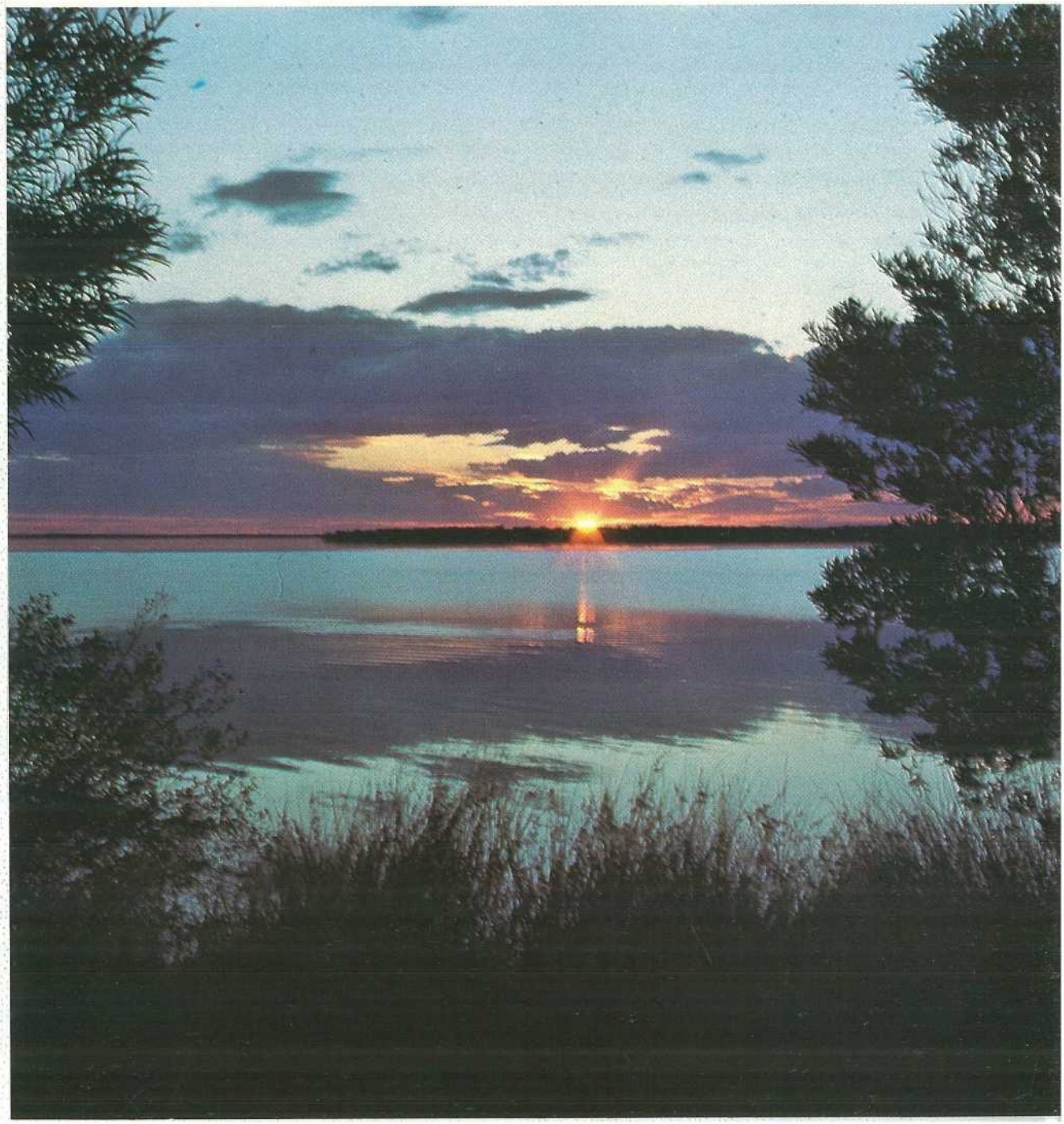
Queensland AGRICULTURAL JOURNAL

July–August 1978 Vol. 104 No. 4



DEPARTMENT OF PRIMARY INDUSTRIES

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

COVER. Sunset over Fairbairn Dam—the water supply for the developing Emerald Irrigation Area. Photograph by A. Ernst.

QUEENSLAND AGRICULTURAL JOURNAL

Vol. 104 No. 4 July–August 1978

Editor, P. R. Lee

Contents

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

29—63696

New Director-General of Primary Industries

MR E. O. BURNS, appointed on 6 July as the Director-General of Primary Industries, is the first agricultural economist to hold this top executive position in the Department of Primary Industries.

He also will act as Under-Secretary of the Department.

Announcing Mr Burns' appointment, the Minister for Primary Industries, Mr. V. B. Sullivan, said it followed the retirement in June of the former Director-General, Mr A. A. Ross.

Mr Burns, who has served as Deputy Director-General since September 1976, has had a wide experience in farm economics and marketing.

He is known mainly throughout Australia for his pioneering work in the development and promotion of management accounting for farmers.

Mr Burns is the senior author of 'Accounting and Planning for Farm Management', which was published in 1966 and still is a standard text in Australian universities and agricultural colleges.

Mr Sullivan said his new Director-General, while Director of the Economic Services Branch in the 1960s, largely was responsible for developing the Department's whole-farm approach to extension.

This was achieved by instituting farm management training for extension officers and farmers and by posting agricultural economists to major centres in the State to work in collaboration with other scientists.

From 1971 to 1973, Mr Burns was a member of a special three-man committee appointed by the Standing Committee on Agriculture to study the activities of Government extension services in farm business management in Australia and suggest guidelines for future developments.

Mr E. O. Burns, B.Com., F.A.S.A.

During his 45 years of service with the Department, Mr Burns has held a number of important positions, including Director of Economic Services, Deputy Director of the Division of Marketing and Chief Advisory Officer (Administration).

A graduate in Commerce from Queensland University, he is a member of a number of professional organizations and a past President (1972) of the Australian Agricultural Economics Society.

He was Chairman of the Queensland Fish Board from 1971 to 1975 and deputy Chairman of the Brisbane Milk Board until it ceased to operate at the end of May this year.

Mr Burns is a member of the Council of Queensland Agricultural College and of the Finance Committee of the Queensland Board of Advanced Education.

Mr Sullivan added that Mr Burns had acted as adviser to the Queensland Government's trade mission promoting sales of the State's primary products to Middle East and Far East countries in 1974.

Insect pests of sunflower

QUEENSLAND'S sunflower growers contend with a number of insect pests.

These are mostly generalized feeders, capable of breeding on other crops and weeds and subsequently infesting sunflower crops. Fortunately, routine control is not required as the sunflower plant is able to tolerate a significant degree of damage.

However, circumstances do arise where insecticide application is necessary. Each case should be considered on its merits.

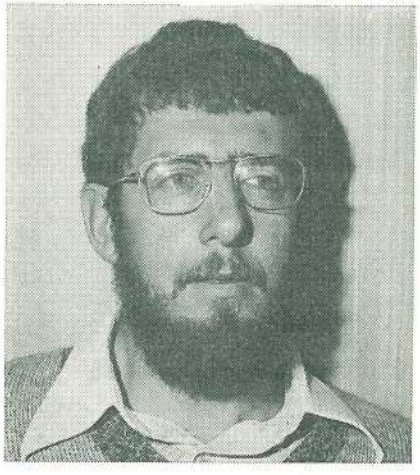
Seedling pests

Seedling pests are defined as those insects which injure sunflowers before they develop four or five 'true' leaves.

