Bay where planting is in progress. Rows are 80 cm apart and plants are spaced 38 cm apart in the row.

Hilling up recently planted sweet potatoes after rain.

Centennial variety. The first commercial area grown in Queensland at Deception Bay. Note the extra large leaves and bunched top growth.

A flail type pulverizer stripping the vines off the rows preparatory to using the mechanical digger. The flails are set to fit the contours of the rows.



Harvesting Centennial sweet potatoes at Deception Bay with a locally adapted digger.

In the U.S.A., over 40 distinct varieties were grown in the early twentieth century and of those, only two or three are now grown commercially. Newly developed varieties now make up the most popular varieties grown commercially in that country. Chance genetic mutations have been the main source of new varieties but lately, varietal improvement has been undertaken in cross-pollination breeding programmes.

Many varieties have lost their identity in Queensland and there is quite a range of variance in the "white" and "red" skinned types grown commercially under the common names of "White Maltese" and "Abundance". Of the two, White Maltese has retained more of the characteristics of the original plant type than has Abundance.

The red skinned variety grown in Northern N.S.W. for the Brisbane Market is possibly H.A.C. Pink, or a strain derived from that variety and it is probable that this variety is also grown in Queensland under the name of Abundance. There is certainly a range of reddish skinned sweet potatoes marketed in Brisbane with colours varying from pink to purple, and shapes from long ridged to globular smooth. White to off-white flesh is common to all, irrespective of skin colour.

Porto Rico is another variety which has survived and is now again being grown commercially on a limited scale mainly in North Queensland. Centennial, Copper Skin Gold Rush and Nemagold have been the most popular varieties grown in the U.S.A. Planting material of these three varieties was introduced into Australia a few years ago together with Baker and an unnamed line. These lines are undergoing evaluation trials in both N.S.W. and Queensland. All these introduced varieties have orange-coloured skin and flesh. Planting material of Centennial, Baker and Nemagold was released to commercial growers in Queensland in 1975.

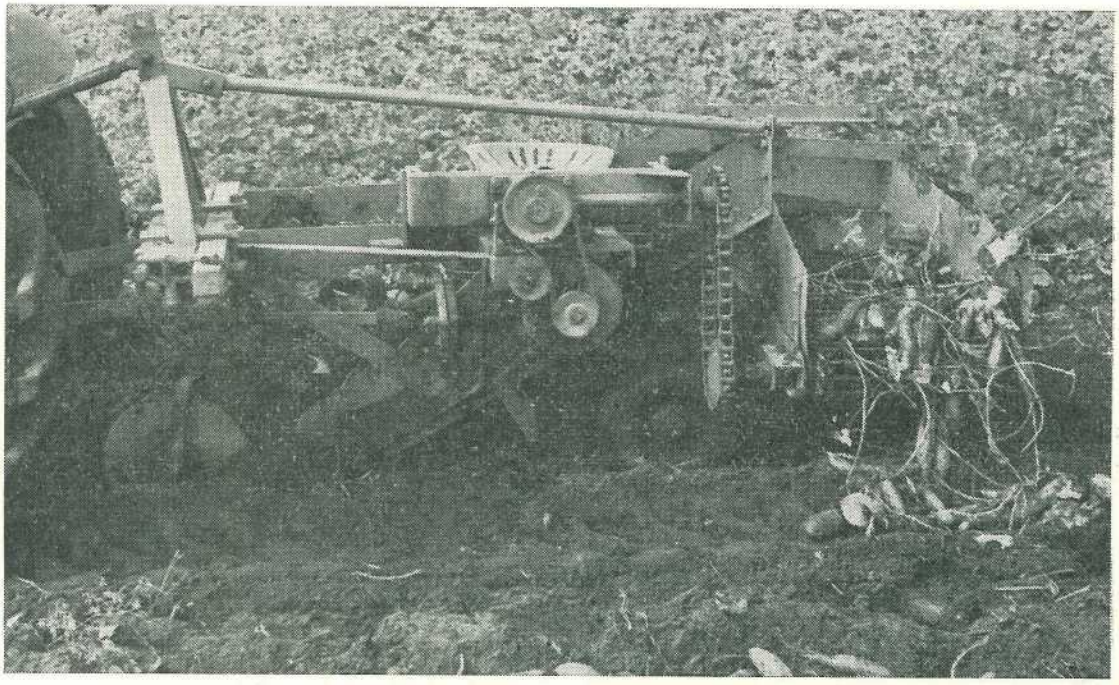
The noticeable characteristics of all of the U.S.A. varieties are:—

- the tight bunching of the roots near the vine crown which should be of great assistance in harvesting;
- their early maturity;
- their attractive smooth skin, shape and colour;
- their greater susceptibility to insect and disease attacks.

Nucleus planting material of these varieties is available from the Department of Primary Industries, Brisbane.

Growth requirements

A minimum frost-free growing season of 4–6 months is needed with consistent warm days and nights and a minimum of cool, cloudy weather. Irrigation is normally necessary for top yields as the plant requirement of moisture is equivalent to 25 mm per week to obtain best development.



Close up of the digger operating. Note the double coulters to cut the vines on either side of the row and the side delivery to allow continued digging without damage by tractor wheels.

Picking up dug Centennial roots and placing P.V.C. containers for transport.

Sweet potatoes will grow on a wide range of soils but to produce quality roots of acceptable shape, skin colour and texture with high yields, the best results are obtained from soils which have not grown a sweet potato crop before. The ideal soil needs to be moderately fertile, friable, well drained sandy loam with firm but porous sandy clay subsoil.

Very light sands give smooth skins and good colour, but to achieve high yields, fertilizer and irrigation requirements are high. Heavy soils tend to produce rough, misshapen roots of poor colour. Rich alluvial soils will very often produce a disappointing crop with luxuriant vines but a light crop of roots.

Ideally, soils pH should be between 5·5 and 6·5, but reasonable yields can be expected from soils with pH between 4·5 and 7·5. Certain sweet potato disease organisms are controlled by growing in acid soils with pH 4·5–5·5 as these organisms are quite active in soils with a higher pH.

Crop rotation

Sweet potatoes should not be planted on the same land more than once in 3 or 4 seasons, to avoid a build up of disease and pests within the soil. Legume crops should follow sweet potatoes rather than precede them in a rotation as high soil nitrogen encourages excessive vine growth, irregular root shape and lower yields. Dense forage sorghum or maize crops are ideal green manure crops to precede sweet potatoes in a rotation particularly in the light coastal soils.

Where root knot nematodes are a problem, cover crops such as oats or maize should be used. Crops such as cowpeas and forage sorghums should be avoided in these situations.

Land preparation

A 16–20 cm depth of well-worked soil is required. This depth will permit easy hilling prior to planting but will not promote excessively long harvest roots.

It is customary in Queensland to plant on formed ridges 1 to 1·25 m apart, the height of the ridges being governed by the soil type. Ridges on light soils settle down to about 20 cm whilst on heavier soil they may be up to 30–40 cm and correspondingly the ridges are further apart. Some plantings are still made on the flat in the Lockyer Valley.

Ridge planting ensures harvest root development within the ridge and makes for much easier and more thorough harvesting with minimum damage. South African experimental work indicates that yields from plants grown on the flat are only two-thirds of those grown on ridges. Planting on the flat is more reliable where irrigation is not available and there is likelihood of moisture stress.

Sweet potatoes require moderate amounts of nitrogen and phosphorus but potassium requirements are higher. A 35 t/ha crop removes approximately 100 kg of nitrogen, 30 kg of phosphorus, 170 kg of potash, 55 kg of calcium and 20 kg of magnesium. Light sandy soils are prone to leaching and levels of the very soluble nitrogen and potassium nutrients have to be carefully maintained. Phosphorus levels can be more easily maintained.

Most coastal soils of Queensland used for sweet potato growing require an inital dressing of a 10–4–16 N.P.K. mixture at rates up to 350 kg/ha, followed, if necessary, by a side dressing at the last cultivation (7–8 weeks) of nitrogen. These rates are for irrigated areas with high plant populations and must be adjusted according to the existing soil nutrient values.

A P.V.C. container of Centennial roots holding about 20 kg. The use of containers similar to these for transport eliminates a lot of the damage suffered by roots when thrown into rows and bulk loaded.

The planting fertilizer should be thoroughly mixed with the soil a few weeks before hilling up the plant. The use of poultry manure is not recommended as it tends to promote top development with very little root production. The nitrogen requirements of White Maltese and Abundance are less than that of the newly released orange fleshed varieties.

Boron is the only trace element which has shown up as a deficiency in local coastal soils. Plant symptoms are:—stunting of terminal growth, short internodes, curling of the leaf petioles and brown flecks in the flesh of the harvested roots. Applications of borax (6 kg/ha) thoroughly mixed with the initial fertilizer will correct this deficiency.

Calcium and magnesium are supplied by applications of dolomitic limestone which is normally applied to control pH levels.

Plant material

The sweet potato is propagated vegetatively using transplants or vine cuttings. Vine cuttings are of two types, terminal (growing point portion) and base (sections of the runners). Terminal cuttings bear more harvest roots than base cuttings and are preferred.

There are problems in having adequate supplies of material available for planting early in the growing season. Adequate supplies are possible only in a frost-free area where planting material could be available in the spring from an area carried over from the previous summer. In these situations, vines are cut back in July to about 15 to 20 cm from the base of the plant. New growth suitable for cuttings is then produced. Additional planting material can be harvested from small areas of early-planted crops after they develop.

Vine cuttings for field planting should only be selected from vigorously growing, healthy plants. They should never be selected in regrowth areas of previously harvested crops. All cuttings should be approximately 25–30 cm long. One unit area of carryover crop will produce enough plants for 6 unit areas of field planting. Cuttings can be stored, tightly-packed vertically in wooden crates in the shade for several days. They should be watered frequently.

An alternative method is to carefully select smaller roots from the previous crop. In August, these can be closely planted 12–15 mm apart in fertilized nursery beds which have a well drained, light sandy soil in a sunny position and can be irrigated. The roots should be covered with 5–7·5 cm of river sand. These roots should be selected from high producing plants, free from diseases and pests. A close check for pests and diseases should be carried out again before pulling for field planting. Using presprouted roots before bedding will mean a greater number (up to 50%) of transplants ready for field planting at an earlier date.

When the sprouts have 6–8 well developed leaves (15–20 cm long) they are ready for pulling and transplanting. These transplants have several roots developed at the base and readily break off from the seed root when pulled. This method is common in the U.S.A. using electrically-heated nursery beds. Recent trends indicate that the transplants are now being cut from the beds just above ground level rather than pulled, as a disease control measure.

In cold areas in late winter/early spring, the use of translucent polyethylene sheets over field nursery beds after watering will raise the soil temperatures and provide early sprouting. This means plants will be available up to a month earlier. The sheets must be removed as soon as sprouts appear which is normally in 16–21 days. More extensive use of unheated field nursery beds is now being made in the U.S.A. using mechanical means to set the roots in the beds, and to lay the polyethylene sheeting.

These practices could easily be adapted to Queensland conditions by large scale commercial growers in order to be able to plant in time for harvesting in the high price early summer period.

Approximately 35 m^2 of bedded sweet potatoes will provide enough transplants for 1 ha. This can be increased by using second and third pullings which are available at approximately 10–20 day intervals. A good sprouting variety will produce up to 1 000 plants per 1·4 m^2 of bedded roots.

Care must be taken in the production and collection of quality planting material. There is not only the selection requirements for yield, quality and variability to be considered but also the control of virus diseases and pests.

Sweet potato varieties

Copper Skin Goldrush

COPPER SKIN GOLDRUSH was released by the Louisiana Research Station, U.S.A. in 1951.

The leaves are medium size and arrow pointed with a heart-shaped base. Its vine growth is bunched, but not as vigorous as Centennial being short to medium in length, with deep, reddish-purple vines and leaf stalks.

The roots are bunched, well-shaped and normally tapering, with attractive copper-orange coloured flesh with a moist texture.

While popular in some States of the U.S.A., yields in Queensland trials were disappointing and planting material has not been released.

This variety matures at 20 weeks and is suitable both for the fresh market and for processing.

Centennial

CENTENNIAL was released by the Louisiana Research Station, U.S.A. in 1960.

The leaf is large, heart-shaped, occasionally lightly-toothed and light green in colour. Very vigorous, short, thick, trailing vines reddish-purple in colour but green at the terminal ends suppress weeds effectively.

Roots are bunched, medium to large, well-shaped with smooth, light-orange skin. The flesh is deep orange and is of moist texture with good flavour and is very suitable for the fresh market and for processing.

It reaches maturity in 17 to 21 weeks and yields heavily but is a moderately shy sprout producer.

Approximately 50% of sweet potatoes grown in the U.S.A. are of this variety and it is recommended for commercial production in Queensland.

Baker

BAKER (V2158) has dark green leaves with a slight purplish tinge.

The leaves are heart-shaped with a slightly elongated arrow point. The vine growth is slow initially but then develops long, trailing vines with leaves spaced well apart.

Roots are bunched, of medium size with orange skin. The flesh is light orange with semi-moist texture.

Maturity is reached in 21 to 23 weeks. This variety yields very well and is suitable for both the fresh market and processing.

Sweetgold

L-892 was named SWEETGOLD by the N.S.W. Department of Agriculture.

This variety was bred at the Louisiana Research Station in the U.S.A. After evaluation trials, it was not released in that country as it did not show any distinct advantages over Centennial to which it is closely related.

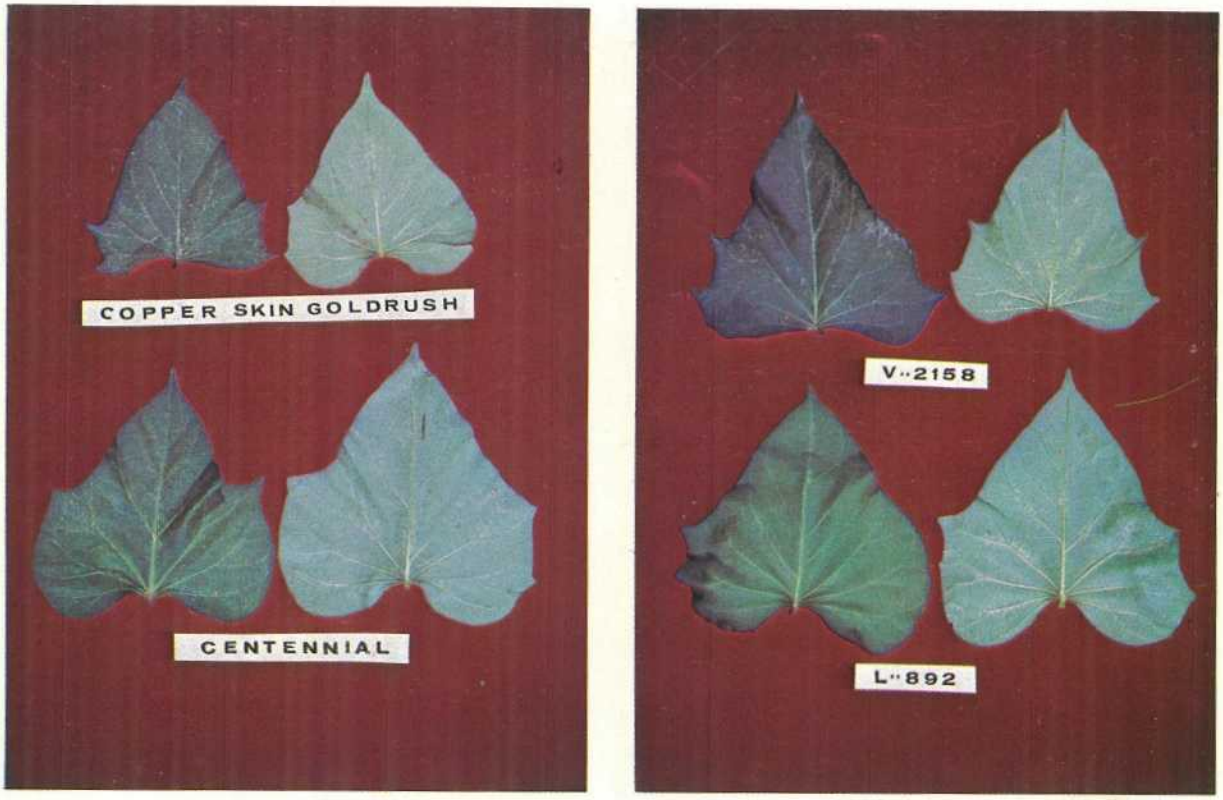
The leaf is large, heart-shaped and light green in colour. The very vigorous, short, thick, trailing vines are all green in colour as distinct from Centennial which has reddish purple vines. The roots are bunched, medium to large, well-shaped with a bronze-orange coloured skin.

The flesh is slightly deeper orange colour than Centennial with a moist texture and good flavour. It is very suitable for fresh market and processing.

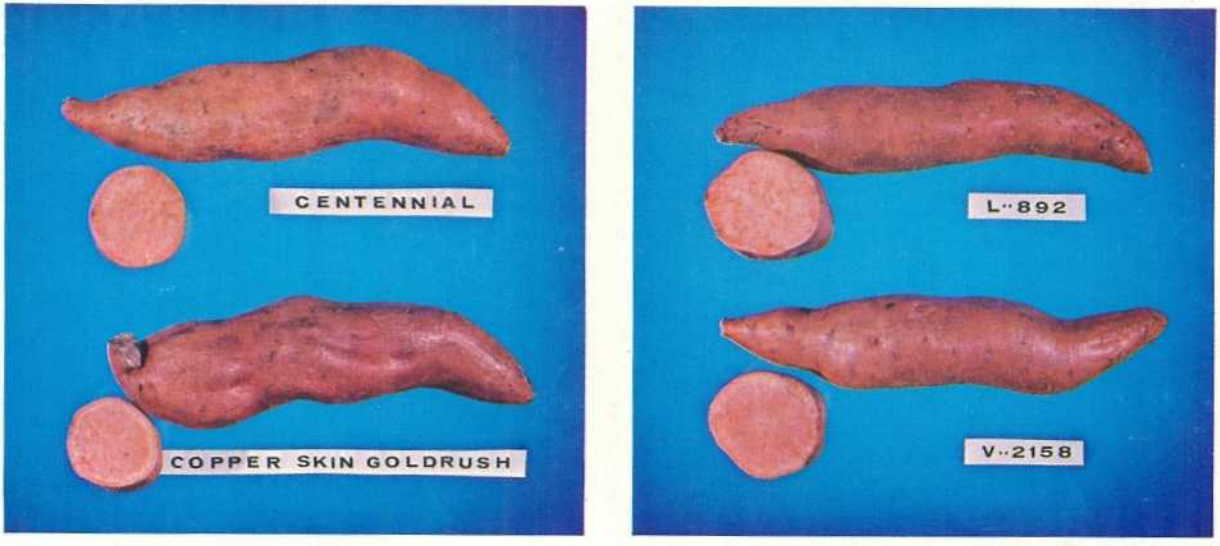
Maturity is reached in 17 to 21 weeks and yields heavily. In trial plots over several years, odd roots were affected by Soft Rot (*Rhizopus stolonifer*) in 15 weeks and up to 20% were affected at the 27 weeks harvest.

While this variety gave top yields in many of the trials, the Queensland release has been withheld as the roots would probably have a poor shelf performance when marketed.

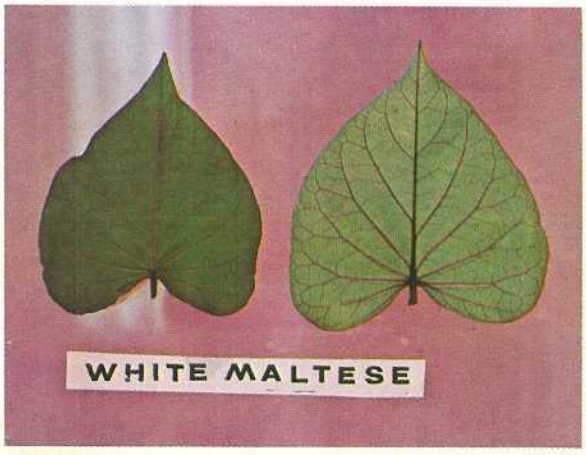
Sweet potato varieties for

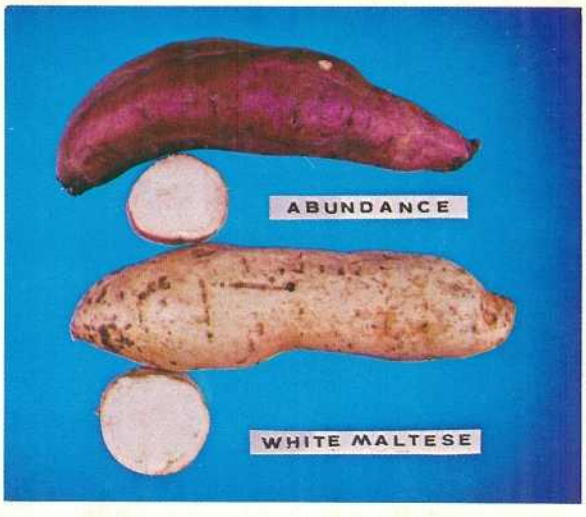


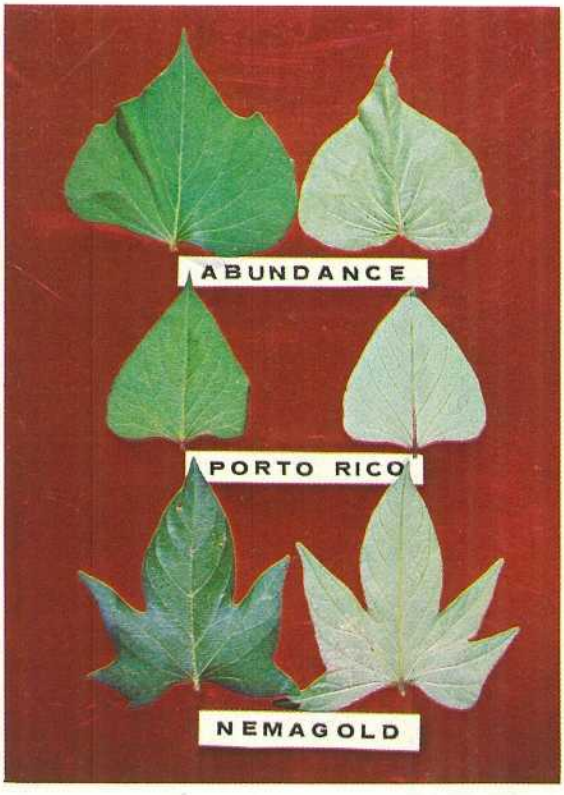
A comparison between the leaves and tubers of four important sweet potato varieties.



Queensland farmers







These sweet potato varieties are gaining greater acceptance of this crop as a table vegetable.

Sweet potato varieties

White Maltese

WHITE MALTESE has small, heart-shaped leaves with purple main veins and green lateral veins.

A purple spot occurs at the base of the leaf. The stems are green and thin and the variety rambles extensively which suppresses weed growth.

The roots have a rough, white skin and may grow to a large size under favourable conditions. The flesh is white, with a soft texture and a sweet flavour.

It is classed as a long-season (at least 24 weeks) variety, yields heavily and is popular on the Sydney and Melbourne markets. It is mainly grown in the red kraznozem-type soils.

Porto Rico

PORTO RICO (Local) has leaves that are variable in shape and size but, for the most part, are heart-shaped with distinct shoulders.

The veins are green with a purple spot on the base of the leaf. The stem is purple and an abundance of leaf and vine is produced.

The roots are medium to large in size, well-shaped, with a bronzy-yellow skin. The flesh is creamy-yellow with a dry texture and a good flavour.

This variety is normally ready for harvest at 21 to 24 weeks. It is unsuitable for light, sandy coastal soils.

Abundance

ABUNDANCE has small, pointed and lightly shouldered leaves with green veins.

The stems are green, thick and hairy and the variety has a strong, rambling habit of growth which suppresses weeds effectively.

The roots are usually long and tapering and are sometimes ridged with red to purple-coloured skin. The flesh is white with grey flecks, floury in texture with a very favourable, mild-sweet flavour.

It is a mid-season (21 to 24 weeks) variety that yields well. It is popular on the Brisbane and Melbourne markets. Abundance is most suitable for light coastal soils.

Nemagold

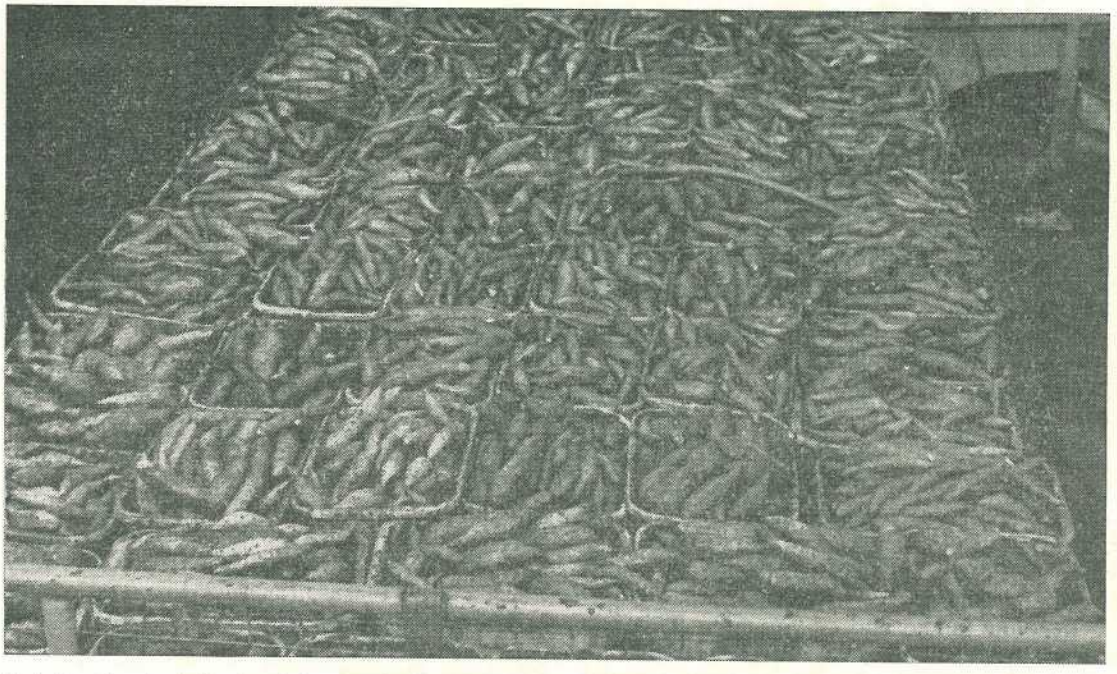
NEMAGOLD was released by the Oklahoma Research Station, U.S.A. in 1958.

The leaves are dark green, small and distinctly lobed. Vines are green, very long, slender and trailing.

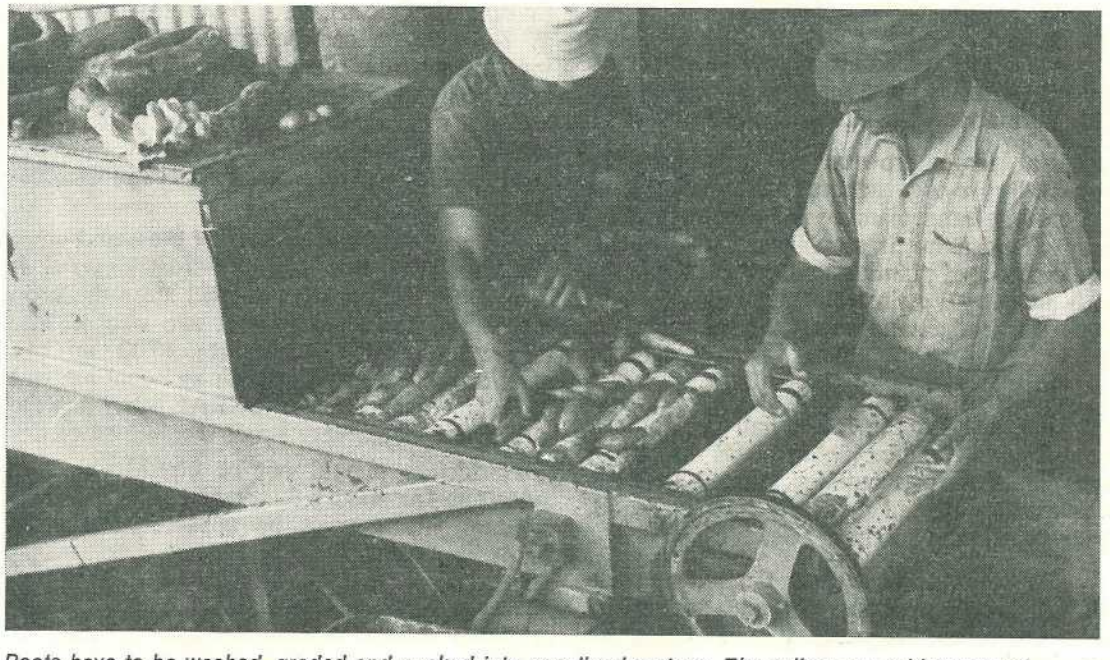
The roots are plentiful, medium to small sized, tapered uniformly and tightly bunched. The skin is smooth, orange-tan in colour and the flesh is pale orange with a semi-moist texture.

This variety yields moderately well and matures at 20 to 24 weeks and is suitable for both the fresh market and processing.

It is a prolific sprout producer and roots should be well-separated in nursery beds. It is resistant to root knot nematodes.



A trailer load of Centennial roots in P.V.C. containers at Deception Bay ready for washing.



Roots have to be washed, graded and packed into wax-lined cartons. The rollers are rubber coated.

Vine cuttings taken at random from a stand-over area as is a common practice will be from high and low-yielding plants. These cuttings will produce plants with variable yields.

During harvest, roots from plants with high yields and other desirable characteristics should be kept aside and stored for planting in nursery seed beds in August to supply sprouts for planting in the spring. There is great scope for improving the yields, particularly of the high yielding varieties. In trials, the N.S.W. Department of Agriculture at Alstonville raised yields up to 20% by using selected planting material as against unselected material.

Planting out

Sweet potatoes mature in four to five months. All planting should be completed so the crop matures before frosts occur. In southern Queensland coastal areas the normal planting deadline is the end of January. This can be extended to the end of February in coastal, central Queensland. In far northern coastal areas plantings can be made practically at any time of the year, although in practice, plantings are synchronized with the "wet" season. In inland areas the end of December would probably be a safe planting deadline. In "frost-free" areas in southern coastal Queensland, a second planting is made in March which carries through the winter and matures in midsummer when normal supplies are unavailable.

Several large growers are now planting successfully using adapted tobacco transplanters but hand planting is still widely practised. Handsetting is a relatively slow, inefficient method of planting and only suitable for small areas. An estimate of 150 man hours is required to collect and plant cuttings over 1 ha by hand.

South African experiments indicate that cuttings planted with the lower half horizontally in the ground produce higher yields and larger sweet potatoes than cuttings planted with the lower portion placed vertically in the ground. Local experience confirms this.

Whichever method is used, the soil must be well compacted around the plant, and if the soil is not moist, irrigation should take place immediately.

Machine transplanters save labour as well as planting more uniformly. Three men with a single row planter can set 2 500 to 3 000 plants per hour, two men setting the plants and one driving.

Plant spacing

A plant spacing of 30–38 cm in the row is recommended although many plantings are still made at 45 cm. Wider spacings tend to produce oversize roots unsuitable for marketing. Row width varies from 1m to 1·25m.

Cultivation and weed control

In well prepared land usually only one cultivation is necessary to control weeds before the vines begin to run and smother weed growth. The tillage equipment must throw the soil well toward each row to maintain the ridges and smother the weeds. Multiple row rotary finger cultivators are ideal for this field operation.

Chemical Control

Herbicides can also be used to control weeds early in the season in order to reduce cultivations. Whilst pre-emergent herbicides are used overseas very little use has been made of them to date in Queensland. DACTHAL W 75* at 7–16 kg/ha can be used safely in bands immediately after plant setting. The area should then be lightly irrigated to set the plants in the soil and to activate the herbicide. (Alternative chemicals are used overseas but as yet are not registered for use on sweet potatoes in Queensland).

For post-emergent control of grass and other weed seedlings PARAQUAT 20·0% w/v† is commonly used in Queensland after the crop has been established at least two weeks. The minimum recommended rate (700 ml/ha) should be used together with an equal amount of wetting agent such as AGRAL 60† when the weeds are in the very small seedling stage.

Herbicides should not be considered as a substitute for good cultural practices and their residual effects must be considered for the following crop.

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* Trade name of Agchem Pty. Ltd.

† Trade name of I.C.I. Australia Ltd.

A carton of Centennial sweet potatoes packed for market with an attractive branded sleeve cover. Each carton weighs approx. 22-23 kg.

Harvesting and assessing varieties in a trial at Redland Bay.

Water requirements

Consistent high yields of quality sweet potatoes can only be expected where there is adequate soil moisture at planting and this is maintained through the growing and developing period of the plant and harvest roots. Yields and quality are seriously affected if the crop is stressed when the harvest roots begin to develop. This is normally 50–60 days after planting.

The main sweet potato growing localities are in fairly humid, coastal areas with at least an annual rainfall of 1 000 mm, the majority of which falls in the growing period. Even so, supplementary irrigation is necessary to maintain soil moisture and is practised by successful growers.

The moisture requirements for the crop are between 450–600 mm of total rain and irrigation. The majority of roots are in the top 60 cm of soil and readily available soil moisture should be kept in that root zone.

Portable overhead sprinkler-type equipment is generally used in Queensland.

Harvesting the crop

Usually 120–150 days' growth are required before harvesting. All roots will not be the same size and growers should inspect their plantings frequently in order to harvest a high portion of the crop when it is the preferred market size.

The sweet potato is extremely sensitive to abrasion, especially at the time of harvest. Careful handling is required to maintain high market quality.

At the time of harvest, the sweet potato plant covers the entire ground area in a mat of interlacing vines which may also be attached to the ground surface by roots from the nodes. It is necessary to cut or detach the vines and then carefully lift the roots from the soil with the minimum of mechanical handling. This is done in varying ways.

Slashers or adapted flail type forage harvesters are used to remove the bulk of the vines. A modified single furrow mouldboard plough with a left offset coulter has been commonly used in Queensland to lift the roots but larger growers are now using adapted English potato diggers with shortened chains moving slightly faster than ground speed with two coulters cutting the remaining vines on either side of the row. In both cases, the roots have yet to be removed by hand from the soil, detached from the vine and placed in some form of field container for transport to the packing shed.

Manufacturers are having difficulty in producing a mechanical harvester that will harvest sweet potatoes satisfactorily with acceptable levels of damage to the roots for the table market trade. In the U.S.A., large scale operators use tractor operated rotary type mowers to remove the vines in a separate operation prior to digging with a combine type harvester on which the roots are hand graded and placed directly into field containers.

Much hand labour has always been required in harvesting sweet potatoes and the reduction of this labour demand is a continuing incentive to improve harvesting equipment.

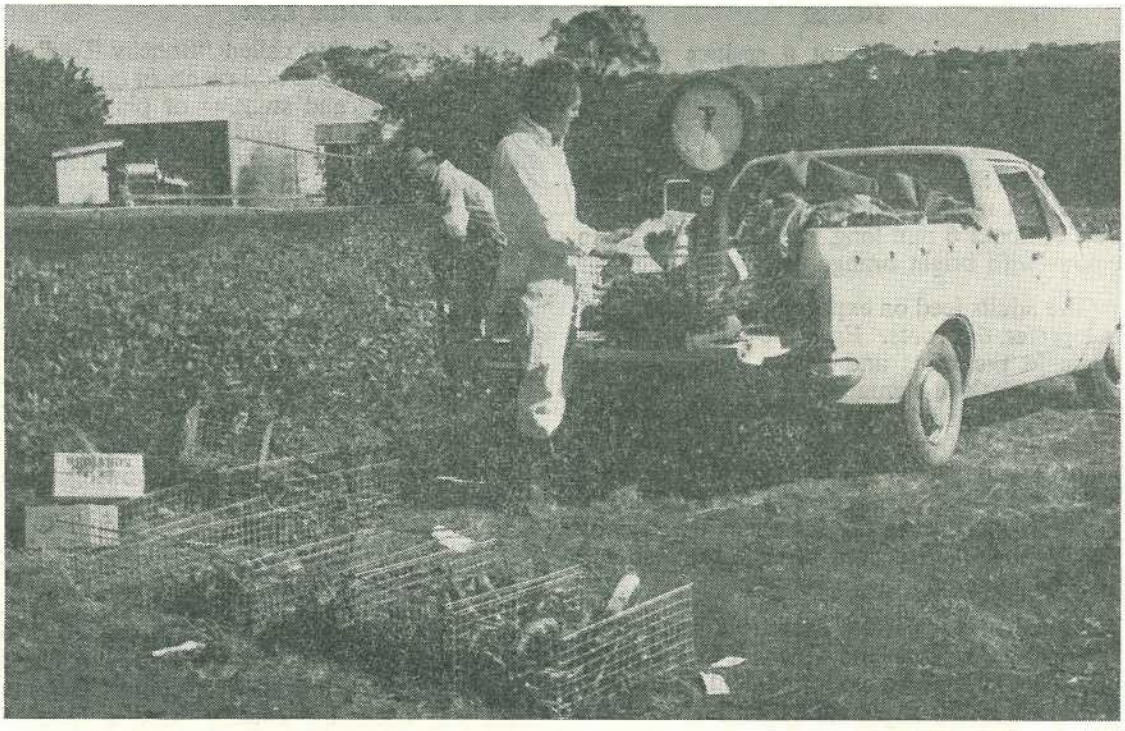
The use of strong P.V.C. field containers holding approximately 20 kg which can be conveniently handled is recommended for the collection of roots in the field rather than throwing into heaps in adjoining rows and then loading loose into trucks or trailers. This method results in unnecessary bruising and skin damage that lowers the market appearance and encourages root rot.