False wireworms

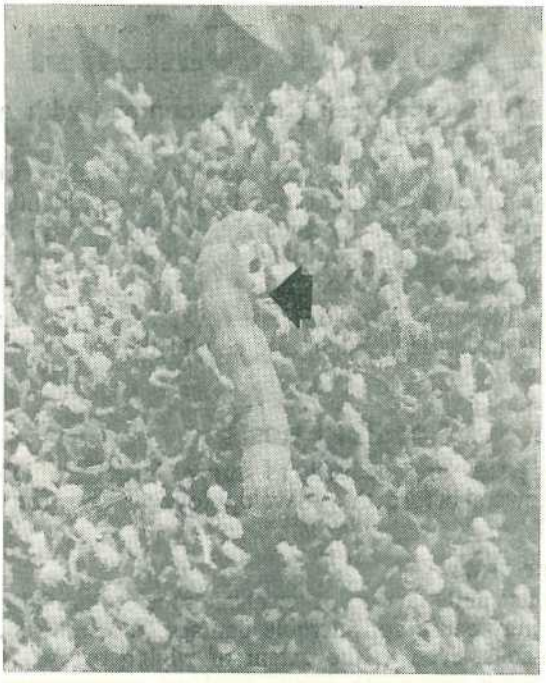
The adults and larvae of several species of false wireworms may cause considerable damage to sunflowers in some seasons, even to the extent of wiping out some plantings. False wireworm larvae feed on underground stems and roots, while adult beetles nibble the aerial parts of the plant. Sunflower seedlings are very susceptible to damage until they develop three or four 'true' leaves and during periods of moisture stress.

It has been noted that seedling mortality is often higher in areas where stubble mulching is practised. This is not a condemnation of stubble mulching. Any increase in insect numbers has to be balanced against the energy, water and soil conserving advantages of stubble mulching.



The author, Roger H. Broadley, is an entomologist based in Toowoomba.

Budding sunflower plant. Heliothis eggs are laid on the upper surfaces of the upper leaves and in the leaf bracts of the bud.



ABOVE. Heliothis larva feeding among florets in sunflower head.

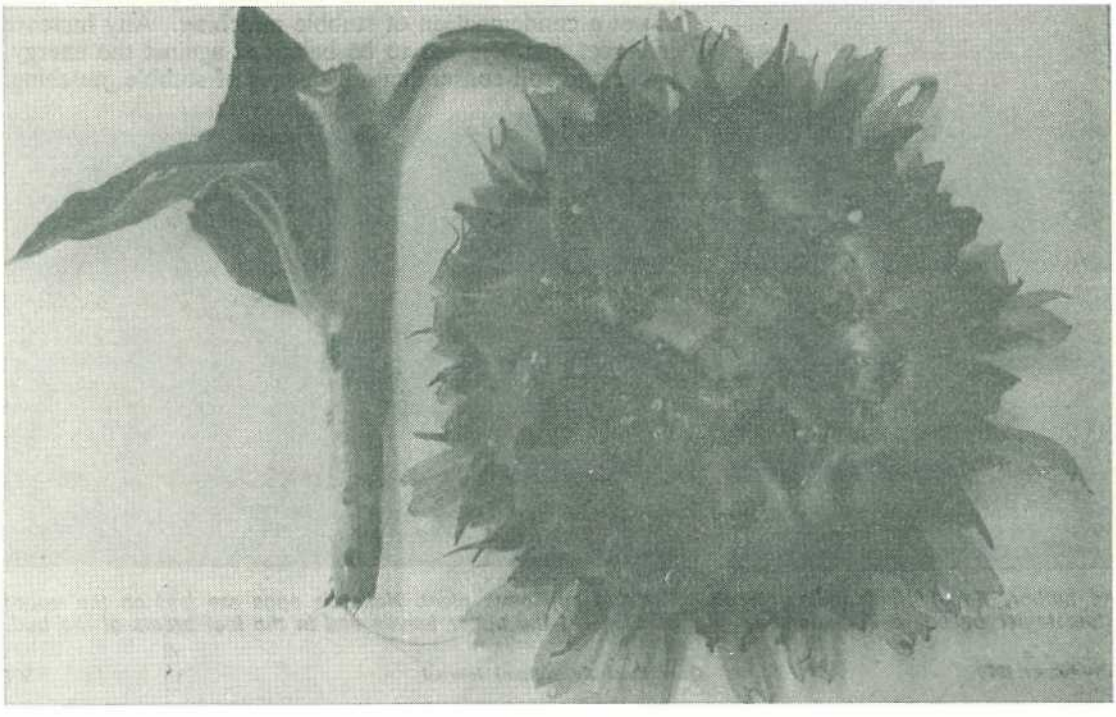
BELOW. Extensive scarification of the back of the seed receptable caused by Heliothis larvae. Note excavations in the stem.

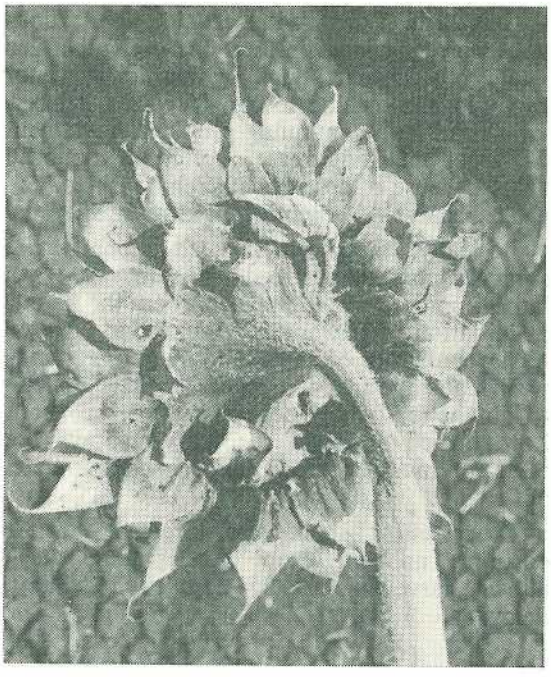
Pre-planting inspections to determine populations of soil dwelling pests are recommended. This should enable growers to decide whether insecticide treatment of the seed is necessary. Control of adult false wireworm beetles is costly and largely impractical. Basically, this is a coverage problem, and the difficulty lies in placing sufficient insecticide on a mobile soil dwelling pest and on the young seedlings on which they feed.

Wireworms

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

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





Rhizopus *head rot in a mature sunflower head. Establishment of the fungus was facilitated by Heliothis wounding of the pith behind the head.*

Mole crickets

These large, soil-dwelling insects are light brown in colour, and possess forelegs adapted for digging tunnels in the soil. A tunnel may have several entrances, and these holes (about 1 cm in width) are often diagnostic of mole cricket activity. It is presently uncertain whether these insects feed directly on young sunflower seedlings or merely damage them during tunnel building.

Earwigs

Two types of earwigs are commonly found in sunflower paddocks. One is a small, black, plant-feeding insect (1·5 cm long), with a pair of curving pincers attached to the rear end of the body. These are arched over the back in a threatening posture when the earwig is disturbed.

The other earwig is a much larger (2·5 cm long) cream and brown-coloured insect. This earwig is a predator and has been recorded feeding on false wireworm larvae in the laboratory.

Field crickets

Both nymphs (young crickets) and adults are capable of causing injury. They feed on the cotyledon leaves as well as on the 'true' leaves. Stems may be excavated and in extreme instances the stem is severed above ground level. The availability of alternate sources of food probably plays a major role in determining whether crickets feed on young sunflowers.

Post-establishment pests

These pests are defined as those which assume importance in the period following plant establishment.

Dead Heliothis larva infected with a nuclear polyhedrosis virus.

Rutherglen and grey cluster bugs

Two species of similar, dull-grey bugs are among the first pests which move into developing sunflower crops from surrounding vegetation. These small, mobile, sap-sucking insects can then usually be observed within crops until completion of harvesting.

Young plants, especially those in the outside rows, are often affected by Rutherglen and grey cluster bugs—plant wilting being the generally observed symptom. Stems of such plants are often discoloured and marked by numerous feeding punctures. High populations, however, particularly during the periods of moisture stress, may result in terminal collapse followed by plant death. In older plants, they are usually found around the seedheads. They shelter in the leaf bracts, and among the flowers and developing seed.

Large breeding populations, which often reach 2 000 per plant, generally coincide with ripening of the seed. Elongate, white eggs are deposited between the seeds. From these hatch small nymphs which are similar to adults in appearance except that wings are not developed. Larger nymphs sometimes are reddish-coloured and they may also be more swollen in shape.

Nymphs and adults feed on both the stem and maturing seed by insertion of tube-like mouthparts. Seed yield and oil quality are affected. In addition, tissue wounding may predispose the head to disease organisms which produce head rot.

CONTROL. Localized insecticide applications will control isolated infestations of Rutherglen and grey cluster bugs within crops (for example, the outside rows). However, reinfestation can be a continuing problem. Treatment of large, infested areas is often of doubtful value because of cost/benefit relationships, and again because of potential rapid re-infestatiion.

Basically, there are two situations where spraying may be justified. The first is when large numbers of adults occur on the plants at initiation of flowering. The second is when high populations of adults and nymphs coincide with maturation of the seed. As it is difficult to obtain reasonable coverage after the heads have turned down, a decision to spray (see table 1) must be made beforehand based on anticipated infestation levels.

Every effort should be directed towards ensuring uniform crop development which allows harvesting to be completed without delay.

Soybean looper

Soybean looper is the common name applied to white-striped, green larvae of a night-flying moth. This species, only discovered in Australia recently, is known to attack both soybeans and sunflowers. Larvae occur predominantly on the leaves and it is rare to find one on the seedhead. For this reason, the pest is not associated with sunflower head rots.

TABLE 1

INSECTICIDES FOR CONTROL OF SUNFLOWER PESTS

Insecticide	Some trade names	Rate (active constituent per hectare)	Withholding period (time before harvest in days)	Pests controlled
maldison U.L.V.*	Malathion U.L.V.	450 ml	1	Rutherglen bug**
methidathion*	Supracide ..	400 g	3	Rutherglen bug
endosulfan	Thiodan .. .. Endosan Endosulfan	750 g	28	Heliothis** green vegetable bug, Rutherglen bug
chlorpyrifos	Lorsban .. .. Nabsol	40 g/100 kg seed	..	false wireworms

* Apply from aircraft only.

** Chemicals recommended for Rutherglen bug will suppress populations of grey cluster bug and those for Heliothis will suppress soybean looper.

The life cycle commences with the deposition of eggs (singly) on the undersides of the larger leaves. Larvae emerge from the eggs after 3 to 4 days and begin feeding immediately. Tissue damage is insignificant during early larval development, but increases dramatically once larvae reach about 1·5 cm in length. Large, irregular-shaped holes in the leaves, therefore, usually coincide with the appearance of large larvae.

Fully developed larvae, approximately 3 cm in length, pupate inside a cocoon of threads. These are normally located on sheltered parts of the plant or in debris at the base of the plant. After an incubation period lasting several days, adult moths with distinctive bronze-gold wing markings emerge from the pupae.

CONTROL. Soybean looper control is usually unwarranted on sunflower, though severe damage late in crop development could necessitate pesticide consideration.

Heliothis

Larvae of two closely related species of night flying moths are known by a range of common names including: corn earworm, tomato grub, cotton bollworm and native budworm. It is not uncommon to find four or more large larvae on a mature sunflower plant. They grow to approximately 3 cm in length. Overall colouration of individual larvae may be fawn, brown, yellow, pink or green.

The moths lay the majority of their eggs (singly) on the upper surfaces of the apical leaves, and among the hairy leaf bracts enclosing the developing seedhead. During daylight hours, moths can often be flushed from their sheltered resting sites within the crop. They quickly move to other plants with a short, erratic flight.

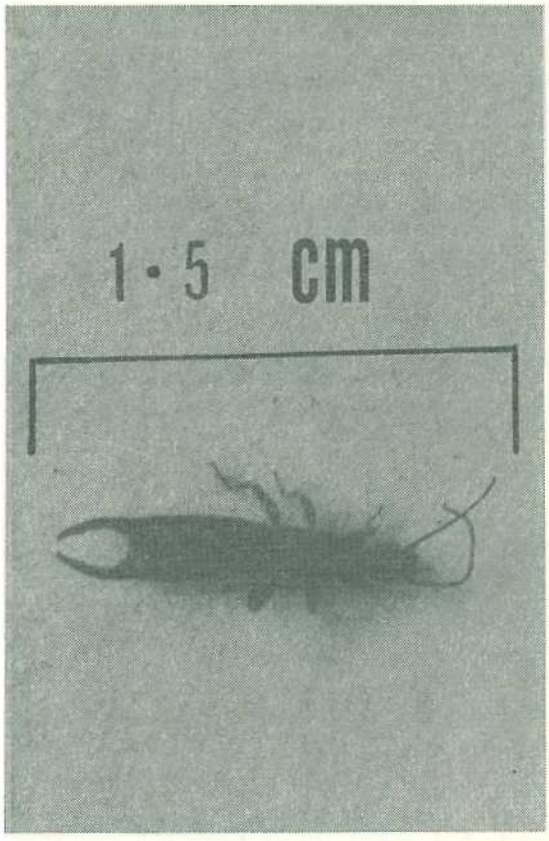
The tiny, globular, pearly-white eggs hatch in 3 to 4 days under favourable conditions. Young larvae, 1 mm in length with a dark head capsule and grey-white body colour, exit by chewing through the confining egg shell.

As might be expected from the sites of egg-laying, younger larvae tend to be found at the plant apex. The leaf bracts are favoured sites of larval concealment, and frass and feeding punctures are often indicative of larval activity. It is difficult to be precise in categorizing

Rutherglen bug (magnified).

Heliothis damage, the main reasons being the considerable variation in behaviour of individual larvae, and cannibalism between larvae. Plant damage can be highly variable but the following comments can be made:

- Favoured feeding sites are the flowerheads. Larvae feed on the pithy tissue at the back of the head, on developing seeds, ray florets and florets in the face of the seedhead. Although most are exposed, partial burrowing and tunnelling are commonplace.



The black field earwig.

- In extreme cases, larvae can cause deformation of growth of the young seedhead and sometimes actual loss of the head by chewing into its connection with the stem.
- Larvae also feed on the leaves (giving them a ragged appearance) and on the stems.

Fully-grown larvae move off the plant into the soil to pupate—and from the pupae, adults emerge to burrow to the surface and begin the life cycle anew. Larval development may take as little as 10 days, and pupal development another 10 to 12 days. A single generation, therefore, takes about a month to complete in midsummer.

CONTROL. Although endosulfan is registered for Heliothis control it is seldom required as the sunflower plant can tolerate substantial damage. Furthermore, insecticide spraying is unlikely to reduce head rot which may develop from within the pest's feeding areas. However, if high populations of medium to large-sized larvae occur at budding, spraying will be required.

Green vegetable bug

This insect is not a common sunflower pest. On occasion, winged adults have been noted on sunflowers, but these probably migrated from preferred hosts such as soybeans and navy beans.

The green vegetable bug feeds by inserting a set of tubular mouthparts into the plant tissues. The point of attachment of the stem to the head is a favoured feeding site. Wilting of the upper parts of the plant is a common sign of green vegetable bug attack.

CONTROL. If large numbers of adult bugs are present, a spray application might be warranted. However, this is rare.