Preparation for market

Roots should be washed and further graded before packing. The most effective method if washing is through specially built washing machines with rubber covered roller conveyors and multiple high pressure fine nozzle jets. The roots should go through a soaking trough immediately before entering the spray chamber to get effective cleaning.

The roots are packed immediately into wax lined cartons holding approximately 22 kg. The most desirable sizes of roots for market range from 4·5–9 cm in diameter and 15–25 cm long. In packing, the top layer is arranged in an orderly manner to present an attractive pack. There is usually an outlet for smaller roots at fruit and vegetable prepack warehouses and probably in the near future at processors.

Specially stamped sweet potato cartons promote sales on the market floor. Prices per carton range from $4–$10.



Harvesting and weighing varietal trial plots at Redland Bay.

A bunch of roots of the Nemagold. Note the tight bunching of the roots near the crown typical of the U.S.A. varieties.

Pests

Pests are normally not a serious problem where good agronomic practices are adhered to.

The sweet potato weevil *Cylas formicarius elegantus* (Summers) can do the most damage to harvest roots. The adult weevils are antlike beetles about 6 mm long, metallic dark blue in colour with bright orange thorax and legs.

The adults feed on exposed parts of the plant but prefer the roots. Eggs are laid in cavities made in the roots and vines. Eggs hatch in about a week in summer and the larvae are an offwhite colour with brown heads. When fully grown in 2–3 weeks they are about 10 mm long. The pupae change into adults in about a week and 6–8 generations may be produced in 1 year. The larvae do the main damage by making tunnels that start beneath the skin and become larger as they proceed.

As the pest is carried over from one season to another in roots and vines, it is vital that infested material be collected and destroyed. Volunteer plants in the area after harvest must also be destroyed.

The sweet potato leaf miner *Bedellia somnulentella* (Zell) can be a problem in newly planted crops. The newly introduced American varieties appear to be much more susceptible than local varieties. Repeated sprayings of insecticides such as Endosulphan in a 0·07% concentration gave effective control in varietal trial areas.

Several species of root knot nematodes affect sweet potatoes, reducing yield and quality.

Control is achieved by—

- the use of nematode-free planting material;
- soil fumigation with EDB 15 or D.D. at 220 litres per hectare and;
- the avoidance of root-knot susceptible crops in rotation.

Diseases

Diseases normally pose no major problem in Queensland provided a strict system of crop rotation is practised.

Sweet Potato Little Leaf

This disease, also called "Bunchy Top" or "Big Bud" appears in odd plants in crops causing a yellowing and stunting of plants and a considerable loss in production. It is introduced by leafhoppers and all affected plants should be destroyed, including the roots.

Russet Crack

Virus infection of plants can result in extensive longitudinal cracking in the skin of harvest roots. These cracks usually extend in transverse bands of uniform width often encircling the roots.

Avoid using planting material showing these symptoms.

Scurf

Scurf is the most important fungal disease in Queensland. Symptoms are a grey or black surface discoloration of the roots. Definite spots may occur but usually the discoloration is uniform over a large area of the root. Although the infection is very superficial, it often results in roots being unmarketable.

The disease may be reduced by crop rotation and propagation by cuttings rather than roots.

Soft Rot

This is normally a storage rot but has been recorded in the field on some of the recent introductions from the U.S.A. The fungus generally gains entrance to the sweet potato through flesh wounds caused by digging, rough handling or bites of insects or rodents. Soft rot also develops in roots injured by cold or wet soils.

It progresses rapidly in the root and with favourable conditions breakdown of the whole root is complete in a few days. A copious growth of white spore bearing fungus strands usually develops quickly on the infected root surface.

Varieties susceptible to soft rot should be harvested early and only grown in well drained locations.

Fire Fighting at "Fairymead", Winton

by D. E. HOLMES, District Adviser, Sheep and Wool and G. J. GRIMSHAW, "Fairymead", Winton.

BUSH fires are the fear of all people in grazing areas of Queensland particularly during the dry spring.

A succession of good seasons, lack of station labour and consequent reduced maintenance of fire plough tracks and equipment have led to big property and stock losses through fire in Queensland in recent years.

Fires can be controlled and losses minimised or avoided by forethought and common sense.

This article describes effective fire fighting equipment and procedure that have been devised at "Fairymead" on the open downs near Winton. Mr. Grimshaw is First Officer and Secretary of the Aspley Fire Brigade.

Preparedness on the property

Maps (preferably 1:250 000 (4 miles to the inch))

A map of the property showing all waters, fences, gates, roads and fire plough tracks was compiled. It was covered with plastic and copies given to all neighbours and members of the local bush fire brigade.

Maps are essential to ensure quick arrival at fires and water points with minimum damage to fences.

When maps for the fire district are assembled they are cross-referenced. This enables a fire to be pin-pointed quickly, after two or three phone calls, with protractor and compass or by reckoning.

Fire breaks

Areas around buildings and yards are heavily grazed, cleared of excess grass or burnt off. This gives adequate protection to expensive capital assets as well as providing safe areas for people trapped by the fire.

These areas are 100–500 m wide depending on the site to be protected and expected winds during the fire season.

The property is divided into at least two portions by a wide burnt area. This is done by controlled burning between two parallel fire plough tracks usually at night in mid winter. By this means a fire is restricted to only one portion of the property and a safe area is provided for people and stock. Creeks with excess rough vegetation are treated this way.

Fire plough tracks while not providing an adequate fire break give quick access to the fire and allow back-burning. They give some protection to fences. Diagonal tracks in a paddock allow back-burning to be kept to a minimum.

Overhead tanks

These tanks at the homestead or sheds are kept full during the fire season. This prevents rapid heating and subsequent collapse of the tank, and ensures a limited supply of water against house fires and for protection during back-burning from buildings.

It is most important to have tanks full for quick filling of truck tanks when needed.

Maintenance of fire fighting plant

Equipment and vehicles are checked well before the fire season to ensure all are working perfectly—at least by June. The electrical, steering and braking systems together with the tyres on all trucks are checked.

Tanks

Tanks are taken off the trucks after every season, and all rust and deposits removed from inside walls. If necessary the inside walls of steel tanks are coated with bitumastic paint. (Coal tar or bitumen are not recommended for inside walls as pieces come adrift and clog up pumps and nozzles.) The outside is cleaned, especially the base. Coal tar or bitumen can be used here.

Pumps, engines, hoses

These are checked for mechanical soundness and repaired as required. Perished hoses are replaced. All fuel systems are checked for rust and dirt.

Leather beaters

These are cleaned and coated with neatsfoot oil, repaired and replaced when required.

Fire lighting bags

These are made from coke bags soaked for two weeks in equal parts of sump oil and diesel (or power kerosine). They are then stored in two four-gallon buckets. A better and more effective appliance now available is the "FIRE LITER" drip torch.

The towing wire is also checked for weakness.

Accessory equipment

All accessory equipment is checked and safely stored on the trucks.

Fire unit

The fire unit at "Fairymead", consists of two trucks each equipped for fire fighting.

Main truck

This is a five ton International four wheel drive. The advantages of this truck are high clearance, assured fast access to fires, plus a reliable slow speed if required. This is a two man unit. Fixed on the truck is the following equipment:—

(a) PLATFORM. This is mounted on the front bumper bar of the truck. It is 30 cm (1 ft.) wide with a hand rail the full width of the platform about waist high. Lugs on the hand rail hold a roll of the delivery hose.

(b) WATER TANK. A 2 730 l (600 gal.) square ship's tank rests on conveyer belting (from Mt. Isa Mine disposals) on the tray of the truck. It is held down at the four corners by chains with adjustable turnbuckles. The belting prevents chafing of the base of the tank.

(c) No. 1 PUMP. A 50 mm (2″) Pacific self priming, centrifugal pump is powered by a 6·7 kW (9 h.p.) Wisconsin engine. Both are bolted to the floor and are directly coupled through a 50 mm (2″) cock and a short length of rubber suction hose. The rubber hose allows for independent movement between the truck, water tank, and the motor. A 38 mm (1½″) delivery hose passes from the pump to the running board, over the mudguard and onto the lug on the front platform. The hose is clamped at intervals on the mudguard and running board.

The nozzle of the delivery hose is a 6 mm (¼″) fixed size with an adjustable spray from a fine mist to a straight jet of water.

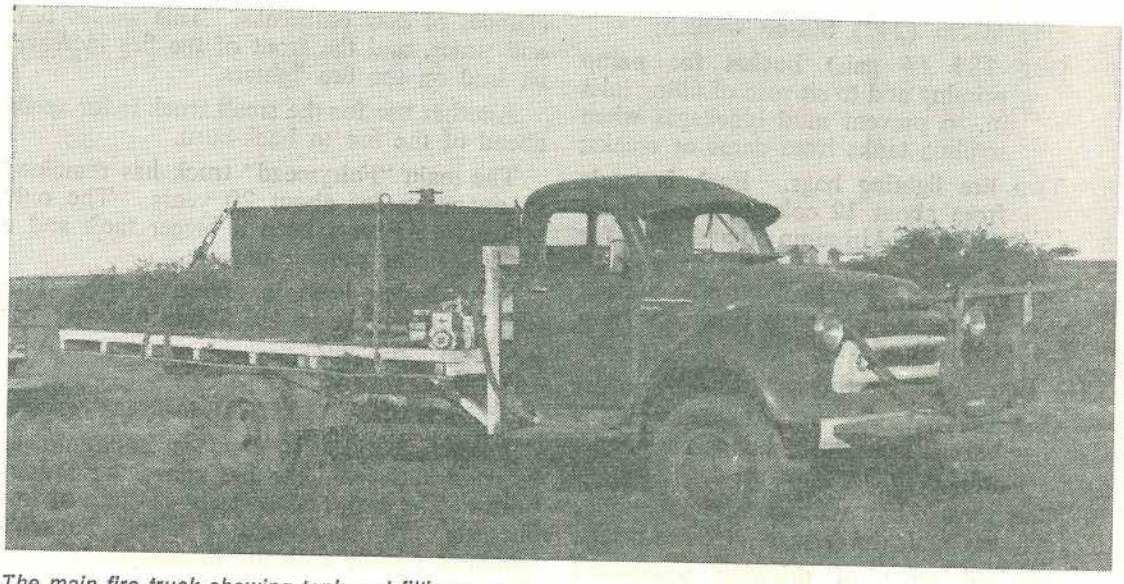
(d) No. 2 PUMP. Mounted on the truck also is a 50 mm (2″) Davey self priming, centrifugal pump powered by a 2·98 kW (4 h.p.) Briggs and Stratton motor.

This pump, solely used for quick filling of the tank, has a 50 mm (2″) suction and a 38 mm (1½″) outlet hose.

Time taken to fill the tank is very important. By using a second pump, the crew can save half an hour on filling time.

(e) OTHER FIRE EQUIPMENT. Extra fire equipment on the truck, apart from the normal spare tyres, tools, etc., includes:

- Three leather beaters 45 cm (18″) wide x 75 cm (30″) long attached to 2 m (6 ft.) handles;
- One axe;
- One shovel;
- One crowbar;
- 4·5 l (1 gal.) of oil for engines;
- 18 l (4 gal.) of fuel in a metal drum for motors or truck;
- One funnel;
- One syphon hose;
- One strong chain with hooks both ends for bogs, obstacles, etc.;



The main fire truck showing tank and filling pump.

The second truck is used for "mopping up" and back-burning.

One 60 cm (24″) Stilson wrench;

One 18 l (4 gal.) bucket for pump priming and to sit rose of filling inlet in, to prevent mud blockages when refilling tanks from dams or creeks;

Two fire lighting bags. Each is made from about 12 coke bags rolled up and soaked in sump oil and diesel for 2 weeks then stored in an 18 l (4 gal.) tin. For back-burning the roll is dragged behind a truck on 10 m (30 ft.) of wire.

(f) Equipment for the crew:

One first-aid box with medication for burns, eye drops, bandages, slings, smoke filters (wet or dry);

One tucker box with sufficient supplies to enable the crew to have two meals;

18 l (4 gal.) of drinking water—9 l (2 gal.) cold and 9 l (2 gal.) spare.

Small truck

This is a Toyota, 1 tonne, four wheel drive Landcruiser equipped with:

(a) Water Tank—a 910 l (200 gal.) fibreglass tank.

(b) Pump—a "Hi-Jet" self-priming, diaphragm pump coupled to the tank through a 38 mm (1½″) rubber pipe. A "Honda" G145 belt drive motor is used to drive the pump. The engine, tank, steel frames and pump are all bolted to the tray of the Landcruiser. A 12 mm (½″) high pressure hose runs forward to a handpiece operated by the driver. The handpiece is a 3-hole type which produces a strong wide spray, ideal for mopping up.

(c) Other Fire Equipment—One shovel, one beater, 18 l (4 gal.) water plus normal spare tyres and tools.

The small truck is normally kept at the homestead for emergencies but can be used to do the "mopping up" if needed where two trucks are used in file. The first kills the bulk of the fire at speed and the small truck extinguishes smouldering remains.

If the file system is not used, the main truck must progress very slowly, extinguishing all chances of new outbreaks. This wastes time and water, and the front of the fire increases its lead on the fire fighters.

Another use for the small truck is for speed ahead of the fire to back-burn.

The main "Fairymead" truck has remained in operation for about 20 years. The only replacements have been a bigger tank and a more efficient water pump.

Since it has been in action, despite eight fires in one night in 1957, this property has not been burnt out.

Clothing for the crew

Protection for the crew is important as radiated heat from the fire can cause serious burns. The temperature from the face of low intensity fire is around 1 000°C but this increases rapidly with fire intensity.

Clothing worn by the crew is:

Long sleeved shirts;

Long trousers—not floppy cuffs;

Heavy work boots;

Singlet—can prevent burns;

Hat.

Close weave materials are chosen, and highly flammable materials or loose fitting garments are avoided.

Types of grass fire

Basically there are three types of grass fire—creeping, rushing and unpredictable, and each must be fought individually, and periodically assessed as progress is made.

1. Creeping Fire. This occurs in mild conditions with no winds and the fire burns steadily in one direction.

It is attacked from each flank if enough equipment is available, and narrowed down to a small head and extinguished.

2. Rushing Fire. This fire is fierce being pushed in one direction by a high wind.

It is attacked from the flanks with main trucks. The small trucks race 1·6–2·4 km (1–1½ miles) ahead of the fire and back-burn from a break or fire plough track. As the two fires are attracted to one another both are extinguished.

All trucks then mop up with care and speed.

3. UNPREDICTABLE FIRE. This fire is very dangerous. The front varies in speed and direction with wind changes. Whirly-winds during a fire would bring it into this category.

The flanks are attacked as in a rushing fire. Extreme care is required here for unit and crew safety. Burning back is done much closer to the front (0·4–0·8 km (¼–½ mile)). This allows for the unpredictable winds and lessens the risk of the fire fighters' being confronted with two fires instead of one. All trucks should operate on the burnt country even though conditions may be uncomfortable because of smoke. Speed of operation is essential as the position and direction of the front vary rapidly. Three main trucks are ideal for this type of fire. The one with the best pump goes first and quells the initial fierce flame. Another kills the bulk of the flame and the third mops up.

On some occasions it may be necessary to bring another truck abreast or slightly ahead of the first to concentrate both sprays on the fire. This is normally done in cases of extreme heat. The operator on the front of the truck wets the fire side of the truck about every three minutes to cool it down.

For all types of fire the small truck is used next morning to check that all cattle manure, logs, posts, etc., are extinguished properly.

On returning home from fighting the tanks are filled and the trucks refuelled to enable a quick getaway in the event of another flare up of the fire.

Conclusion

Essential points in property fire management which can save lives, stock and improvements are:

1. Forethought and early preparation of property, district and equipment.
2. Sensible dress and attention to crew safety.
3. Common sense and a calm attitude.

CHANGING YOUR ADDRESS?

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

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

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

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

D.P.I. releases Corvette, a new barley variety

Corvette, a new barley variety developed at the Hermitage Research Station, was recently released by the Department of Primary Industries.

Mr. V. B. Sullivan, Queensland Minister for Primary Industries said, 'Corvette has been released in conjunction with the Waite Agricultural Research Institute in South Australia. It is an example of the co-operation between the barley breeding programmes in these two States.'

The original cross was made in South Australia by Dr. Keith Finlay, now Deputy Director of CIMMYT, an international plant breeding group centred in Mexico.

Subsequent selections were made in South Australia and Queensland and were tested first in Queensland in 1968.

D.P.I. research workers have conducted more than 60 trials with Corvette and it has given an average yield increase of almost 18% over the current commercial variety, Clipper.

This yield advantage should appeal to growers who produce barley for feeding to either pigs or cattle.

It is not yet clear whether Corvette would be acceptable to the human food markets in Japan and Korea.

'Corvette is the first barley variety released specifically for the stock feed industry, and will not be suitable for malting,' the Minister stated. 'It has a very large seed, with a distinctive blue colouration which makes it easily distinguishable from the registered malting quality varieties.

'Corvette has some resistance to the races of powdery mildew prevalent in Queensland and is also much less susceptible to lodging than Clipper.'

Mr. Sullivan added that the Queensland Barley Marketing Board should have adequate supplies of seed for the 1977 planting season.

Advances restricted

The Minister for Primary Industries, Mr. V. B. Sullivan, announced that loan advances from the Agricultural Bank would be restricted to existing clients for the present time.

This was due to the shortage of available loan funds and a heavy commitment in undrawn approvals.

The Bank could not accept applications other than from existing clients, except in cases where the property already was mortgaged to the Bank and the advance sought would not involve a substantial increase in the debt to the Bank.

'Should the position improve following the mid-year review of the State's loan programme, the restrictions will be relaxed as early as possible,' Mr. Sullivan said.

Grower member

Mr. W. D. Nelson, of Yandina, has been appointed one of the two growers' representatives on the Banana Industry Protection Board.

He replaced Mr. R. R. May, of Wamuran, who had been a Board member for many years and who did not seek re-nomination.

Mr. Sullivan, Queensland Minister for Primary Industries, paid a special tribute to Mr. May for his long and valuable service to the industry as a whole and to the Board in particular.

Mr. L. J. Missingham, of Mena Creek, North Queensland, has been re-appointed for a further three-year term as the other grower representative.

Both men were nominated by the Committee of Direction of Fruit Marketing from the Banana Sectional Group Committee.

Soybeans in Queensland

An auto–header harvesting a mature soybean crop in the Kingaroy district.

SOYBEAN (*Glycine max* (L.) Merrill) is one of the oldest cultivated crops. It originated in China over 4 800 years ago but is now grown throughout the world. Today, the main producing countries are the U.S.A., China and Brazil.

Soybeans have been grown commercially in Queensland for several decades, but until 1970 the area planted to the crop had not exceeded 2 000 ha. Details of area, production and yield in Queensland since 1963 are given in Table 1.

The main areas of production in Queensland are the Darling Downs, the West Moreton and the South Burnett regions. Successful crops have been grown in the Dawson–Callide, Emerald, Mareeba–Dimbulah, Lower Burdekin and the Lakeland Downs–Cooktown areas. In all of these districts further suitable land is available for expansion which will occur when market prices are suitable.

Uses of soybean

The principal soybean products are oil for edible and industrial purposes and protein meal. This protein meal contains more of the essential amino acids, which are necessary for good animal growth, than many other vegetable proteins. The meal is, therefore, in demand as a stock food.

Australian production, imports, exports and consumption of soybeans in selected years are given in Table 2. This shows how Australian production has increased from 1966 to 1975 in an attempt to meet local demand.

by A. J. P. WILLIAMSON, Agriculture Branch.

TABLE 1

AREA, PRODUCTION AND YIELD OF SOYBEANS IN QUEENSLAND

Year of Harvest	Area	Production	Yield
	ha	tonnes	kg/ha
1963	1 674	749	447
1964	1 838	1 114	606
1965	1 915	674	352
1966	1 090	752	690
1967	959	862	899
1968	1 382	1 098	795
1969	1 876	1 620	864
1970	2 979	3 775	1 267
1971	4 764	6 417	1 347
1972	14 303	22 008	1 539
1973	22 374	30 262	1 353
1974	32 181	48 929	1 520
1975	33 013	52 542	1 592

TABLE 2

AUSTRALIAN PRODUCTION, IMPORTS, EXPORTS AND NETT CONSUMPTION OF SOYBEANS (TONNES)

Year	Production	Imports	Exports	Net consumption	Production as percentage of consumption
1966	752	55 968	1 000	55 720	1·35
1970	3 775	64 324	1 000	67 099	5·63
1974	62 541	79 188	2 880	138 849	45·04
1975	65 181	38 901	31 845	72 237	90·23

Not all States produce their requirements of soybeans. In 1975, States in this category found it cheaper to import their needs than to pay freight on interstate products. Queensland found it more profitable to export its surplus crop than to move it interstate.

The soybean plant

There are two main types of cultivated soybean. One is an upright branching type such as is normally grown for grain. The other has a more viny, leafy habit, and is the type normally used for forage. Most varieties grown in Queensland are of the upright branching type.

The plant is a summer growing, annual legume. There are many varieties and they vary considerably in maturity, plant type and colour and size of seed. The tri-foliate leaves, stems and pods are densely covered with grey or tawny hairs (pubescence). Depending upon variety small purple or white flowers are borne in the axils of the leaves.

The seed pods usually contain two or three seeds which vary in colour, according to variety, from pale cream and yellow through various shades of green and brown to black. Seed of some varieties will include blends or mottling of these colours. The colour of seed preferred by the oil extracting industry is a pale cream with a hilum (point of attachment of the seed to the pod) colour as light as possible.

Oil and protein content of the seed vary according to variety and growing conditions. The oil content may vary from 14 to 22% and protein content from 30 to 48%. Low oil content is usually associated with high protein content and vice versa.

Varieties

The climatic limitations of soybeans are generally similar to those of maize. Soybeans are, however, very sensitive to day length. Each variety will make normal growth only when the period of daylight to which it is exposed during the growing season lies between certain limits. These limits vary with the variety. This means most varieties are suited only to a short range of latitude.

Since soybeans have been grown in Queensland, farmers have relied heavily on varieties introduced from overseas. The majority of these introduced varieties came from the U.S.A., including the well-known varieties Bragg, Davis, Hampton and Hill.

Varieties have been bred in Queensland. In the early 1960s Delroy and Mamroy were bred and released by the Department of Primary Industries. These two varieties had virtually disappeared from cultivation by 1970 as they were replaced by more productive varieties. The 1960s also saw the release of Burke, Leslie and Wills by Mr. J. Bligh of Brookstead; of Semstar and Telstar by Mr. E. Semgreen of Wooroolin; of Bellaire by Mr. H. Tod of Jondaryan; and of Melrose by Mr. J. Eggleston of Brookstead. In 1976 Semstar and Wills are still varieties of major importance in the Queensland soybean industry.

At present, two major soybean breeding programmes are being conducted in Queensland by the Department of Primary Industries and the University of Queensland. In the early 1970s, the University released the varieties Daintree, Gilbert and Ross. These met an urgent need for varieties suited to the tropical areas of Queensland. In 1976 the Department of Primary Industries released Collee and Flegler which are adapted to the southern half of the State. Further releases from these programmes can be expected in the future.

Varieties selected for grain production possess several important agronomic characteristics in addition to the trade requirements of protein and oil content. As well as high yielding ability, a variety must nodulate freely, have resistance to seed shattering and possess a habit suited to direct harvesting. An erect habit at maturity is desirable and the major problem of direct harvesting is overcome if the seed pods have a minimum clearance of 10 cm from the ground.

Varieties recommended for commercial production in the various districts will be given in subsequent articles dealing with the different districts.

Description of varieties

In the varietal descriptions which follow, reference is made to U.S. maturity groups. These are based on the system of rating in the U.S.A. where a variety is placed in one of eleven groups from 00 for the earliest maturing to IX for the latest maturing varieties.

Hill (U.S. maturity group V) is the earliest maturing variety recommended for Queensland. It is determinate* and has white flowers, tawny pubescence and straw yellow seeds with brown hila. It is resistant to the leaf diseases bacterial pustule and wildfire. It is fairly susceptible to shattering in early plantings but more resistant in later plantings.

Collee (group V) is similar in maturity to Hill. It is determinate and has purple flowers, tawny pubescence and yellow seeds with black hila. It is resistant to the leaf diseases and is much more resistant to shattering than Hill.

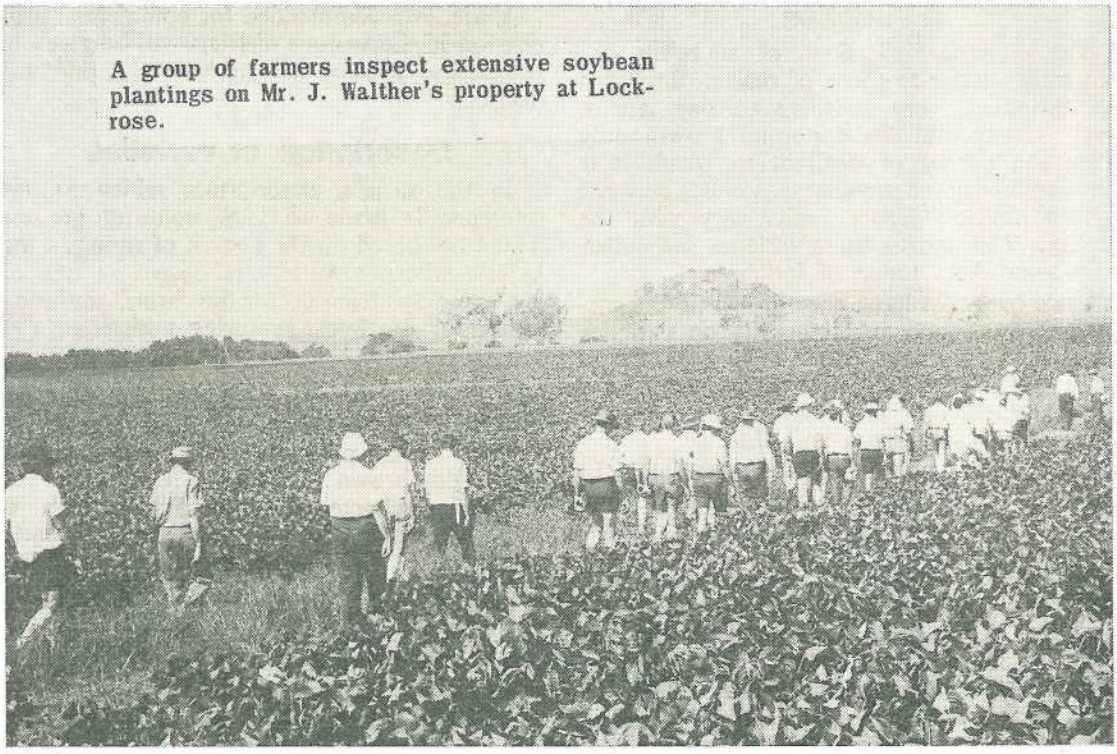
Bragg (group VII) is much later in maturity than Hill (about 10 days). It is determinate and has white flowers, tawny pubescence and yellow seeds with black hila. It is resistant to the leaf diseases and to shattering.

Davis (group VII) is slightly later in maturity than Bragg. It is determinate and has white flowers, grey pubescence and cream seeds with brown hila. It is resistant to the leaf diseases. It resists shattering only for about 14 days after maturity.

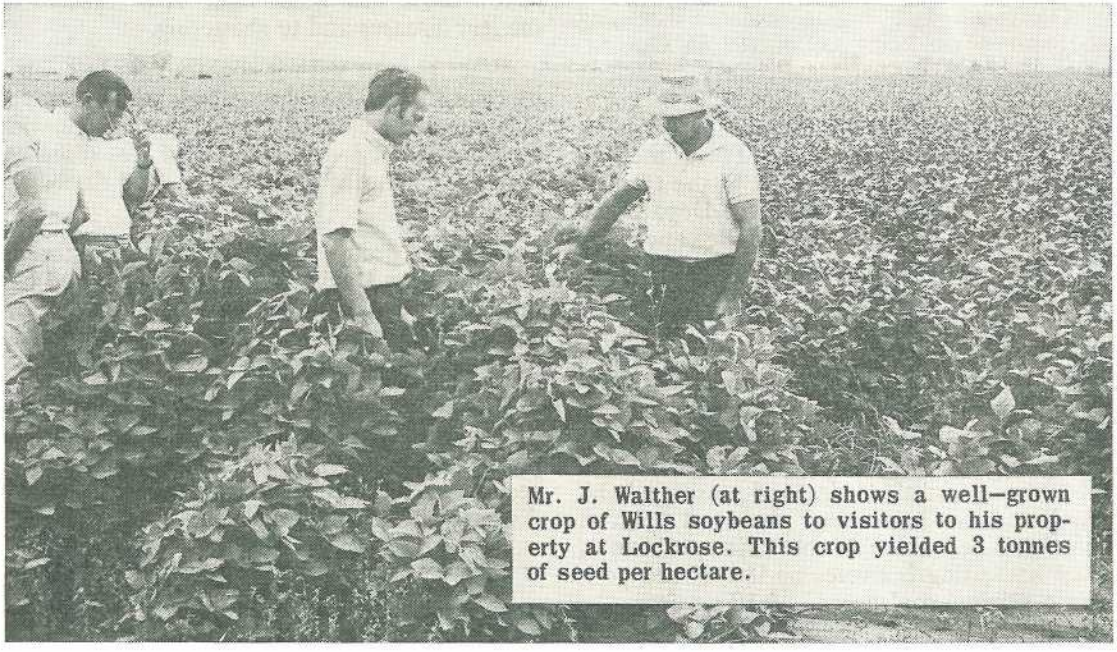
Flegler (group VII) is slightly later in maturity than Davis. It is determinate and has purple flowers, tawny pubescence and yellow seeds with black hila. It is resistant to the leaf diseases and to shattering.

Wills (group VIII) is slightly later in maturity than Flegler. It is determinate and has purple flowers, tawny pubescence and yellow seeds with black hila. It is resistant to the leaf diseases and to shattering.

** A determinate variety is one in which the terminal bud produces a flower, upon which further growth of the main stem is prevented.*



A group of farmers inspect extensive soybean plantings on Mr. J. Walther's property at Lockrose.



Mr. J. Walther (at right) shows a well-grown crop of Wills soybeans to visitors to his property at Lockrose. This crop yielded 3 tonnes of seed per hectare.

Hampton (group VIII) is slightly later in maturity than Wills. It is determinate and has purple flowers, grey pubescence and cream seeds with brown hila. It is resistant to the leaf diseases and to shattering.

Semstar (group VIII) is similar in maturity to Hampton. It is indeterminate† and has white flowers‡, grey pubescence and cream seeds with brown hila. It is susceptible to the leaf diseases but resistant to shattering.

Daintree (group IX) is very late maturing. It is determinate and has purple flowers, tawny pubescence and yellow seeds with brown hila. It is normally resistant to the leaf diseases but under some field conditions can be susceptible to bacterial pustule. It is resistant to shattering.

Gilbert (group IX) is very late maturing. It is determinate and has purple flowers, grey pubescence and yellow seeds with brown hila. It is resistant to the leaf diseases but under some field conditions can be susceptible to bacterial pustule. It is resistant to shattering.

Ross (group IX) is very late maturing. It is determinate and has purple flowers, tawny pubescence and yellow seeds with black hila. It is resistant to the leaf diseases and to shattering.

Rotation

The value of a planned system of crop rotation is recognized by most farmers. Soybean is a desirable rotation crop. Its nitrogen requirement is met by the fixation of atmospheric nitrogen by bacteria in the root nodules. The crop residue, after grain harvesting, when returned to the soil benefits the soil structure. Soil on which soybeans have been grown is generally left loose and friable and is in better condition than after most other crops.

Soybeans appear to do well following maize, sorghum and other cereals. It is not usual to grow soybeans in close rotation with peanuts and navy beans as it loses much of its advantage when grown after these legume crops. If cereals are to follow soybeans the soil requires little preparation.

The full value of soybeans in the rotation is realized only by the return of the plant residue to the soil. When the crop is used for hay or removed for fodder, the benefit is less than when only the grain is removed.

Soils, fertilizer and nodulation

Fertile loams produce the best yields of soybeans but satisfactory yields can be obtained from friable clay loams to sandy loams. Heavy clay soils and soils of low fertility give poorer results.

Though soybeans are more acid-tolerant than many other legumes, both very acid and very alkaline soils are unsuitable. Liming of acid soils will improve production.

Soybeans have shown more tolerance to wet conditions than navy beans, maize or peanuts. The stage of crop growth at the time of experiencing wet conditions is, however, very important and generally best results will be obtained on well-drained soils.

Phosphate deficient soils will require an application of superphosphate. Yield responses to phosphorus, however, are likely to occur only if a soil test shows less than 30 kg per ha available phosphorus.

Comparatively large amounts of potassium are required by soybeans and yield responses to potassium may occur if the available soil potassium is less than 80 kg per ha.

It may be advisable to use trial strips to determine the response of particular areas to phosphorus and potassium fertilizers.

Nitrogen uptake in the soybean crop is very complex. A 2 500 kg crop (common in the West Moreton region) contains about 156 kg of nitrogen. Experimental work has shown that much higher levels of nitrogen can be provided by nodulation alone. Under certain conditions, small applications of nitrogen fertilizer can give small increases in yield but applications of fertilizer nitrogen should not

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†An indeterminate variety is one in which the terminal bud does not produce a flower but the flowers are produced laterally and successively as the stem elongates.

‡There is a strain of Semstar which has purple flowers. Seed from crops containing this strain may still be available.

This is the stage of growth at which to start cultivation. The plants are carrying 1 or 2 trifoliate leaves.

exceed 35 kg per ha. Large amounts of fertilizer nitrogen suppress nodulation and can lead to reductions in grain yield.

When soybeans are being grown for the first time in a particular field, it is essential to treat the seed, before planting, with a culture of the specific nitrogen-fixing bacteria. These form the nodules on the roots of the plants. In some soils it may be advisable or even necessary to inoculate subsequent crops of soybeans. Time and effort spent in carefully inoculating the seed before planting will be more than compensated for by better nodulation leading to improved growth and high yields.

Fertilizers affect the germinating capacity of the seed so should not at any time be placed in contact with it.

The cultivator tynes should be carefully adjusted so that the young plants are not buried by soil.

Land preparation and tillage

Successful production of soybeans will depend on careful preparation of the land before planting. Cultivation should be designed to produce a medium-fine compact seedbed free from weeds, sticks and rocks. The presence of adequate sub soil moisture is essential. If there is not sufficient stored water before planting, the crop will have to depend on rainfall during its growing period. If this is insufficient, the yield will be reduced unless the crop is irrigated.

It is important to control weeds immediately before and immediately after the soybean seedlings have emerged. Thereafter, cultivations to control weeds are necessary until the plants are large enough to shade the soil sufficiently to keep weed growth down. Two inter-row cultivations may be necessary for this.

Weeds can be controlled by chemical herbicides. Such herbicides are, however, rather expensive and this may limit their use to irrigated crops or to raingrown crops in areas with a plentiful and assured rainfall.

Hormone-type herbicides should not be used on soybeans, except 2,4–DB under exceptional circumstances.

Trifluralin and chlorthal will control annual grasses and some susceptible broadleaf weeds. Trifluralin is applied pre-planting and must be incorporated immediately after application to a depth of about 5 cm. Chlorthal can be applied after planting but before emergence of the crop.

Where the weed problem occurs post-emergence of the crop, bentazon can be very useful particularly where *Datura* spp. or *Ipomoea* spp. are troublesome.

Time of planting

Length of day has a marked influence on the development and yield of soybeans. Other factors to be considered include the normal period of suitable planting rains and the maturity period of the selected soybean variety.

Each variety and district has a most favourable planting date. Any delay in planting beyond this date will retard maturity and will also normally result in reduced yield.