Leafhoppers

Several species of leafhoppers (small green or brown bugs with soft transparent wings) are often seen on sunflower leaves and stems. However, they are usually present in low numbers, and spraying is rarely, if ever, required.

Miscellaneous pests

Another two bugs may be found in small numbers on or in the seedheads. One is approximately the size of the Rutherglen bug, and it is black with white markings. It is known as the cotton seed bug. The other is *Spilostethus hospes,* a red and black insect about 1 cm in length.

TABLE 2

SUSCEPTIBILITY OF BEES TO CHEMICALS REGISTERED FOR SUNFLOWER PEST CONTROL (AFTER JOHANSEN, 1977)

Category	Chemical
1. Hazardous at any time on blooming crops	Maldison U.L.V., Methidathion
2. Minimal hazard if applied during late evening, night or early morning on blooming crops.	Endosulfan

Field cricket (nymph).

Thrips (juveniles are translucent white, adults are black with white wings) are small, elongate insects which frequent the flower-heads. Their damage is insignificant. Grasshoppers and aphids have also been recorded feeding on sunflowers.

Only in exceptional circumstances would a control be needed for any of the above pests.

Numerous species of beneficial insects have been recorded on sunflowers. They fall into two basic categories—those associated with pollination and those that are parasites or predators of pests.

Pollinators

Honey bees constitute approximately 98% of insects visiting sunflowers during daylight hours. Hence, honey bees are the dominant pollinators and spray application should be timed to avoid peak periods of activity. Late afternoon is best in this respect.

Parasites and predators

A situation where spraying occurs infrequently (if at all) allows the build-up of the natural enemies of sunflower pests. These include wasps, ants, bugs, parasitic flies, spiders and predatory earwigs.

Insect-disease relationships

Head rots are important sunflower diseases and the main type is *Rhizopus* head rot. It develops on wounded, mature plants when the atmospheric humidity is high. Young, healthy, undamaged plants are not very susceptible to *Rhizopus* head rot.

Therefore, some form of wounding in ripening heads increases the chance of a *Rhizopus* head rot infection. Insects (also birds and hail) are the chief causes of tissue damage in and around the head. In some instances, Heliothis larvae scarify the whole area at the back of the seed receptacle.

Damage as severe as this is not surprising when it is realized that up to 15 larvae have been recorded on individual plants. However, it is more common to find scattered feeding sites around the head. Apart from Heliothis, the only other insects likely to cause head injury are Rutherglen and grey cluster bugs.

It is not possible to predict the conditions (that is, high humidity and insect damage) which favour the development of *Rhizopus* head rot. In some seasons, atmospheric humidity will be quite high, but insect damage low. At other times, the reverse occurs—severe insect injury may not coincide with high relative humidities.

Uneconomic and undesirable routine insecticide sprays will not prevent insect damage and head rot will still occur. For these reasons, no general recommendations for head rot control can be made. One possibility, where head rot is found, is the use of a dessicant. Where convenient, planting times should be adjusted so that ripening does not occur during periods of high humidity.

Exotic pests

The sunflower (*Helianthus annuus*) is a native of the Americas. In its place of origin (and in Russia into which it was introduced), it supports a numerous and specialized pest fauna. Amongst the most important of these are head and stem feeding moths (*Homoeosoma electellum* and *Suleima helianthana* respectively) and a flower feeding midge (*Contarinia schulzi*). As there is an ever-present danger that pests such as these could be brought into Australia with disastrous consequences, introduction of unauthorized material such as seed must not be attempted.

Scientific names of the pests mentioned in this article are listed alphabetically:

Aphids	*Aphis gossypii* Glov.
Black field earwig	*Nala lividipes* (Duf.)
Cotton seed bug	*Oxycarenus luctuosus* (Montr. and Sign.)
False wireworms	*Gonocephalum* spp. and *Pteroheleus* spp.
Field crickets	*Teleogryllus commodus* (Walk.) and *Teleogryllus lepidus* (Walk.)
Grasshoppers	*Attractomorpha crenaticeps* (Blanch.) and family Acrididae
Green vegetable bug	*Nezara viridula* (L.)
Grey cluster bug	*Nysius clevelandensis* Evans
Heliothis	mainly *Heliothis punctigera* Wall., but also *Heliothis armigera* (Hubn.)
Leafhoppers	family Cicadellidae and family Cixiidae (*Oliarus* sp.)
Mole cricket	*Gryllotalpa africana* Palisot de Beauv.
Predatory earwig	*Labidura riparia truncata* (Kirby)
Rutherglen bug	*Nysius vinitor* Bergr.
Soybean looper	*Trichoplusia orichalcea* (F.)
Thrips	*Thrips tabaci* Lind.
Wireworms	family Elateridae (click beetles)

New State President for Rural Youth

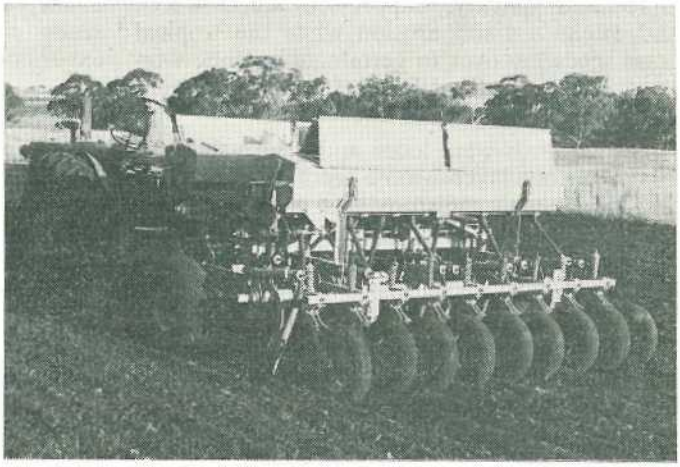
AT the recent State Conference of the Rural Youth Organisation of Queensland, Mr John Burnett was elected State President for 1978–79.

John, aged 24, was educated at Rockhampton Grammar School and lives on a 22 275 ha cattle and grain property, 40 km north of Clermont. John has been a member of Rural Youth since 1971. He is a past president of the Clermont Club, and served a term on the Rural Youth State Council.

John emphasised in his letter to Rural Youth members that it is the clubs which give the Organisation its strength and it is at the club level that members may and should participate enthusiastically in as many activities as they desire.

John is keen to serve the Organisation during this period of umprecedented growth where membership has increased by 100% in 12 months.

Contour furrow and press wheel in pasture establishment



OVER the last 4 years, a method of contour furrow seeding with press wheel compaction of pasture seed mixtures has been successfully demonstrated on the self-mulching, black soils of the eastern Darling Downs.

Pasture establishment using this technique has been far superior to that obtained by broadcasting or shallow seeding.

The problem

Tropical grasses sown by conventional methods are difficult to establish on these basaltic soils. The rapid drying and crusting of the surface soil hinders establishment of the small seeds, which can take more than 14 days to germinate. The position is often compounded by prolific germination of weed seeds present in the soil.

The method

With this planting technique, the small grass and legume seeds are placed on or just in the moist soil at the bottom of the furrow. The press wheel following the furrow gently firms the seed into the soil (see plate 2). Time of planting should coincide with minimum soil and seed pick-up by the press wheels.

Planting on the contour enables the furrow to collect rainwater like a miniature dam. This firms the soil around the small seeds and keeps it moist for a longer period.

A series of demonstration plantings was made on upland black soils in the Cambooya Shire at three different times of year. These were: late summer (early February), winter (June–July), and late spring (November).

by R. G. Wilson, formerly of Agriculture Branch.

ABOVE. Plate 1. The fluted roller—press wheel seeder used in the demonstrations. Only the rear seed/fertilizer box was used.