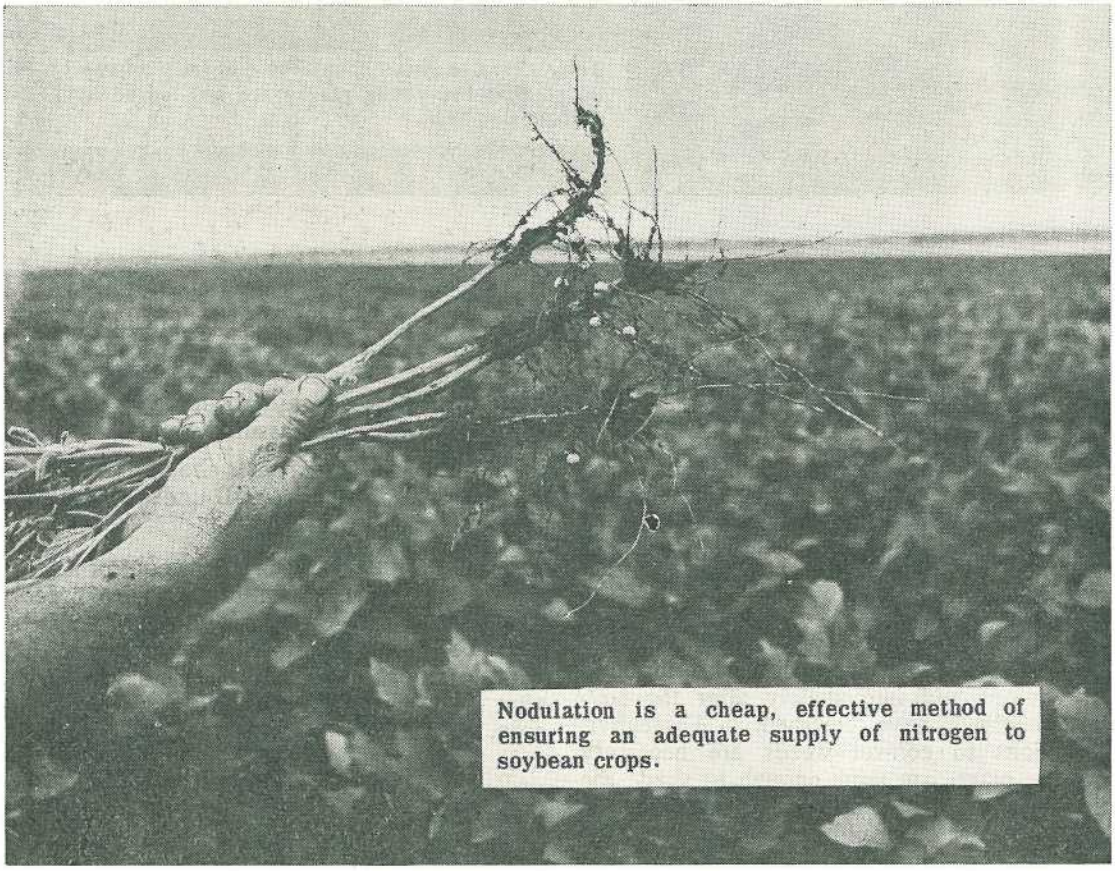
Observance of the recommended planting time is especially important if late maturing varieties are to be planted in areas prone to early frosts. If plants are not in the advanced stages of seed ripening when frost occurs, damage will reduce yields.

Row and plant spacings

Under favourable soil and moisture conditions, high yields of grain are possible from large plant populations planted at narrow row spacings. However, where suitable herbicides cannot be used economically, wider spacing of the rows will be needed to allow the passage of machinery for inter-row cultivation.

For rain-grown crops, row spacings of 65 to 105 cm will be suitable over a number of seasons, with earlier plantings at the wider spacings and later plantings at the narrower spacings.

In high rainfall or irrigation areas, higher yields are possible with narrower spacings in the range of 35 to 75 cm. Again, earlier plantings should be made at the wider spacings and later plantings at the narrower spacings.



Nodulation is a cheap, effective method of ensuring an adequate supply of nitrogen to soybean crops.

Plant stands of 16 to 38 plants per metre of row are desirable to give plant populations of 250 000 to 500 000 plants per hectare. The larger populations should be used where soil moisture conditions are favourable. To obtain such plant populations it may be necessary to plant 25 to 58 seeds per metre of row depending on seed germination.

Planting

Seed can be planted by maize planter or combine drill (blocking off the intermediate runs) or special planters. A planting depth of 5 cm should not be exceeded. The practice of planting deep to ensure germination when soil moisture is marginal is not recommended for soybeans. It is much better to wait for a suitable planting rain.

Light press wheels on the planting equipment can prove beneficial on many soils but heavy rollers should not be used after planting soybeans, nor should planter wheels run directly over the covered seed. Such compression will reduce emergence to a very low level.

Irrigation

Moisture stress will reduce soybean yields. Any stress situation however, can be avoided by the judicious use of irrigation.

Irrigation water may be limited and it may be necessary to impose a stress at some period of the crop progress. It is better that this should occur during the pre-flowering stage than at any other stage.

A heavy application of irrigation water on heavy soils before or at planting should be enough to maintain the crop until flowering unless planting has been early in the season. On light soils, or in areas where evaporation rates are high, further irrigation may be necessary before flowering. Moisture stress during flowering and pod-filling is most undesirable and will reduce yields.

A few generous applications of water will probably give better results than a number of small applications. However, it should be noted that a heavy late irrigation may cause lodging.

Irrigation on heavy soils can upset nodule activity and cause nitrogen deficiency. This is shown by a yellowing of the leaves. Normally, this condition is only temporary and clears up after a few days as the soil surface dries out. Should the condition persist, it is advisable to fertilize the crop with a nitrogenous fertilizer.

Pests and diseases

Many insects feed and breed in soybean crops. The most widespread damage to date has been caused by green vegetable bugs. Other insects such as *Heliothis* spp., spur throat locusts and lucerne crown borers have been responsible for serious damage in a few crops.

A comprehensive article on soybean pests, their identification and control will appear in a future issue of this journal.

The most common diseases in Queensland are bacterial pustule (*Xanthomonas phaseoli* var. *sojense*), wildfire (*Pseudomonas tabaci*), bacterial blight (*Pseudomonas glycinea*), rust (*Phakopsora pachyrhiza*), charcoal rot (*Macrophomina phaseoli*) and sclerotinia stem rot (*Sclerotinia sclerotiorum*). A comprehensive description of these and other diseases and their control was given in the *Queensland Agricultural Journal* (Vol. 100 p. 194), June 1974. Soybean varieties with resistance to bacterial pustule and wildfire are available.

Harvesting

The leaves usually fall as the crop matures, leaving a plant framework with exposed ripening pods. The crop should be inspected regularly from this stage and harvesting begun without delay when the seeds have matured. Pod shattering will then be avoided and high quality seed can be harvested.

Combine harvesters will harvest soybeans satisfactorily and manufacturers' recommendations for drum speeds and concave adjustment should be followed closely. High drum speed and close concave settings result in excessive cracking and splitting of the seed.

Harvesting losses can result from excessive height of cut, excessive ground speed, incorrect reel adjustment or delay in harvesting. During harvesting, the cutter bar should be kept as close to the ground as possible but not low enough to contaminate the seed with soil.

Yields

Yields will vary according to soil and season. Commercial crops in Queensland in excess of 2 tonnes per hectare are quite numerous and yields in excess of 4 tonnes per hectare have been recorded. However, in rain-grown crops, yields of 1 to 1·75 tonnes per hectare could be considered satisfactory.

Seed handling and storage

Excessive handling of soybean seed, particularly with augers, causes damage to the seed coat, reduces germination and may produce seed splitting.

The germination percentage of soybean seed deteriorates in storage, the drop depending upon temperature and seed moisture content. Seed intended for future plantings should not contain more than 10% moisture and should be kept in cool, dry conditions. Even at this moisture content, there is usually an appreciable drop in germination percentage after 12 months.

No soybean grain should be stored with a moisture content in excess of 13%.

Fodder and hay

Soybeans alone or in combination with Sudan grass have been used successfully for grazing.

Soybeans with maize or sweet sorghum form satisfactory combinations for ensilage.

The recommended time to harvest soybeans for hay is when the seed is half developed.

In rain-grown plantings, if the crop is subjected to severe moisture stress during the flowering period, few pods may be set and only low, uneconomic grain yields may be expected. Such a situation becomes apparent 2 to 4 weeks after termination of flowering and there may be advantage in making such crops into hay or grazing them with stock.

Marketing

Soybeans produced in Queensland may be grown under contract to processing companies. Other crops are grown for sale through a pool organised by the Queensland Graingrowers' Association. A few crops are grown privately for sale on the open market. The negotiation of contracts or sales through the pool help to stabilize and simplify marketing.

Before completing contracts, the terms of the proposals should be carefully studied and considered. There may be differences between companies' contract terms in such things as quality (including oil and/or protein content), terms of payment and seed supplies.

Contracting agencies will supply seed and inoculum and these are also available from normal supply sources.

Agronomic advice is available from the field services of the processing companies, the Queensland Graingrowers' Association and the extension service of the Department of Primary Industries.

Soybeans in the regions

Future issues of the *Queensland Agricultural Journal* will contain articles covering the culture of soybeans in the individual regions of Queensland.

New Mango Varieties

Kensington mango in full flower.

by P. R. BEAL,
Senior Plant Breeder.

THE mango *(Mangifera indica)* is in the family Anacardiaceae and is probably native to south-eastern Asia. However, the mango is now found in most tropical and sub-tropical areas of the world.

The crop is grown along the coastal strip of Queensland from the New South Wales border to the far north. However, the main producing areas are around Bowen, Home Hill and Ayr in the dry tropics of Queensland. Mangoes have been grown in the dry tropics since before the turn of the century and the industry is well established on the flood plains of the Burdekin and Don Rivers. Mangoes grow well on the coastal and sub-coastal dry tropics because of the suitable well-drained alluvial soils and the dry and frost-free winter and spring.

Fruit production from the Bowen and Burdekin districts of the dry tropics in recent years has ranged from about 1 000 to 2 000 tonnes a year, with the Bowen district producing 50 to 60% of total production (Table 1). The most important outlet for mango fruit is the wholesale fresh fruit market, and 75% of the fresh fruit is normally forwarded to the Sydney market (Table 2). A substantial private order trade in fresh fruit has also developed. A processing market also exists, but this is not large or stable.

TABLE 1

DRY TROPICS FRUIT PRODUCTION (TONNES)*†

Year	1970	1971	1972	1973	1974	1975
Bowen ..	1 198	935	1 195	458	1 498	593
Burdekin	851	669	1 051	477	630	385
Total ..	2 049	1 604	2 246	935	2 128	978

* Based on railing data

† Essentially Kensington variety

TABLE 2

BOWEN RAILINGS OF MANGOES TO THE FRESH FRUIT MARKET (AS 10 kg CONTAINERS)

Year	Sydney	Brisbane	Other	Total Containers
1972	87 404	21 836	10 426	119 486
1973	34 822	7 940	1 660	45 860
1974	100 896	41 068	3 840	149 784
1975	40 970	14 294	4 032	59 296

In 1970–71, the total area under mangoes in the dry tropics was conservatively estimated to be 500 hectares, with 300 hectares of bearing trees (Table 3). The Bowen district had 50% more bearing trees and three times as many non-bearing trees as the Burdekin district.

Mango production should remain at current levels or increase slightly for the remainder of the 1970's. The recent development of commodity treatments has improved control of commercial fruit quality. Also, the development of fruit fly disinfestation procedures acceptable to Australian Government authorities allowed entry to the Victorian market in 1975. However, the promise of high returns from the vegetable industry and expansion in the sugar industry, will probably curtail substantial increases in mango production in this period.

TABLE 3

TREE POPULATIONS AND AREAS OF KENSINGTON MANGOES IN BOWEN AND BURDEKIN DISTRICTS OF DRY TROPICS (1970–71)

District	Bowen	Burdekin	Total
Number trees not bearing	12 540	4 154	16 694
Number trees bearing ..	15 681	10 102	25 783
Total tree number ..	28 221	14 256	42 477
Area bearing trees (ha)*	176	114	290
Area all trees (ha)* ..	317	160	477

* An assumed plant spacing of 89 to ha (i.e. 10·7 m x 10·7 m on square planting)

Commercial production is essentially based on a single variety, Kensington Pride, and the major part of the crop in the dry tropics is produced over a short period of 4–6 weeks. (Figure 1.) This may result in periods of over supply to the fresh market. Further, the level of annual production fluctuates substantially (Table 1) which is not conducive to stable markets. Also, the knowledge of suitable management techniques is limited. The stability of the industry may be improved by lengthening the production period, by minimising, the fluctuations in annual production levels, by increasing storage life, and by developing new outlets.

Present commercial varieties

The most important commercial mango varieties presently grown in the dry tropics are Kensington Pride (or Bowen Special) and the 'Common' variety. Kensington Pride or Bowen Special is believed to be of Indian origin. It was first grown at Adelaide Point in the Bowen area, between 1864 and 1888. Seedlings from this source were subsequently used to establish commercial plantings.

Fruit of the Kensington variety is sweet, juicy and fibreless. The fruit is yellow-green when mature, with an attractive red blush. The Common variety is a hardy, vigorous type.

The fruit is sweet, juicy and fibrous, and green-yellow when ripe. The Common variety is of minor significance on the fresh fruit market, and then only in early November, because it begins maturing three weeks earlier than Kensington.

The Kensington variety has been determined in Queensland Department of Primary Industries appraisals to be very suitable for high quality canned or quick-frozen dessert fruit products. Also, the Common variety in particular, has been in demand for some years to supply chipped and sliced fruit for chutney and ripe fruit for flavouring of confectionery.

Varietal improvement

Many kinds of mango are scattered over the State, although records of origin are meagre. Most varieties were originally introduced from India, Ceylon, Indonesia and the Philippines. Historical records do show that mango orchards were established in many sites in coastal Queensland including Cape York (1874), Cardwell (early 1900s), Bowen (around 1870), Mackay (in the 1930s) and Rockhampton (1875).

Most early orchards were certainly established from haphazard introductions brought as fruit on trading ships. However, grafts of recognised Indian varieties were reputed to have been introduced in the 1930s to establish an orchard near Mackay. Fruit of the majority of these varieties in this Mackay orchard was of unacceptable quality and the planting was eventually eradicated.

A survey over North and Central Queensland was initiated in 1939 by the Queensland Department of Primary Industries in order to locate desirable mango accessions. These local selections were then propagated and established at Kamerunga Horticultural Research Station. However, none of the final sixteen selections, as well as some other additions to the Kamerunga collection proved as outstanding as Kensington.

A survey was also conducted in the Ayr–Bowen area over 1960–62 by local horticulture officers in co-operation with the Food Preservation Research Laboratory to locate promising selections and evaluate them for their processing value for both frozen and canned product. Of the 21 selections evaluated, Kensington was outstanding, although Goldsworthy and Roberts accessions were also considered promising for processing. A planting of the seven most promising varieties including Kensington was established at Millaroo Research Station in 1964, so varietal performance could be evaluated. Kensington variety yielded most consistently of all varieties. Goldsworthy and Roberts accessions had different cropping seasons to Kensington, but were not favoured because of irregular bearing and lack of acceptable fruit quality for the fresh market.

The varietal research programme was given a new emphasis from the early 1960s when earlier varietal improvement research had failed to isolate any mango variety among local accessions which was as outstanding as Kensington and was worth commercial exploitation. Further, the stability of the mango growing industries in Florida and other countries was known to be largely due to an extended cropping season of three months or more. The long cropping season mainly resulted from the use of several varieties which cropped at different times of the season. On this basis a mango variety introduction and evaluation programme was initiated in the early 1060s by Mr. H. Groszmann, the present Director of Horticulture in the Queensland Department of Primary Industries, to extend the cropping season and build up a range of good commercial varieties.

Varieties with good fruit quality and with different cropping season were sought from several countries including Florida, West Indies, Hawaii, India and Ceylon. Most of the introduced varieties do not grow true-to-type from seed, as do Kensington and Common varieties. Clonal material of the introduced variety on entry to Queensland is generally worked (grafted or budded) to seedling rootstocks of the common variety in containers and then quarantined for twelve months or more. Varieties are released for preliminary evaluation at Bowen Horticultural Research Station when inspections over the quarantine period confirm the absence of potentially harmful pests or diseases.

Mango varietal planting at Bowen.

Current programme

The variety evaluation programme currently involves two phases. The first phase involves close planting (at 3 m x 3 m) of two to three grafted trees of each of the available varieties in the field on Bowen Horticultural Research Station. Fruit quality and cropping habit and other characteristics of these varieties are compared with variety Kensington. These procedures involve a small commitment in land and facilitate the speedy determination of the few varieties with the greater commercial potential. The second phase involves releasing clonal material of the more promising varieties to industry. This of course, obliges industry to accept vegetative propagation methods which were not previously necessary when seedling varieties were solely used. The detailed performance of the released varieties which have been widely distributed and established in different parts of Queensland will be recorded and further evaluated.

Interim results

Thirty-five varieties of good repute have been introduced from overseas and established at Bowen Horticultural Research Station since 1971. Five varieties with fruit of good commercial quality and a total cropping period in excess of twelve weeks, were included in the first release to industry in December 1975, after initial evaluation at Bowen Horticultural Research Station in 1974. Early varieties as yet untested will probably provide a further extension of cropping. Twenty varieties in the present collection remain to be evaluated. As well, other introductions from South Africa, Fiji, Thailand and Malaysia are being considered.

The new varieties

The five varieties, all introductions from Florida, which were recently released are Palmer, Haden, Zill, Carrie and Kent. Palmer, Haden, Zill and Carrie, based on cropping behaviour at Bowen, are expected to mature their crop around the same time as Kensington, being one or two weeks earlier or later. Kent was five weeks later than Kensington and is expected to extend the cropping season considerably. The five new varieties are described on the next page.

Palmer

This variety has a large, oblong fruit, averaging 0·4 kg in weight, with an attractive red blush on a yellow background when ripe. The flesh is free of fibre, sweet and very smooth in texture.

Haden

The fruit of this variety is oval, averages 0·3 kg in weight, and is most attractively blushed with red. The flesh has a moderate amount of fibre as does Kensington, is sweet with a detectable turpentine flavour near the shoulders, which is sufficiently mild as not to interfere with acceptability.

Zill

The small, oval fruit of this variety averages 0·2 kg in weight, and has a conspicuous red blush on a yellow background. The flesh is very sweet, is free of fibre and with mild turpentine flavour near the shoulders, not sufficient to conflict with acceptability.

Carrie

This variety has fruit slightly oblong in shape, with a yellow skin colour when ripe, and of similar size to Haden. Flesh is very sweet and free of fibre.