The winter planting involved using lucerne and/or temperate grasses and legumes as companion plants. The temperate species established quickly, suppressed some weeds and minimized soil erosion while the tropical grass seeds lay over to germinate on follow-up rains in spring. Seed losses from rotting were minimal.

All seedbeds were loose and dry in the 5 to 10 cm surface layer—some sections were quite cloddy. Subsoil moisture was good. Though the seedbeds were not of the cherished firm, fine seedbed recommendation, establishments have been most encouraging.

As shown in plate 1, a 2·75 m fluted roller seedbox mounted on an 18-tine high clearance trash cultivator was used. The seed was fed through nine seed tubes fitted to the seed boots on the rear tines. Scarifier points on the seed boots were 10 cm wide while those on the forward cultivating feet were 30 cm wide. These made furrows up to 10 cm deep and 35 cm apart. Closer furrow spacing was not possible with the machine used. A high intensity storm rain following summer plantings could erode the soil and cover the tiny grass seeds too deep. This situation was not experienced with these plantings.

The furrows made were followed, as illustrated, by a 51 cm diameter, 4·00 x .12 ribbed farm implement tyres fitted to a 5·00 x 12 safety rim.

Planter calibration and seed mixtures

The planter was calibrated in the field according to the seed-box length, the circumference of the land driving wheel (2·16 m) and the amount of seed collected over a 0·04 ha test area. Revolutions of the land wheel were counted either by sitting on the equipment or walking alongside the planter. A chalk mark was placed on the land driving wheel and the equipment frame.

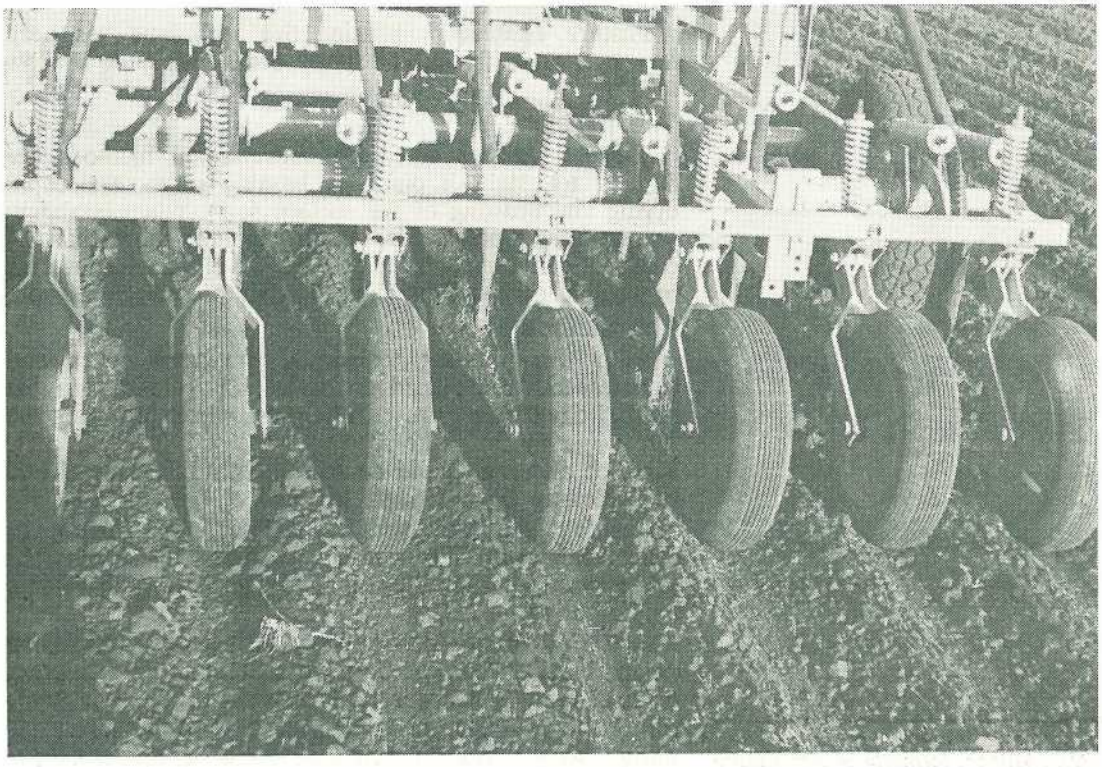


Plate 2. The press wheels firm the seed and fertilizer into the moist soil at the base of the furrows.

When either an 8 or 16 change cog was used the number of revolutions over the same distance was 66 and 53 respectively. Some adjustment for wheel-slip may be necessary.

Care has to be exercised in adjusting the seed rate control lever on the fluted roller planter box. The lever has to be drawn back hard before moving direct to the required setting. Some operators measure the fluted roller spacing as a movement check.

Planting mixtures varied. A late summer planting comprised green and Gatton panics (*Panicum maximum*), Priebie prairie (*Bromus unioloides*), lucerne (*Medicago sativa*) and mixed Jemalong, Cyprus and snail medics (*Medicago* spp.). Demeter fescue (*Festuca arundinacea*) was added for a winter seeding.

Simpler mixtures have also been used:—

A late summer planting comprised Whittet kikuyu (*Pennisetum clandestinum*) and lucerne.

ABOVE LEFT. Plate 3. A uniform strike of pasture 3 weeks after planting.

BELOW. Plate 4. James and Theresa McGovern in the pasture which resulted from the mixed sowing of tropical and temperate species illustrated in plate 3.

ABOVE. Plate 5. Heavy weed growth following a summer planting. Spraying with atrazine can be used to treat this.

BELOW. Plate 6. Background—a plot sprayed with atrazine at 3 kg per ha product. Foreground—an unsprayed plot.

Two late spring plantings comprised *Sorghum almum*, Pioneer Rhodes grass (*Chloris gayana*) and lucerne.

Seeding rates were calculated according to pure live seed values. This was especially necessary with the tropical grasses because much of the commercially available seed had a low germination.

The seeding rates of a recent June planting (illustrated in plates 1 and 2) were 2 kg per ha of Demeter fescue and 1 kg per ha of each of Pioneer Rhodes grass, green panic, Kangaroo Valley ryegrass (*Lolium perenne*), lucerne, and 0·5 kg per ha of mixed annual medics.

Fertilizers used in these trials were based on soil analyses.

Weeds and atrazine

Weeds were a problem in most plantings and competed vigorously with the establishing pasture seedlings. Prominent, heavy-seeding weeds were mintweed (*Salvia reflexa*) in the spring and barnyard grass (*Echinochloa crus-galli*) in late spring and early summer.

On two sites infested with mintweed seed, a light sowing of Minhafer oats (12 kg per ha) was drilled in with nitrogen and phosphorus fertilizer 2 to 4 days ahead of the pasture sowing. From observation, the oat companion crop replaced most of the weed seedlings.

Post-emergence herbicide trials conducted by Departmental research officers on a mint-weed-infested, furrow-planted pasture at Nobby showed the performance of a number of herbicides applied 50 days after planting.

Green and Gatton panic seedlings showed a high tolerance to atrazine from the primary root stage, even at the 5 kg per ha product (80% active constituent) rate. Seedling numbers of Demeter fescue were severely reduced at this rate. When atrazine was applied at 1 to 2 kg per ha of product, a reasonably good stand of panics, fescue and lucerne resulted.

Following these trials, atrazine at 1 kg per ha product was applied by a boom spray ground rig 70 days after the July planting. This controlled a profuse strike of mintweed seedlings with little damage to the pasture.

Acknowledgements

I wish to thank farmer co-operators Messrs T. McGovern, Nobby; W. and J. Kunde, Ramsay; Keith Turner, Cambooya, and W. and G. Guard, East Greenmount. Thanks are also due to Soil Conservation Branch for the use of the press wheel planter; also to Dr W. Scattini and Messrs B. Johnson and J. Marley for assistance in the project.