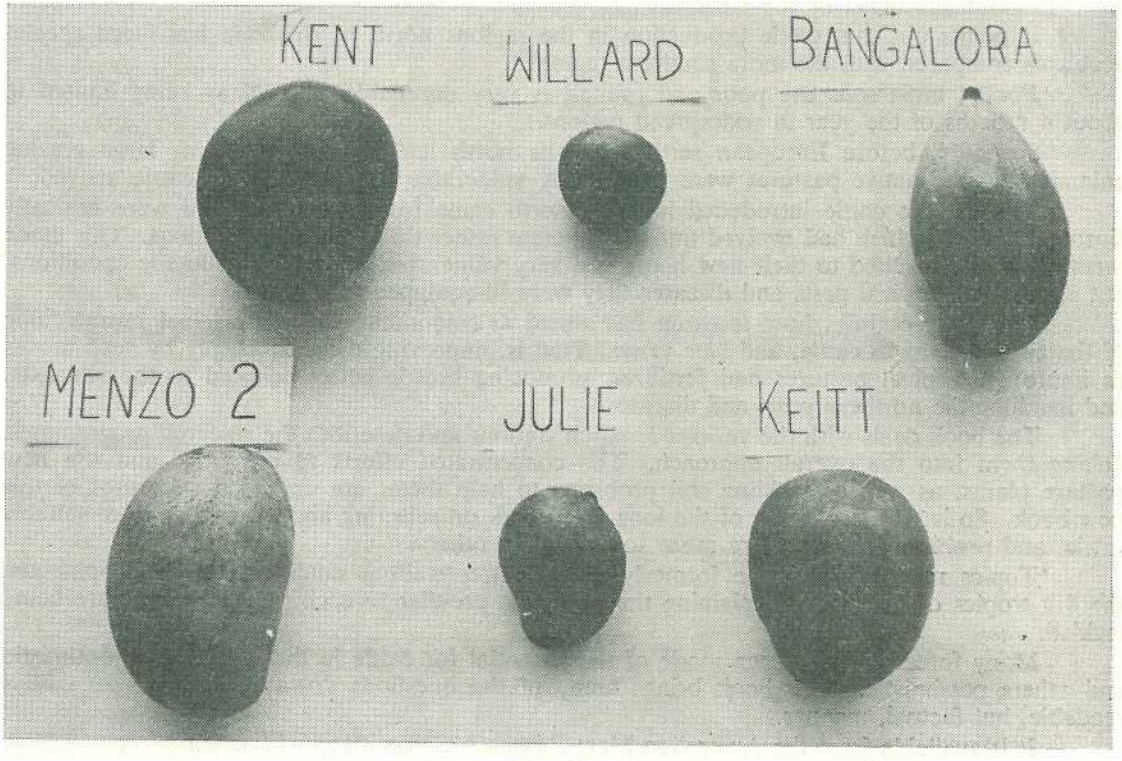
Kent

The fruit of this variety is very large, oblong, averages 0·6 kg in weight, and has a red blushed skin when ripe. Flesh is very sweet, fine textured and free of fibre.

Release of propagation material

Commercial mango growers and nurserymen were invited to apply for propagation material of the five new varieties in mid 1975. Over 540 pieces of graftwood of the five varieties in this first release were sent to 50 Queensland applicants by May 1976. It is anticipated that further propagation material of these five varieties and any other promising varieties will be released in the future.

Some of the recently introduced mango varieties being tested at the Bowen Horticultural Research Station.



The new mango varieties are monoembryonic and do not come true-to-type from seed. Multiplication must be by vegetative propagation. A 40% take can readily be obtained from grafting when using mature graftwood (the scion) and vigorous stocks. The cleft graft or whip and tongue methods can be used and the new graft should be adequately protected by shading.

Budding should certainly be an acceptable alternative means of vegetative propagation. Numerous methods of budding have been used successfully for commercial propagation of mangoes in other countries.

Mango seedlings of the Common variety (which is polyembryonic) being vigorous and uniform, are very suitable as stocks on which to work the new varieties. Other varieties could be as suitable or possibly offer some advantage. The possibility of selecting a particular rootstock because its effect on the growth of the scion variety is advantageous is presently the subject of further research.

Benefits

The potential benefits to industry of such a mango variety introduction and evaluation programme are substantial. Only a few weeks extension of the cropping period would bring more stability to the industry. However, the initial impact on industry may only be obvious in another fifteen years, because of delays from the introduction stage to onset of significant production from commercial plantings.

Cattle research in the north

THE massive Australian research effort in tackling the problems of the beef cattle industry in the north are described in a new book published by the Australian Meat Research Committee.

The new book, *Cattle Research* 1962–1975:1. *The North,* is one of a series on Australian cattle research produced by the AMRC.

It points out that cattle production in the regions north of Brisbane has faced special problems compared with the more southern regions.

Firstly, most soils are poor and rainfall is very unreliable, as well as being limited to about 4 months of the year in widespread regions.

Secondly, before European settlement, the north had seen no cattle or large grazing animals, and the native pastures were particularly vulnerable to grazing when cattle arrived.

Thirdly, the cattle introduced into the north came from the south, and were basically European breeds which had evolved under temperate rather than tropical conditions. This made them relatively unsuited to their new home and very vulnerable, not only to climatic conditions, but also to the tropical pests and diseases they were ill-equipped to resist.

The book outlines how research has aimed at smoothing out this original mismatching of the environment to cattle, and *vice versa.* That is, improving the feed supply by such moves as improved tropical pastures and fertilizer, producing breeds better adapted to the situation, and handling the northern pests and diseases.

The book deals with the various research stations and describes the research programmes, linking them into the overall approach. The concentrated efforts to introduce and use new pasture plants, as well as tackling soil problems to help them, are one of the features of this new book. So is the description of the long-term work on selecting and producing more suitable cattle, and probing why some are more suitable than others.

Topics range through the formerly unproductive wallum sands to the wet tropics and the dry tropics of the north, explaining the problems peculiar to each, and how they are being tackled.

Many forecasts have been made of the potential for cattle in the north, some optimistic and others pessimistic. This book brings many of the questions down to earth in an easily-readable, but factual, manner.

It is available from the Australian Meat Research Committee, 5 Elizabeth Street, Sydney, 2000 at a cost of $4.50 to cover publication, distribution and postage.

Dipping Brahman Crossbred Steers in Central Queensland

DOES IT PAY?

P. L. CORLIS, Q.D.P.I., Rockhampton,
and
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THE use of acaricides to control cattle tick has been one of the major costs incurred in the production of beef in the tick infested areas of Queensland. This cost includes not only the acaricide but also labour for mustering for tick control.

The ability of the cattle tick to develop resistance to acaricides necessitates the continual development of new acaricides. Chemical control is already more expensive than it was in the past and is likely to become increasingly costly in the future. The stage may also be reached where chemical companies cannot afford to spend the large amounts of money necessary to develop new chemicals to control resistant ticks.

Trials at the National Cattle Breeding Station "Belmont" have shown that dipping to control ticks had no significant effect on the liveweight gain of Brahman x British cattle. Many producers are aware that Brahman x British carry fewer ticks than British cattle, and have introduced Brahman blood into their herds. However, it is still a common practice to dip Brahman x British cattle six to eight times per year. This frequency of dipping appears to be much higher than research results indicate to be necessary.

This article reports the results of a trial designed to test, under commercial conditions, research results which indicate that fewer dippings will not seriously impede liveweight gain of Brahman x British cattle.

Design of the trial

The trial was conducted at "Ocean View", Byfield a commercial property approximately 65 km north-east from Rockhampton. The average annual rainfall is 1 775 mm of which 75% falls between November to April. Hot, humid conditions prevail during spring, summer and autumn and are favourable to the build-up of large numbers of cattle tick.

In August 1974, 40 yearling steers containing from 50% to 75% Brahman component were divided into two groups of about equal body weight. One group (average liveweight 291 kg) did not receive any acaricide treatment for the period of the trial, the other group (average liveweight 307 kg) was dipped in "Dipofene" at 28 day intervals. This interval was selected because it approximates common practice on many properties. Both groups grazed together in a paddock of Kazungula Setaria and Siratro at one beast per hectare until the trial ended on June 26, 1975.

Liveweight and tick numbers were recorded at 28 day intervals. Tick counts were based on the number of semi-engorged female ticks from 4·5 to 8 mm in length on one complete side of the animal. These counts were doubled to estimate the daily burden of engorged ticks over different periods of the trial and over the whole period. On dipped cattle it was assumed that dipping prevented ticks from maturing for 21 days.

Results

For analysis the trial was divided into three periods on the basis of prevailing climatic conditions.

(a) 19–8–74 to 11–11–74 (84 days) which was generally warm to hot, and dry.

(b) 11–11–74 to 3–3–75 (112 days) which was generally hot with frequent heavy rain occurring.

(c) 3–3–75 to 26–6–75 (115 days) which was warm to hot with moderate rainfall.

Liveweight gains and daily tick burdens are shown in Table 1 and the seasonal changes in tick numbers on the untreated cattle in Figure 1.

TABLE 1

EFFECT OF DIPPING ON LIVEWEIGHT GAINS AND ENGORGED TICK BURDENS

Period	Average liveweight gain* kg		Average numbers of engorged ticks per day	
	Dipped	Not dipped	Dipped	Not dipped
19–8–74 to 11–11–74 (84 days)	33	27	1	15
11–11–74 to 3–3–75 (112 days)	48	53	5	79
3–3–75 to 26–6–75 (115 days)	40	36	6	96
19–8–74 to 26–6–75 (311 days)	121	116	4	68

* Initial average liveweight equalled for both groups.

Tick numbers fluctuated considerably over the period of the trial. They were low during the August–November period, but increased to nearly 120 engorged ticks per animal in January and over 200 in March, then fell to about 60 in April and increased again to over 120 in May. On the dipped cattle tick numbers were much lower but over 40 per animal were recorded in March, 28 days after dipping.

Analyses of these data showed that dipping did not increase liveweight gain significantly even though considerable numbers of engorged ticks were present on the untreated cattle.

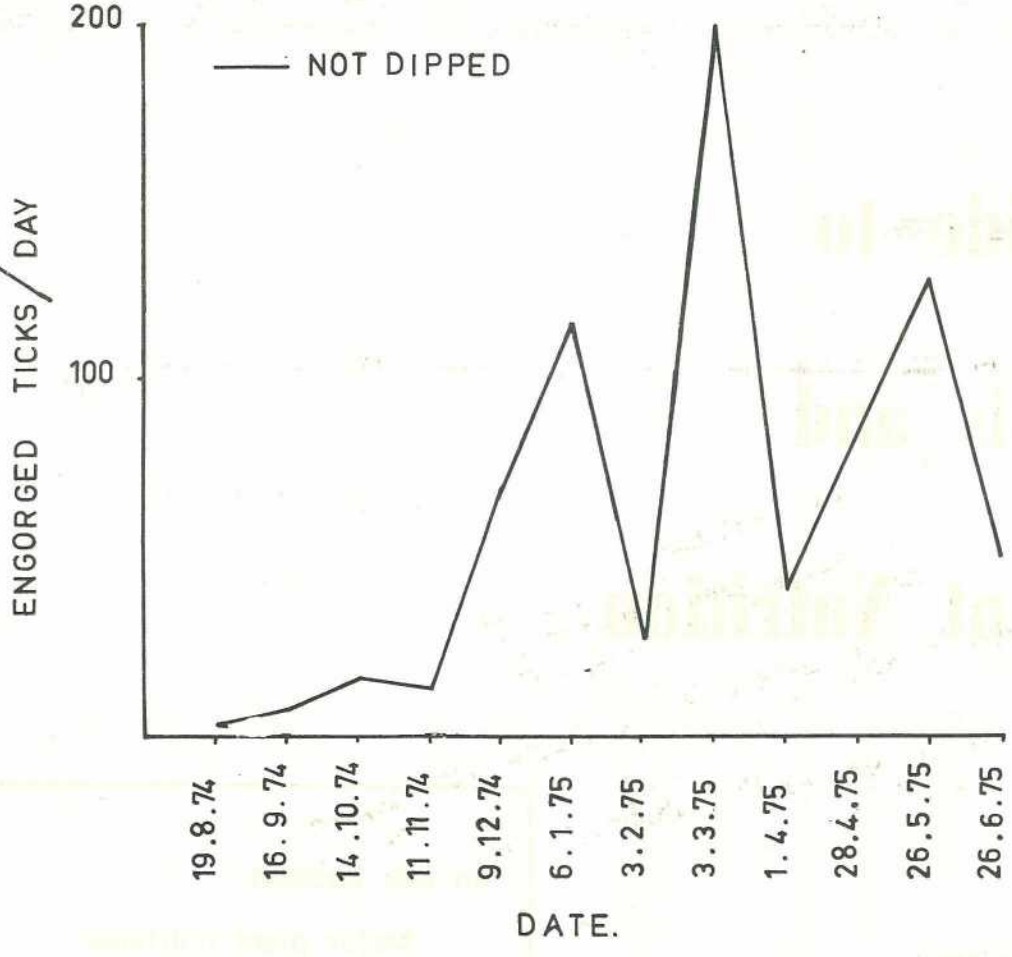
Practical implications

This trial was conducted under commercial conditions and supports results from Belmont which have shown negligible differences in terms of liveweight gain between dipped and not dipped Brahman x British steers. These results make it difficult to justify dipping steers which have at least half Brahman component. There are three points to remember when undertaking a minimal dipping programme:—

(i) Cattle have to be exposed to ticks to develop resistance. A change from a frequent to minimal dipping regime ought to be started after the wet season has begun when nutrition is satisfactory and when tick numbers are increasing (Figure 1).

(ii) Cattle have lowered resistance to ticks during periods of nutritional stress. When seasonal conditions are

FIG 1. SEASONAL CHANGES IN AVERAGE NUMBERS OF ENGORGED TICKS PER DAY ON NON-DIPPED BRAHMAN CROSSBRED STEERS.



extremely adverse it would be desirable to prevent a build-up of ticks by strategic dipping in the early autumn.

(iii) Extremely ticky cattle, or cattle which obviously have had high tick burdens recently are unattractive to buyers. It is therefore a sound practice to ensure that cattle do not carry excessively high tick burdens for about two months before sale.

Acknowledgements

The contribution of Mr. A. Setu in providing cattle and labour for this trial is gratefully acknowledged. Also, the assistance given by colleagues is appreciated.

Part 6

Guide to Soils and Plant Nutrition

by N. G. CASSIDY

In this Section

Major plant nutrients

Minor plant nutrients

Nutrient deficiency symptoms

Major plant nutrients

Nitrogen is a prime necessity in plant biological systems because it makes up about 16% of all protein; and it is also present in chlorophyll, the green colouring matter of leaves.

In terms of chemical equivalence it is the element needed in largest amount:

- because it is the element removed in greatest amount when a crop is harvested.
- it is the element most easily washed out of the soil by heavy rain.

Legumes may contain as much as 4·8% nitrogen, which means that protein then constitutes 30% of the dry weight.

Nitrogen is taken up from the soil mainly as nitrate ion (NO_3^-) though small amounts of ammonium ion (NH_4^+) are also present and some plants, notably rice, can easily assimilate the ammonium ion.

Together, nitrate and ammonium ions make up the *water-soluble nitrogen* in the soil, although in very anaerobic conditions nitrite ions (NO_2^-) may be present. The source of the nitrogen in the soil is usually the decaying organic matter from former crops; but whenever legumes are grown, nitrogen gas contained in the soil-air can be transformed to nitrate by Rhizobium bacteria which live on these plant roots. In return the plants supply the bacteria with foods for their own development.

It will be seen that nitrogen compounds are not normally needed by leguminous plants. It is only when something goes radically wrong that a legume needs to get its nitrogen from fertilizer or from the soil solution.

The following table gives an indication of how much nitrate-nitrogen should be present for wheat-growing in Queensland.

Similar standards need to be established for the rational fertilizing of any economic crop.

Response of Wheat to N	Nitrate in Soil (0–60) cm
Definite	Less than 70 kg/ha .. 14 ppm. in soil
Doubtful	70–100 kg/ha .. .. 14–20 ppm.
Nil	More than 100 kg/ha .. 20 ppm.

Mineralization of soil nitrogen (the change from complex, insoluble organic-matter to simple inorganic salts) involves ammonification followed by nitrification. Nitrogen is then completely available to the plant as nitrate ion. Provided the organic matter has a C/N ratio less than 20, and moisture and temperature are adequate for bacterial action, the process goes to completion and little ammonia is usually present in the soil.

The exception can arise when *partial sterilization* of the soil occurs, for example by heating. This is often done with potting mixtures, in order to destroy weeds and insect pests. In such a case nitrification ceases whilst ammonification is still going on. This leads to a very high content of ammonia, which may even become toxic. Partial sterilization of soil by chemicals can have the same effect.

Re-cycling

Uninterrupted moist conditions in soil retards the release of nitrogen from organic matter. It is found that moist soil incubated at 50°C will produce less nitrate than similar soil which has first been air-dried and then re-moistened.

The process of wetting followed by drying is essential in nature if the soil is to yield a continuing supply of nitrates. Other plant nutrients are released at the same time, and the process amounts to a RE-CYCLING OF NUTRIENTS.

When a drought situation arises, plant growth stops; yet nitrification may not have ceased, and in this way the plant may accumulate an excessive amount of nitrate. It happens particularly on fertile soils, and (with leguminous crops) when molybdenum is deficient. In the latter case nitrate in the plant cannot be converted to protein because the plant lacks molybdenum.

In a maize crop on heavy clay soil it was found that the butt end of the stalks contained far more nitrate than the upper end, and the leaves. In fact it would have been safe to feed the tops only, whilst the butts were actually lethal to cattle.

Total organic nitrogen and total carbon can be used to assess whether a soil is improving or deteriorating under cultivation. Periods under pasture, with grazing animals, are found to act as "resting" periods for a soil. Continuous cultivation tends to represent the opposite effect of deterioration. On the Darling Downs in Queensland, the best of a series of crop rotations compared in the following way with the continuous cultivation plots:—

BEST ROTATIONS (CF CONTINUOUS CULTIVATION)

—	Change in Total N	Change in Total C
1 year of wheat, 4 years of pasture	+ 23%	+ 15%
2 years of wheat, 3 years of pasture	+ 10%	+ 7%

This shows that four prior crops of pasture produced a better result than three crops. The absolute value of the gain in total nitrogen (after four pasture crops) was 250 kg/ha to a depth of 10 cm.

Vegetative stage

Nitrogen is particularly necessary in the *vegetative* or growth *stage* of plant life. It will help to prolong this stage of growth, but if applied too late it delays the maturing of crops. A sugar cane crop should therefore be top-dressed with nitrogen early in its life.

Leafy vegetables such as lettuce and cabbage need regular additions of nitrogenous fertilizer to keep them "young" and tender.

Nitrogen has been seen to act both as cation (ammonium——NH_4^+) and as anion (nitrate ——NO_3').

As a cation (NH_4^+) it is antagonistic to Mg, another cation; but as an anion NO_3' it favours the uptake of Mg.

Phosphorus is an element concerned particularly in carbohydrate metabolism, in the development of tillers and roots, and in the production of fruits and seeds.

It is taken up by the plant perhaps entirely as the phosphate ion $H_2PO_4^-$, which carries one negative charge. As an anion its absorption is increased by the cation NH_4 (ammonium) but retarded by the anions NO_3 (nitrate) and SO_4 (sulphate).

The cations iron and aluminium form very insoluble compounds with the phosphate ion. This prevents the uptake of phosphorus. Calcium also forms insoluble phosphate but the effect is only severe in alkaline soils (high pH).

Sulphur is present in all plant proteins, to which it contributes the constituent AMINO-ACIDS cystine and methionine.

It is absorbed from the soil as the sulphate ion SO_4. The ratio S/N is usually higher in soil than in plant tissue; and both sulphur and nitrogen mineralize at the same rate. Therefore any soil that supplies adequate nitrogen for crop production will probably supply enough sulphur.

Legumes and members of the Cruciferae family (cabbage, cauliflower etc.) are the most likely to show sulphur deficiency. When deficiency occurs it affects the tops most, and does not substantially reduce the size of the root system.

Potassium. The selective absorption of potassium makes it the dominant cation in young plant tissue. In older tissue this may be altered because of loss of potassium by translocation, and also because of continued gain of calcium by normal accumulation.

Potassium is completely water-soluble and mobile in plants, and is to be found particularly where cell-division and growth are most active.

Potassium deficiency is most marked in dry seasons. Some clay minerals can contract and cause potassium to be "fixed" within the clay lattice during drought conditions.

In cereal crops 85% of the potassium may be contained in the straw. If the straw as well as the grain is removed from the land, potassium deficiency can set in after a few years of cultivation.

Potassium deficiency and chloride excess often exhibit leaf-symptoms that are very similar.

In potassium deficiency, a dark brown area at the tip of the leaf is often separated by a narrow yellow band from the remaining green part of the leaf. Chloride excess is characterized by necrotic areas along the margin and involving the whole of the leaf tip.

Calcium. Most of the calcium is combined as calcium pectate, and is present in the cell walls. The rest may be combined with organic acids such as malic, citric, oxalic, tartaric. The calcium salts are insoluble. Sometimes crystals such as calcium oxalate can be found in plant tissues.

The amount of calcium needed by plants is small compared with that necessary in soils. Calcium should be the dominant cation in soils, amounting to about 10 times the value for potassium. The reverse holds for plants. This is why calcium deficiency in plants is comparatively rare.

In Kikuyu grass 0·25% Ca (on dry weight) has been found to be sufficient and in sugar cane 0·19% has been considered sufficient.

Calcium and potassium are antagonistic to each other in plant nutrition.

Magnesium is present in the green colouring matter chlorophyll, and also in pectin. Most of the magnesium is water-soluble and therefore mobile. It promotes absorption and translocation of phosphorus. Seeds rich in phosphorus contain more magnesium than calcium. Absorption of magnesium is promoted by nitrate and restricted by the cations ammonium, potassium and calcium.

Plants suffering from magnesium deficiency (little chlorophyll) turn yellow. This gives rise to a streaky effect in monocots (e.g. maize) and a blotchy effect in dicots (e.g. citrus).

Sodium is most notable for its ability to act sometimes as a substitute for potassium. This applies especially in beet species (beetroot, sugar beet).

Sodium also plays a large part in the Chenopodiaceae, but this may be due to the tolerance of members of the species to excess of sodium in soil.

Minor plant nutrients

Iron. When a CHLOROSIS is induced by excess lime (high pH) it usually indicates iron deficiency. The condition is characteristically endemic on coral atolls. In extreme cases the top leaves turn almost white. In less severe cases the veins retain their green colour. The Gramineae are not as sensitive to lack of iron as other plants.

Manganese deficiency is very similar to iron deficiency and both occur on the younger leaves. With manganese the very finest veins show up the green pattern.

Iron deficiency is favoured by high humidity and lack of sunshine. A leaf spray of 0·5% ferrous sulphate can be effective: greenness may re-appear within 48 hours.

Chelates (complex organic molecules) containing iron may be absorbed and distributed readily throughout the plant. Bicarbonate ion or acidification of the soil, also can relieve the condition.

Manganese is absorbed only in divalent form i.e. as the cation Mn^{++} carrying two electric charges. Liming tends to cause precipitation of manganese in the soil. This can be of advantage when manganese is in excess. On a Redlands (Queensland) soil cauliflowers showed the following results:—

		Leaves		
Untreated soil	pH 5·6	Interveinal yellowing	Wt. 0·17 g	Mn. 3 310 ppm.
Limed soil	pH 6·2	Normal plants	Wt. 0·95 g	Mn. 190 ppm.

Water-logging will increase soluble manganese in the soil. For example, lucerne that was flooded for 72 hours showed an increase in leaf Mn from 426 to 6 000 ppm. Lupin plants showed more Mn in leaflets (300 ppm.) than in stems, petioles, pods or seeds (50 ppm.).

Copper deficiency is characteristically associated with chlorosis and leaf fall, as well as with die-back or death of twigs.

Prolonged dry weather provides the conditions when the deficiency is most noticed. It occurs in a wide range of horticultural crops; "summer die-back" of pome fruits and of citrus are examples; and defoliation occurs from both upper and lower parts of branches.

Peats and reclaimed swamp soils are nearly always troubled by lack of copper. Arable crops such as maize and lucerne may be treated with copper sulphate at 20–25 kg/ha whereas pastures may need only a few kilograms per hectare.

Copper tends to be concentrated in leaflets and seeds rather than in stems, petioles and pods.

On pastures, sheep with "steely" (crimpless) wool or black sheep showing a white band in the staple, are indicators of the need for copper.

Zinc deficiency shows as dwarfed growth (short internodes) and little-leaf, often giving a rosette effect.

Horticultural crops such as stone-fruits, apples and citrus are susceptible: also nuts and maize. Cereals and grasses are not very susceptible to this deficiency. Lucerne is notably tolerant to zinc deficiency.

Young linseed plants containing 26 ppm. Zn were quite healthy when others containing only 15 ppm. showed die-back.

Treatment for annual crops, such as maize, is about 5 kg/ha of zinc sulphate. For fruit trees, a spray containing 1 kg zinc sulphate with 0·75 kg hydrated lime is often used.

Deficiency is most pronounced under high light-high temperature conditions and less so in foggy conditions. A high phosphorous/zinc ratio is undesirable; in sensitive areas it is best to use zinc whenever phosphate fertilizer is applied.

Boron. This element is needed in rather small amounts: at the same time it can easily be toxic to some species. Deficiency and toxicity are therefore both possibilities. The following table shows species that are most likely to be affected in either one way or the other.

Deficiency		Excess	
Sensitive	Tolerant	Sensitive	Tolerant
Beetroot (cracking corky core) Turnips Cauliflower (brown curd and stalks) Lucerne Grapes (hen and chickens)	Grasses	Beans Peas Cucumber Coffee Rockmelon Strawberry	Beet Turnips Cauliflower

In boron-deficient lucerne, the plants contained only 13–18 ppm. as against 25 ppm. in healthy plants. In vine leaves 20–25 ppm. represented deficiency and 60–125 ppm. sufficiency. Cereals and grasses usually function well with 1–5 ppm. in leaf tissue, whereas legumes may need 50 ppm.

Deficiency is worst in dry seasons or under waterlogged conditions.

The characteristics of boron deficiency are stunting, distortion (and often death) at the growing point. Multiple branching may occur, as in the crowns of beet. There may be few flowers, little pollen and so, little seed. Root systems may be reduced and there may be internal rots of storage organs.

Molybdenum is required by plants for normal metabolism, and by the organisms Rhizobia and blue-green Algae for symbiotic nitrogen-fixation. More molybdenum may be required by the micro-organisms than by the plants. The latter may thrive in solutions containing as little as 0·025 ppm. Mo.

In plants, molybdenum is essential to the nitrate reductase ENZYME system for the formation of protein. With insufficient molybdenum (or during drought) the changing of nitrate to protein comes to a stop. Tests on the plant tissue then show the presence of large amounts of nitrate.

Molybdenum is required in only the *minutest amounts*: as little as 0·1 ppm. (or less) may be sufficient in plant leaves. Pastures may benefit by 150 grams Mo. per hectare.

Chlorine has been shown to be an essential element for plant growth, but it is rarely deficient in soils. In fact special precautions are required to produce the deficiency artificially; and plants growing anywhere near a sea-coast or in an arid area would be adequately supplied.

Nutrient deficiency symptoms

Plants that are not obtaining sufficient amounts of all the mineral plantfoods show visible signs that are often very picturesque. When there is only a single deficiency, it may produce *foliar symptoms* almost as characteristic (for the plant species and the deficiency) as a finger print is for a person. When more than one element is deficient, a visual diagnosis may be impossible. In any case, local knowledge of plant varieties and soil types will be needed as corroborative evidence. A final diagnosis may also require soil and/or plant analyses, or the results of spray applications with the suspect element.

All this does not lessen the value of careful observation of symptoms. It may help to eliminate (or incriminate) factors such as damage by jassids or leafminers, virus disease, water shortage, salt damage, frost and lack of drainage.

An examination of the fruit as well as the leaves, may be required. For example, potato tubers and cauliflower heads may need to be cut open.

Page 598 gives the overall pattern, that tends to be fairly constant, regardless of species.

Induced deficiency

It will be evident that symptoms depend on the severity of a deficiency, as well as upon the stage of development at which it is observed. This applies particularly to colourations of the foliage. Frequently chlorosis (loss of green colour) is followed by necrosis, or death of the plant tissue. What is actually observed will depend on the time at which the observation is made.

Induced deficiency is also important. The application of a fertilizer can lead to an upset in the normal balance between elements, and so to a deficiency of some other element. Excess of potassium can be the cause of an induced magnesium deficiency.

A pH shift is able to induce deficiencies. Heavy liming can cause both iron and phosphorus deficiency. Manganese, copper and zinc may be affected in the same way.

Molybdenum is an element that becomes *more* available with liming. If there is enough total molybdenum already present in the soil, liming may cure an existing deficiency.

Careful observation of deficiency symptoms must always be supplemented by accurate knowledge of any recent treatments that have been applied.

Visual symptoms of a deficiency may be delayed, and the normal development of plants may already have been jeopardised, even at seedling-emergence. In such a case species having large seeds may be less at risk than other species.

Toxicity

Toxicity is the reverse of deficiency. It is common with the trace elements, and could be mistaken for a deficiency. Toxicity due to excess phosphorus is possible, but rare. Biuret, an impurity that occurs in urea is toxic to plants and should not be present to an extent greater than 2%.

Probably the most common form of toxicity is *fertilizer burn.* Very soluble fertilizers such as ammonium nitrate, potassium nitrate, potassium chloride and ammonium sulphate will cause a burn on the leaf margins unless they are well mixed with soil that is moist.

Sprays are also a potential cause of injury to the foliage of plants. Petroleum solvents are the most toxic, whilst alcohols and ketones (with less than four carbons) are the safest solvents.

Of the materials themselves, chlorinated compounds and organic phopsphates are in general phyto-toxic. Water-insoluble materials are more toxic than water-soluble ones.

Indicators

When a plant is very sensitive to a particular deficiency it becomes an INDICATOR PLANT for that deficiency, and it may allow trouble with other species to be forestalled. This is useful when the soil type (the source of deficiency) is widespread in the region. Zinc-spraying of linseed is a normal procedure on the Darling Downs; other crops may need it also. Some indicator plants are shown below:—

DEFICIENCY	INDICATOR PLANTS
Phosphorus ..	Tomato
Potassium ..	Banana, maize, fruit trees
Boron	Beetroot, sugar beet, cauliflower (black inside stalk), celery, grape, swede, turnips, lucerne
Copper	Citrus, pome fruits
Zinc	Citrus, peach, maize, flax
Molybdenum ..	Rockmelon, cauliflower (whiptail)
Iron	Citrus
Magnesium ..	Maize

Key to Nutrient deficiency symptoms

1. Effects general on whole plant or localised on older lower leaves

(a) *Effects usually general on whole plant,* although often manifested by yellowing and dying of older leaves.

FOLIAGE LIGHT GREEN. Growth stunted, stalks slender, and few new breaks. Leaves small, lower ones lighter yellow than upper. Yellowing followed by a drying to a light brown colour, usually little dropping.

"Minus nitrogen".

FOLIAGE DARK GREEN. Retarded growth. Lower leaves sometimes yellow between veins but more often purplish, particularly on petiole. Leaves dropping early. Lateness in budding, shooting, flowering, and ripening. Reduction in tillering and in size of root system.

"Minus phosphorus".

(b) *Effects usually local on older, lower leaves.*

LOWER LEAVES MOTTLED, usually with necrotic areas near tip and margins. Yellowing beginning at margin and continuing toward centre. Margins later becoming brown and older leaves dropping. In some legumes, small white spots on lower leaflets.

"Minus potassium".

LOWER LEAVES CHLOROTIC and usually necrotic in late stages. Chlorosis between the veins, veins normal green. Leaf margins curling upward or downward or developing a puckering effect. Necrosis developing between the veins very suddenly, usually within 24 hours.

"Minus magnesium".

2. Effects localised on new leaves

(a) *Terminal bud remaining alive.*

NECROTIC SPOTS USUALLY ABSENT. In extreme cases, necrosis of margins and tip of leaf, sometimes extending inward, developing large areas. Larger *veins only* remaining green.

"Minus iron".

NOTE: Certain cultural factors such as high pH, over-watering, low temperature, and nematodes on roots, may cause identical symptoms. However, the symptoms are still probably of iron deficiency in the plant due to unavailability of iron caused by these factors.

NECROTIC SPOTS USUALLY PRESENT and scattered over the leaf surface. Checkered or finely netted effect produced by even the smallest veins remaining green. Poor bloom, both size and colour. Starts on older leaves.

"Minus manganese".

Leaves light green, veins *lighter* than adjoining interveinal areas. Some necrotic spots. Little or no dying of older leaves.

Roots affected less.

"Minus sulphur".

(b) *Terminal bud usually dead.*

NECROSIS AT TIP AND MARGIN OF YOUNG LEAVES. Young leaves often definitely hooked at tip. Death of roots actually preceding all the above symptoms.

"Minus calcium".

BREAKDOWN AT BASE OF YOUNG LEAVES. Stems and petioles brittle. Death of roots, particularly the meristematic tips.

"Minus Boron".

Growing structures (buds, flowers, fruits) are most affected by —B and by —Ca.

Summary

The general nutrient deficiency symptoms for the nine elements listed were:—

Nitrogen deficiency—There was a severe dwarfing of the plant and a uniform yellowing of all the leaves. The yellowing started on the old growth and soon spread to include even the young leaves. The affected leaves tended to dry slowly and remain on the plant for some time.

Phosphorus deficiency—The plant was severly dwarfed and the foliage was an unusualy dark green colour which sometimes took on a greenish-purple cast. There was a marginal leaf yellowing followed by dropping of foliage.

Potassium deficiency—Potassium deficiency was shown by a mottling of foliage and a marginal browning and dying of lower leaves.

Magnesium deficiency—The earliest symptom was a greatly reduced rate of growth. A chlorosis appeared on the lower part of the plant. The yellowing came between the veins, and the veins remained normal green. Petioles were short, and the entire plant became severely stunted. Frequently necrotic areas appeared very suddenly (within 24 hours) between the veins. On some types puckering of leaves was evident. Leaf abscission was prevalent with some types. Roots were few in number. Blooming was delayed and flower colour was poor.

Calcium deficiency—Nearly all of the feeding roots died within 2 to 4 weeks. Death of the terminal bud followed. Severe stunting of the plant resulted, and finally the plant died entirely.

Iron deficiency—The first symptom was a chlorosis between the veins of the top leaves of the plant. On some plants this chlorosis became so severe that necrotic areas appeared on the leaf. These necrotic areas were usually larger than those due to manganese deficiency, and appeared more generally on the margins and tip of the leaf.

Manganese deficiency—The top leaves become chlorotic between the veins. This type of chlorosis could be distinguished from iron chlorosis in several ways. First, manganese deficiency was usually not as severe as iron deficiency. Second, necrotic areas due to manganese deficiency were smaller in size and were located in the middle of the leaf. Third, even the most minute veins remained green in manganese deficiency, and the leaf had a very netted appearance.

Sulphur deficiency—As a general rule, the veins of sulphur deficient leaves were lighter than the rest of the leaf. This condition was exactly opposite to that found in all other deficiencies. Plants had a much slower rate of growth. The top leaves of the plant were affected first.

Boron deficiency—Death of the terminal bud was characteristic. This caused the development of the lateral buds. The leaves on the top of the plant became thick and brittle and tended to roll in a half-circle from the tip toward the base. Growing point of *root* may also be affected.

Elements	Conditions That Favour Deficiency
Nitrogen	Drought and poor soils *or* Continuous high rainfall
Phosphorus	Ferro-aluminous soils. Limestone soils with high pH
Potassium	Drought and swelling clays. Cool summers and little sunshine
Sulphur	Low soil pH
Calcium	When potassium is very high
Magnesium	When potassium is very high
Iron	High soil pH. High humidity and lack of sun
Manganese	When iron is very high. (Excess occurs with poor drainage)
Copper	Droughty weather
Zinc	High light and high temperature
Boron	Droughty weather *or* water-logged conditions
Molybdenum	Drought. Acid soil (liming is often a cure)

WINEMAKERS MUST REGISTER

WINEMAKERS must be registered before November 27 this year under the provisions of the Wine Industry Act, 1974. This was announced by the Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.).

The Act, which provided for registration of a winemaker either as a vigneron or vigneron-vintner, was initiated to assist the development of the wine industry, largely through liberalizing hours of sale.

The Act specified that a person should not carry on a business as a vigneron or vigneron-vintner, or be granted a licence under the Liquor Act in respect of such business, unless firstly registered according to the provisions of the Act.

Winemakers who have not received the appropriate forms for registration in the mail should write to the Director of Marketing Services, Department of Primary Industries, Brisbane, for the relevant forms.