Rural Industry Information Papers 1978

THE autumn 1978 edition of the Rural Industry Information Papers prepared by the Commonwealth Department of Primary Industry has now been released.

The papers detail primary production in Australia, market prospects for produce, and Commonwealth assistance available to producers.

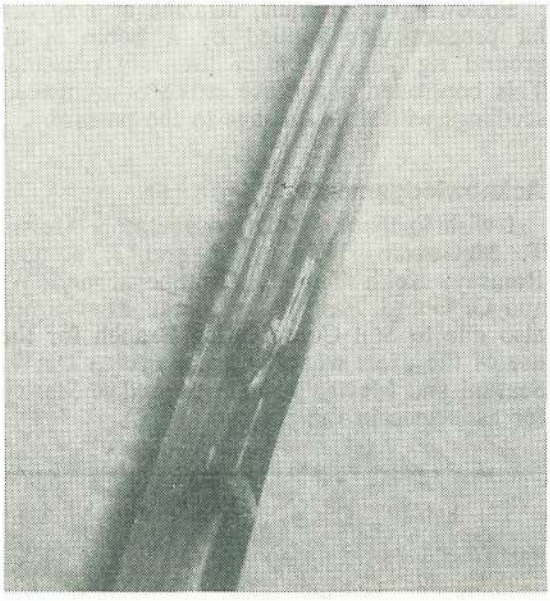
The new publication reports trends in farm incomes and returns for various primary products and includes details of imports of primary products into Australia.

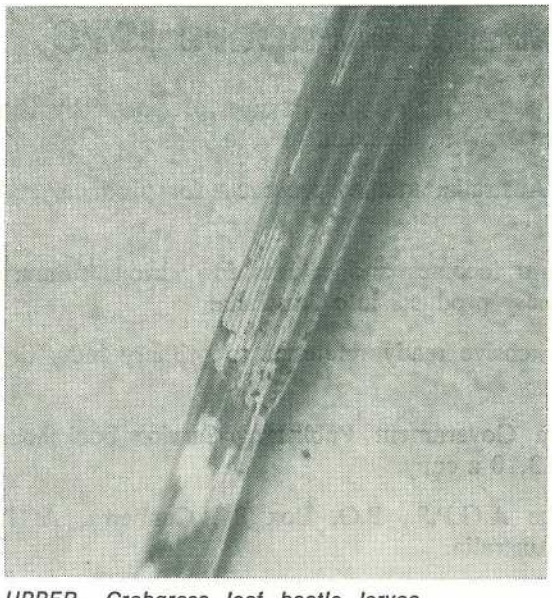
The Information Papers provide a comprehensive ready reference to primary industries in Australia.

The Papers are available from Australian Government Publishing Service bookshops in Canberra and State capital cities at a cost of $3.10 a copy.

Mail order sales are available through the A.G.P.S., P.O. Box 84, Canberra, ACT, 2600, at $3.70 a copy including postage within Australia.

Pests of pangola grass in





UPPER. Crabgrass leaf beetle larvae.

LOWER. Longitudinal striations in a pangola leaf caused by feeding activities of crabgrass leaf beetle larvae.

FOLLOWING extensive plantings up to 1971, pangola grass *(Digitaria decumbens)* had become an important grass for beef production in north Queensland.

It is an introduced species with a number of valuable attributes including high palatability, tolerance to high grazing pressure, ability to grow on a range of soil types and rapid response to nitrogen fertilizers.

In 1971, pangola stands on the wet tropical coast were subjected to damage by pests, particularly pangola aphid and leaf rust. These reduced its value in this area but substantial areas remain—particularly on the Atherton Tableland where stands are irrigated over the winter-spring period, and also on the drier margins of the wet tropical coast especially around Ingham. These will continue to be used as a major source of forage for beef cattle for many years.

In addition to pangola aphid, several other insect pests have been noted to cause occasional problems but as these occur when pangola grass is usually growing vigorously, their damage is of little consequence.

Major pests

Aphids

Pangola grass pastures are attacked regularly by aphids, the most important species being the pangola aphid. The corn aphid is occasionally found in low numbers in pangola aphid colonies, but it is much less important.

OCCURRENCE. In the years when problems occur, aphid populations are generally first noticed in April–May as small colonies on a few leaves. Multiplication is rapid with peak numbers being experienced in July. Populations subsequently decline rapidly, and the pangola aphid virtually disappears by the end of August.

by R. H. Broadley and D. J. Rogers, Entomology Branch.

north Queensland pastures

The pest presents problems to graziers by limiting growth of pangola grass during the cooler, drier months of the year when plant growth is proceeding slowly and feed availability may be critical.

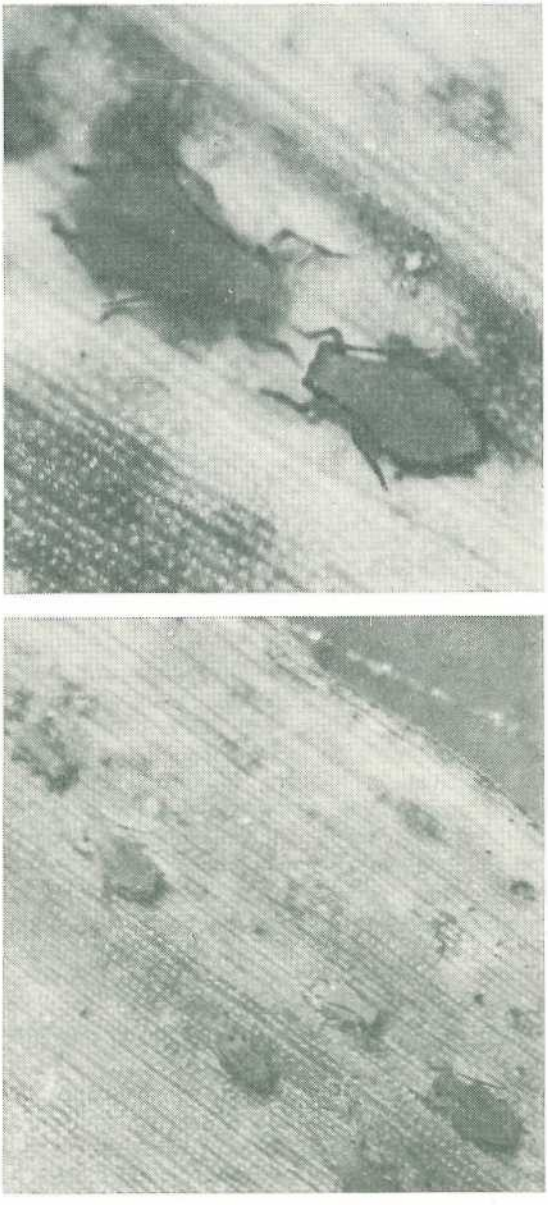
DAMAGE. The aphids are found on the undersides of the pangola grass leaves, and usually concentrated towards the leaf tip. Symptoms of feeding include yellowing and death of the leaf tips. This yellowing and necrosis may move progressively down the leaf blade, resulting in the death of the whole leaf.

Experiments have shown that pangola aphid reduces the rate of growth of pangola grass. As the percentage of grass shoots infested with aphids increased, the rate of dry matter production decreased. This occurs in both young and mature pangola grass pastures. In a particular case noted by the authors, infestation of half the grass shoots reduced the growth rate by nearly one-third over uninfested pangola grass.

CONTROL. There is a high degree of natural biological control of the pangola aphid. Natural enemies most commonly encountered are ladybird beetles (Coccinellids) and hoverflies (Syrphids).