Brucellosis-Tested Swine Herds (As at 7 October 1976)

Aboriginal & Island Affairs Dept., Cherbourg.	L.W.
Barrier Reef Islands Pty. Ltd., Hayman Island.	L., L.W.
Batterham, P. & N., Raby Park, Inglewood.	L., L.W.
Bertolotti, F. E. J. & N. I., Mascotte, Wallumbilla.	L.
Bool, R. A. & B. E., Rossvale, Crows Nest.	L.W., L.
Briskey, R. G. & M. J., Wallingford, Pittsworth.	L.W.
Brosnan, D. J., Bettafield, Mt. Murchison, via Biloela.	L., L.W.
Cauley, J. R., Kulpi, Postal M.S. 918, Toowoomba.	L., L.W. Stud. Com
Clegg, J. A. & M. A., Karoma Stud, Mundubbera.	L.W., L.
Coleman, C. J., Merriland Stud, Britannia Station, Charters Towers.	L., L. W.
Corney, F. D. & E. C. W., Pagel, Tara	L.W.
Cotter, N. J., Olaroy, Goomeri.	L.W.
Craig, K. F., 'Echoes', Bancroft, via Monto.	L.W.
Crawley, R. H., Rockthorpe, Linthorpe.	B.
Dean, G. F. & A. M., Home Creek, Wooroolin.	L.W., L., B.
Diete, E., 'Ettrock', Ingoldsby.	L., L.W.
Douglas, Mrs. W. S. & Son, Greylight, Goombungee.	W.
Duncan, C. P. & B. J., Colley, Flagstone Cr., Helidon.	L.W.
Duncan, J. A. & B. L., Ma Ma Creek.	L.W.
Duckett, R. & L. M., Fairview, Capella.	L., L.W.
Dunlop, B. R., c/- Dunlop Meats Pty. Ltd., 8 Malkara St., Townsville.	L., L.W.
Eagle, D. R. & J. A., 'Walugra', 134 Hogg St., Toowoomba.	L.W.
Fisher, J. & L., 'Lyndhurst', Jimbour.	L., L.W.
Fletcher, L., Par-en-eri, P.O. Box 143, Mundubbera.	L.W., L.
Fowler, K. J. & B. D., Kenstan, M.S. 195, Pittsworth.	L.W., L.
Fowler, K. P., Northlea Stud Farm, Hogg Street, P.S. 1436, Toowoomba.	L.W., L.
Fowler, N. E. P. & M. P., c/- Kewpie Enterprises, Kingaroy.	L., L.W., X
Franke, K. H. & B. Delvue, Cawdor.	L.W.
Freeman, W. A., Trevlac, Rosewood.	L.W.
Geysing, E. F. & N. E., Oakhurst, via Maryborough.	L.W.
Gosdon, T. G. & E. A., Naumia, Dalby.	L., L.W.
Graham, T., 'Dunleigh', Highfields.	L.W., L.
Greyson, D. G., Wodalla, Killarney.	L., L.W.
Grundy, A. H. & R. N., Markwell Piggeries, M.S. 499, Toowoomba.	L.W., L.
Handley, G. R., Locklyn Stud, Lockyer.	B.
Handley, Mrs. M., Meadow Vale, Lockyer.	B.
Head, G. A., East Greenmount.	L.W.
Hinchliffe, D. F. & R. K., Oakview, Milman, via Rockhampton.	L., L.W.
H.M. State Farm, Numinbah.	B., L.W.
H.M. State Farm, Palen Creek.	B.
Hudson, R. F. & V. D., Rondel, Hogg St., Wilsonton.	L., L.W.
Jones, K. B. & I. R., 'Cefn', M.S. 544, Clifton.	L.W., L.
Kajewski, C. & D. I., Glenroy, Glencoe, via Toowoomba.	L.W., L.
Kanowski, A. R., Exton, Rechey.	L.W.
Kanowski, S. E., Miecho, Pinelands.	T.
Kimber, C. F., M.S. 698, Biggenden.	L.
Kimber, E. R., Tarella, M.S. 805, Mundubbera.	L.W., B.
Kruger, V. F. & B. L., 'Greyhurst', Goombungee.	L.W.
Kuhl, V. & C. A., 'The Mounts', Boodua, M.S. 222, Oakey.	L.W.
Law, R. R. & L. M., 'Summerset', M.S. 757, Kingaroy.	L.W., L.
Le Gros, W., Elourea Large White Stud, Mt. Tarampa, via Lowood.	L.W.
Ludwig, A. L., Beau View, Cryna, via Beaudesert.	B.
Maranoa Stud Piggery, Mitchell.	L., L.W.
Marsden, M. G. & H. C., 'Fernflat', Canaga, via Chinchilla.	L.W., L.
Mathieson, K., Ideraway, Gayndah.	L.W.
Neuendorf, W., M.S. 794, Kalbar.	B.
Peters, L. A., Moonlight, Bongeen.	L.
Qld. Agricultural College, Lawes.	B., L.W.
Radel, R. M., 'Turua Stud', Biggenden.	L.
Radel, V. V., Braedella, Coalstoun Lakes	L.W.
Research Station, Biloela.	L.W.
Research Station, Hermitage.	B.
Robin, A. B., Blaxland Road, Dalby.	L.W., L.
Rosenblatt, G., Rosevilla, Biloela.	L., L.W.
Ruge, A. F. & V. M., 'Alvir' Stud, Biggenden.	L.W., L.
Ruge, G. H. & I. E., Al-lester L. W. Stud, Woowoonga, via Biggenden.	L.W.
Sharp, D. W. & L. J., 'Arolla', Lavella, via Millmerran.	L.W., L.
Smith, N. O. & G. A., 'Miandetta', M.S. 162, Warwick.	X
Smyth, R. A. H. & T. N., Barambah Rd., Goomeri.	L.W.
Trout, L. B. & L. J., 'Caminda', Crawford, via Kingaroy.	L., B.
Ward, R. J., 'The Plateau', Mulgildie.	L.W.
Wearmouth Piggeries, c/- G. Varidel, Dalby.	X
Westbrook Training Centre, Westbrook.	B.
Willett, L. J., Wongalea, Irvingdale, M.S. 232, Bowenville.	L.W., L.
Williamson, K., Cattermul Av., Kalkie, Bundaberg.	L.W., L.

KEY

Large White = L.W.	Tamworth = T.
Landrace = L.	Wessex = W.
Berkshire = B.	Crossbreed = X.

Brucellosis Accredited Free Cattle Herds

De Landelles, L., 'Cherokee', Tanby, via Yeppoon.	Brahman
Wilson, R. S., Calliope Station, Gladstone.	Hereford

THE FARM FAMILY

New metric leaflet for cookery writers

CHURCH groups, clubs and women's organisations—or even shearer's cooks—who are planning to publish collections of their favourite recipes will be able to convert them easily to the metric system with the aid of a new leaflet recently prepared by the Metric Conversion Board.

The leaflet, "Metric Conversion of Domestic Recipes", has been prepared for cookery writers who need to convert imperial recipes for publication.

The Metric Conversion Board has recommended that women using proven and popular imperial recipes should continue to do so. "There's no need for the home cook to get rid of that cracked blue cup she has always used for measuring," was how Sheila Mason, the MCB's Women's Adviser put it.

She went on: "The home cook needs to use metric measures only when she wants to try a new recipe written in metric terms. For this she will need a set of metric cups and spoons".

The new leaflet was prepared by the MCB's Cookery Sector Committee. It also forms a supplement to "Cookery and Metric Conversion" published by the MCB in 1973 and distributed to technical and teaching colleges (metric cups and spoons are now used exclusively in schools), to home economists employed in the food industry, by dairy, gas company and electricity board recipe writers and to magazine and newspaper writers.

The original publication did not cater for people producing charity and regional recipe books—the churches, clubs, Country Women's Association groups and the National Council of Women, organisations whose members, while being excellent cooks, may not be home economists. Tables provided in "Cookery and Metric Conversion" require detailed conversions, but the new leaflet will enable recipe writers to convert directly from ounces to cups and spoons.

The leaflet will be distributed to all those who received the original booklet, but the Board is inviting others who want to publish collections receipts to write to the Women's Adviser, The Metric Conversion Board, P.O. Box 587, Crow's Nest, 2065, for this leaflet as well as the leaflet, "Kitchen Metrics".

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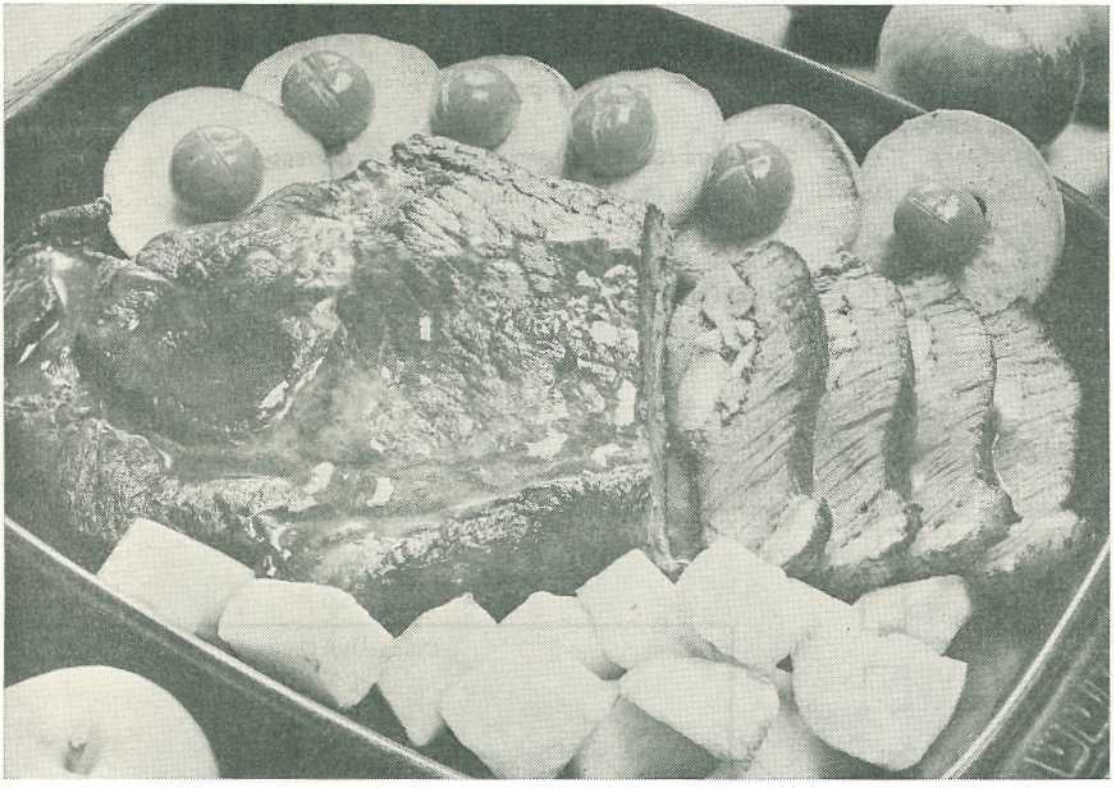
Office Use Only

Pocket a steak

ONE dish which has achieved world recognition as truly Australian is carpetbag steak—a thick slice of prime rump or fillet steak with a pocket cut into it and stuffed with succulent rock oysters. What a delectable combination.

It seems to have inspired countless recipes using this technique. Australian cooks are great innovators and use varying types of steaks, various stuffings and a variety of cookery methods. Our recipes illustrate this point. Ask your butcher to cut the pocket in the steak for you.

Delicious carpetbag steaks—The ideal combination of steak and oysters is to be found in the national Australian dish of the carpetbag steak where the pocket is filled with wonderful Sydney rock oysters. There are other delightful combinations of carpetbag steaks.



Waldorf Steak

1 slice topside steak cut 4 cm (1½″) thick
2 tablespoons butter or margarine
1 large or 2 small cooking apples, peeled and sliced
2 tablespoons chopped celery
2 tablespoons chopped walnuts
2 teaspoons brown sugar
¼ cup stock
Salt and pepper
1 teaspoon cornflour

Spread half of the butter or margarine inside the pocket. Mix together apple, celery, walnuts and sugar and fill pocket. Fasten opening with fine skewers or sew up with thread. Melt remaining butter in a frying pan and brown steak on each side. Reduce heat, add stock and season to taste with salt and pepper. Cover and simmer gently for 1 hour or until meat is tender. Place steak on warm serving dish, remove skewers or thread and keep warm. Thicken liquid in pan with cornflour mixed to a paste with a little cold water. Slice steak into portions and pour sauce over top. Serve with apple slices sauteed in butter and diced, sauteed potatoes. Serves 4 to 6.

Note: Stuffed steak may be baked in the oven. Place in dish, spread with butter, margarine or dripping, and bake in moderate oven for 1 hour, turning and basting during cooking.

★ ★

Banana Steak

1·5 kg slice bolar blade or topside steak
2 rashers bacon
2 large, firm bananas
Salt and pepper
Pinch mixed herbs
2 tablespoons butter
¼ cup semi-sweet sherry or port

Chop bacon; peel and slice each banana into 3 lengthways. Sprinkle inside pocket with salt, pepper and herbs. Insert a layer of banana, top with bacon and place remaining banana on top. Secure pocket with thread. Brown on each side in butter and place browned steak on a large piece of foil. Pour sherry or port into pan and swirl to lift browned juices. Pour over steak and seal foil with double folds. Place on a baking tray and cook in a moderately slow oven, 160°C (325°F) for 1½ hours. Carefully open package and pour juices into a small saucepan. Thicken with a cornflour and water mixture. Remove thread from steak and slice in serving portions. Serve with the sauce (check seasoning), jacket baked potatoes and a green vegetable. Serves 6.

★ ★

Sunshine Steak

1 kg slice topside or round steak
1 rasher bacon, chopped
1 tablespoon butter or margarine
1 cup soft breadcrumbs
½ cup diced fresh or canned pineapple
¼ cup raisins
¼ teaspoon curry powder
Salt and pepper
Dripping or butter for cooking

Cook bacon in butter or margarine until lightly browned. Add with butter to breadcrumbs; mix in pineapple, raisins, curry powder, salt and pepper to taste. Fill pocket with mixture and secure with fine skewers or sew with thread. Heat a little dripping or butter in pan and brown steak on each side. Cover and simmer over low heat for 1½ hours until tender. Add a little water if necessary. Make a sauce from pan liquid. Slice to serve. Serves 6.

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S. R. Hampson, Acting Government Printer, Brisbane

BACTERIAL BLIGHT OF COTTON

BACTERIAL blight caused by *Xanthomonas malvacearum* is the most important bacterial disease of cotton.

Symptoms

The most obvious symptom is an angular, water-soaked leaf spot which becomes reddish-brown in colour. Lesions with a greasy margin extending along and bordering the main veins cause yellowing and death of large segments of the leaf and lead to defoliation.

Spots on bolls are at first water-soaked and later depressed and black. Boll infection leads to shedding, failure to open, lint of poor quality and seed contamination. Secondary organisms in diseased tissue cause boll rots.

Black lesions also occur on the bracts. Stem lesions symptomatic of the condition known elsewhere as 'black arm' have not been observed in Queensland.

Spread

The casual organism may be introduced on seed or persist in the soil on undecomposed plant trash from the previous cotton crop. Once established, rapid spread occurs in wet, windy weather.

Injured tissue is particularly susceptible to attack and severe outbreaks often follow hail damage.

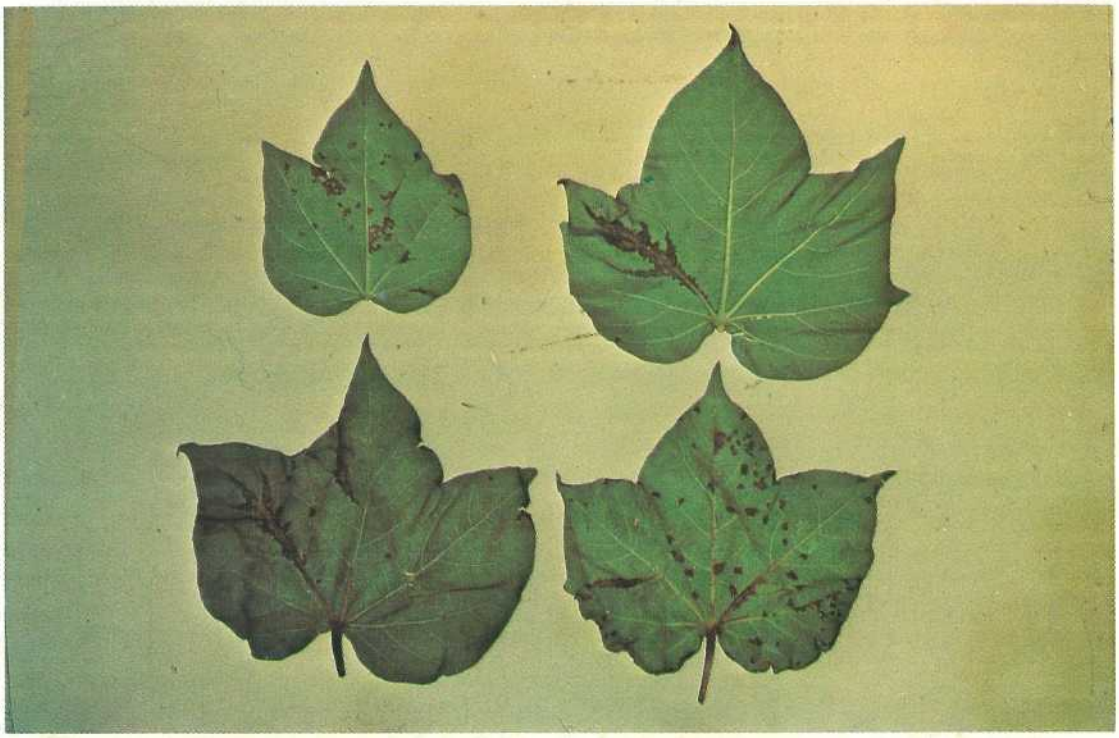
Control

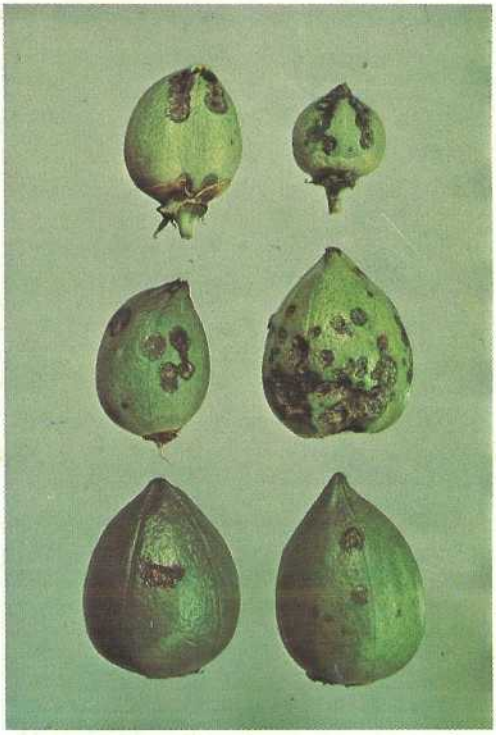
1. Plant acid-delinted seed.
2. Plough in crops as soon as harvesting has been completed to encourage rapid breakdown of diseased tissue.
3. Rotate with crops other than cotton.

—compiled by N. T. Vock, Plant Pathology Branch.

(Further information may be obtained from your nearest Plant Pathology Branch office or by writing to the Director, Plant Pathology Branch, Department of Primary Industries, Meiers Road, Indooroopilly, Q. 4068).

BACTERIAL BLIGHT OF COTTON





Upper: leaf spots showing both the small, angular spots and the large spots spreading along the veins. Lower left: spots on bracts. Lower right: spots on bolls.