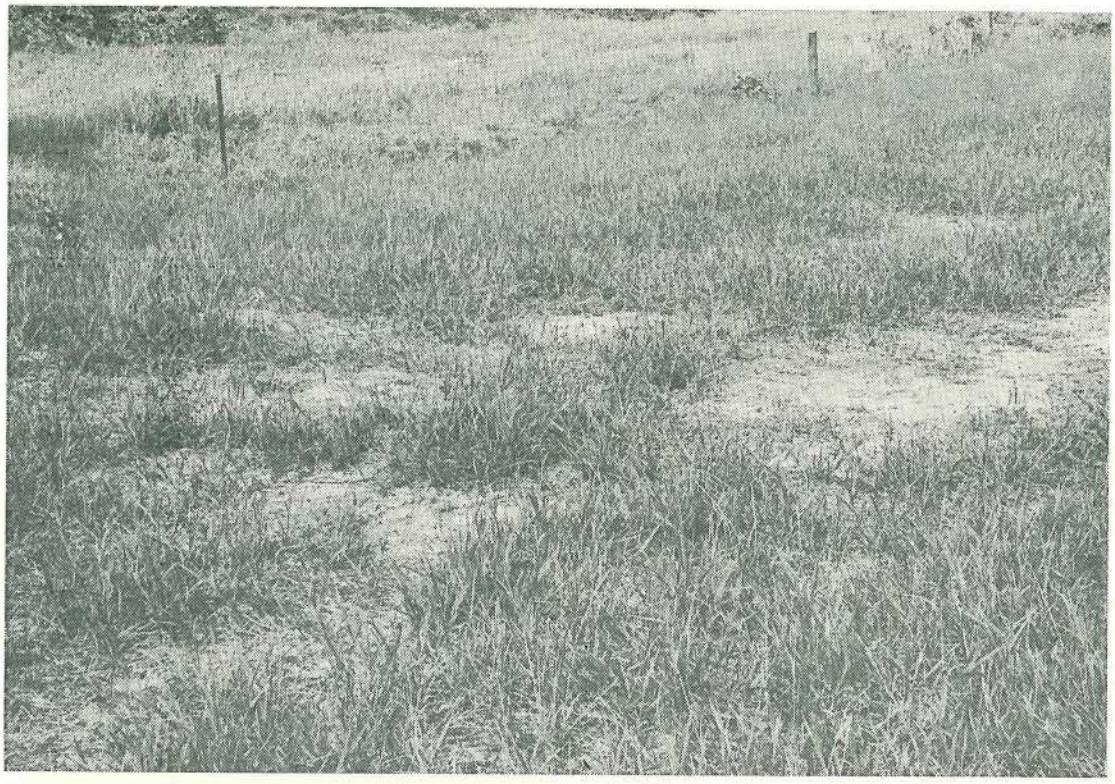
The ladybird beetles are the most important predators of the aphid. Adults lay batches of bright-yellow eggs on grass shoots in infested pastures. On hatching, larvae begin searching actively through the grass stalks for aphid colonies. When fully grown, they transform into pupae on the leaves. Adult beetles emerge from these pupae and also feed on the aphids, both adults and larvae consuming large numbers of the pests.

Hoverflies are less common. Adults are small flies up to 1 cm long with a characteristic yellow banding pattern on the body. They are often seen hovering (hence the common name of hoverfly) over the aphid-infected pastures. The adults lay small, white, elongate eggs among or near aphid colonies.



Wingless pangola aphids feeding on a blade of pangola grass. The upper photograph is more magnified than the lower.

30—63696



Ungrazed pangola grass showing damage by aphids 9 months previously.

Larvae hatching from the eggs are small off-white or brown maggots which grow to about 0·5 cm. They feed actively on aphids but are not able to move through the pasture as effectively as do the ladybird adults and larvae and are therefore somewhat less effective predators. Hoverfly adults do not eat aphids but feed on nectar and pollen.

In most instances, the predators of the pangola aphid provide adequate control of the pest. Chemical control need not be considered where predators, especially ladybird beetles, are active in reasonable numbers.

Where outbreaks of pangola aphid occur in the absence of predators and feed is scarce, consideration may be given to applying chemical control measures. Dimethoate applied at a rate of 75 grams of active constituent per hectare will give good control. On current prices, this treatment would be approximately $1.30 per hectare but application costs must be added to this figure.

Cattle should be removed from the pasture prior to spraying and not reintroduced for 24 hours after treatment.

Crabgrass leaf beetle

It is generally the development of small circular or irregularly-shaped, brown patches that initially attract attention to the activities of this insect, sometimes known as pangola beetle. As infestations develop, such affected areas expand in size and may coalesce with one another. In extreme cases, whole paddocks may be affected, and damage then bears a marked resemblance to frost injury when viewed from a distance.

The beetle, which attains a length of 3 mm, exhibits considerable colour variation unrelated to sex. Two colour forms predominate in the field. The first has metallic green wing covers, while the second possesses two brown spots on the wing covers.

BIOLOGY. Little is known of the feeding or egglaying habits of the beetles, but it is the larvae which hatch from the eggs that cause the most serious damage. Larvae possess a small, dark head capsule which can be partially retracted into the underside of the body. The body itself is almost globular in shape, and is covered with moist excretory or waste products.

Damage to pangola pasture caused by larvae of the crabgrass leaf beetle.

This latter habit presumably plays a part in stopping dehydration (and ultimate death) of the larvae, as these are often found on the upper exposed leaf surfaces. It is common to find both small and large larvae simultaneously on the plants.

Larvae seem to prefer the tender, younger leaves. They usually ignore older leaves and stems. Observations show that populations are higher in pastures well fertilized with nitrogen, indicating that grass with high protein levels may be more suitable for growth and development.

The crabgrass leaf beetle larvae damage leaf tissue in a characteristic manner—by feeding on the upper epidermis and underlying tissue (mesophyll tissue) between the veins. This produces a series of parallel longitudinal striations extending down the leaf blade. Larger larvae, which produce wider striations than smaller larvae, cause most damage to the leaves. Fully-matured larvae form pupae and from these adults emerge to continue the life cycle.

CONTROL. Slashing or grazing affected areas has little effect on numbers of the pest and cattle appear to prefer the more succulent, unaffected parts of the pasture. Irrigation also has little noticeable effect on beetle numbers, though it probably assists in promoting speedy recovery of affected areas. Pastures which are not growing vigorously, either because of a lack of water or for some other reason, are most affected by the activity of the beetle.

Some work with insecticide treatments has been completed and appears promising. However, further evaluation of these chemicals is required before recommendations can be made.

Minor pests

Localized injury has been reported on a number of occasions from the activities of several minor pest species. Attacks generally occur in mid and late summer when pangola grass is growing vigorously and little pasture setback occurs. The most important minor pests are discussed:

Ladybird (Coccinella repanda) *larva.*

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

pangola aphid	*Schizaphis hypersiphonata* Basu
corn aphid	*Rhopalosiphum maidis* (Fitch)
crabgrass leaf beetle	*Lema rufotincta* Clark
lawn armyworm	*Spodoptera mauritia* (Boisduval)
sod webworm	*Herpetogramma licarsisalis* (Walker)
ladybirds	*Harmonia arcuata* (F.) *Coccinella repanda* Thunberg
syrphid flies	*Episyrphus balteatus* (DeGeer) *Sphaerophoria kerteszi* Klock *Simosyrphus grandicornis* (Macquart) *Melanostoma apicale* Bigot

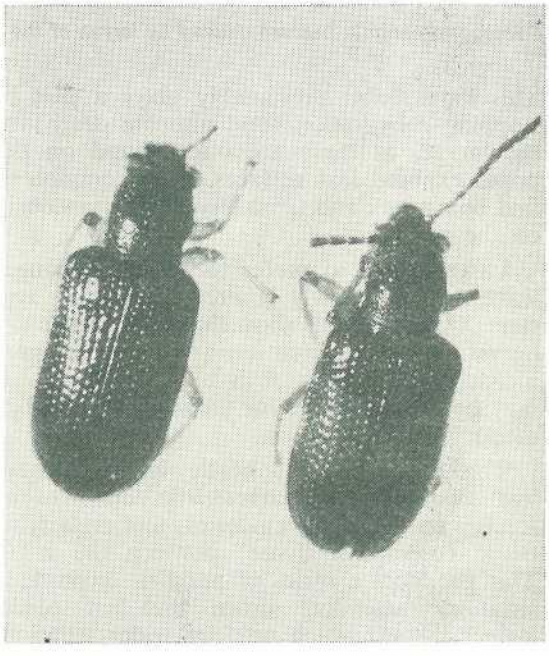
Lawn armyworm

Larvae of a night-flying moth are known as lawn armyworms. These hide in the soil and debris at the base of plants during daylight hours and hence are not commonly encountered. Damage to the aerial parts of the plant occurs mostly at night time.

Sod webworm

Webworm is the name applied to the larvae of a medium-sized, buff-coloured moth which can often be flushed from its resting place in pasture foliage. Larvae, in addition to attacking pangola grass, feed on a number of other grass species.

On the occasional instance where chemical control of these pests may be considered warranted, trichlorfon at 550 g active per hectare will give control of both armyworm and webworm.



Adult crab grass leaf beetles.

Economic aspects of managing beef cattle

by W. J. A. Hall, Beef Cattle Husbandry Branch.

THE age to mate beef heifers is a debatable issue.

Some cattlemen argue that it is more efficient and profitable to mate heifers as soon as they are physically capable.

Others suggest that mating at less than 2 years results in calving difficulties, dead calves and heifers and retarded growth. Success can be measured by the number of calves on the ground but the real yardstick is surely dollars and cents.

This article outlines the economics of different branding rates, calf losses, heifer losses and lowered fertility. Like other increases in productivity, profits are limited by the ceiling on carrying capacity and this factor is taken into consideration. The three ages of first mating which are compared are 15, 24 and 36 months.

Herd structure

If we lower the age of first mating, we influence the structure of the herd. If the branding rate in all 3 herds remains the same (let us say 81%) and the age of turn-off is identical (3-year-old steers and cull heifers) then the herd structure will be as shown in table I.

Gross income

If losses for these 3 herds are the same then the gross income increases as the age of first mating is lowered (table 1). Gross income is defined as the total sales of cattle less bull purchases. Thus, if all factors except the age of first mating remain equal, mating at 15 months (as against 24 months) increases gross income by 11·7%. Similarly, mating at 24 months (as against 36 months) increases gross income by 9·6%.

Of course, all things are not equal. Lowering the age of first mating may increase calf losses, heifer deaths and lower subsequent fertility. What graziers need to know is, will these losses wipe out any extra income?

Left. John Hall is a district adviser in the Department's Beef Cattle Husbandry Branch. John specializes in the economics and marketing of Queensland's beef cattle.

TABLE 1

EFFECT OF AGE OF FIRST MATING ON HERD STRUCTURE AND GROSS INCOME

Age of First Mating (mths)	(1) Herd Structure* % Breeders: Dry Cattle; Bulls	(2) %Sale Cattle to Total Herd	(3) Break-up of Annual Sale Cattle %Cows: Heifers: Steers: Bulls	(4)† Gross Income
36	34 : 64 : 2	26·0	21 : 26 : 52 : 2	17 143
24	38 : 61 : 1	28·0	21 : 26 : 52 : 2	18 781
15	41 : 58 : 1	31·0	22 : 26 : 51 : 1	20 978

* Not including calves less than 12 months of age.

† The prices used and their effect are outlined in the appendix. However, price changes will not have a big effect on the % increase in gross income.

The effect of varying combinations of calf losses etc. are shown in table 2. The first four columns assume some possible effects of yearling mating. Columns 5 to 7 show what would be the effect on income. Column 6 is the most useful. It shows the change in income when compared with mating at 24 months. For example, if we study herd A (which has switched to 15-month-old mating with no increase in losses) we can see that income has increased by 11·7%. Herd B has also switched to 15 month mating but has increased heifer calf losses by 3% and heifer deaths by 1%, the result being an increase in gross income of 11·3%. Herd I has losses of such a magnitude the producer actually loses money by yearling mating (—3·8% column 6).

Only when there is a high level of calf and heifer losses does yearling mating not pay or when subsequent calving rates are very low. The analysis does not consider lower growth rates of heifers' calves because any disadvantage in calf growth normally disappears by the time of turn-off (that is, 3 years of age).

Column 7 is important. At the prices used in this analysis (see appendix) the profit or loss for each heifer mated is shown. If extra feed or work is required to make the project a success, this is the amount that could be spent on each heifer.

Field results

At 'Mt. Eugene', Biloela, the crossbred herd has been yearling mated for many years. Using our analysis, we can compare their herd results with their gross income if they did not yearling mate. This gives a difference in gross income of 11·2%. That is, if Mt. Eugene reverted from yearling mating to mating at 24 months they would lose 11·2% of their current gross income. Clearly, this is very close to our own optimum theoretical advantage of 11·7% (herd A table 2).

Partial yearling mating

Many producers who think that their yearling heifers may not be mature enough to mate at 15 months may opt for a partial strategy. Mate half of the required replacements at 15 months and the other half at 24 months. Alternatively put all heifers to the bull and carry over those that do not conceive. This will produce an increase in gross income of 5·7%. Graph 1 shows the effect of partial yearling mating over a 20 year period. Cattlemen who wish to adopt a cautious approach to yearling mating may find this partial strategy attractive.

Effect of branding percentage

Another question we asked ourselves was: Are the benefits due to yearling mating the same regardless of branding percentage? Calculations indicate that they are (figure 1—see page 329). Herds which achieve a lower branding percentage may find it more profitable to try and raise the branding percentage before they attempt yearling mating (see 'Economic aspects of beef breeder management' in this issue). In practice, those properties with a higher branding percentage are more likely to achieve the growth rates to allow yearling mating.

How to commence yearling mating

If you decide to try yearling mating, you must decide whether to sell all unmated 24-month-old heifers this year and mate all 15-month-old heifers, or to mate both groups of heifers this year and in the future mate heifers at 15 months. Graph 1 shows the effect of these two options on gross income over 20 years. Mating both groups in year 1 yields a much greater return.

TABLE 2

THEORETICAL RESULTS OF SWITCHING FROM 24 MONTH TO 15 MONTH INITIAL MATING

Herd	(1) % Decrease in Initial Calving	(2) % Increase in Heifer Calf Losses at Birth	(3) % Increase in Heifer Deaths at Calving	(4) % Decrease in Subsequent Calving %	(5) Annual Gross Income	(6) % Change in Gross Income from 24 Months Mating	(7) Extra (Less) Return per Yearling Heifer Mated ($)	(8) Source of Data
A	nil	nil	nil	nil	20 978	+11·7	+ 39.16	
B	nil	3·0	1·0	nil	20 911	+11·3	+38.03	Crossbred herds Dystocia Survey, S–W. Qld.
C	10·0	3·0	1·0	nil	20 697	+10·2	+34.21	
D	20·0	3·0	1·0	nil	20 395	+8·6	+29.35	
E	nil	10·0	7·0	nil	20 283	+8·0	+26.82	P. Herefords Dystocia Survey S–W. Qld.
F	nil	10·0	7·0	10·0	19 935	+6·1	+20.98	
G	nil	10·0	7·0	20·0	19 660	+4·7	+16.28	
H	nil	30·5	6·0	nil	19 770	+5·3	+18.31	Brigalow Research Station. 3 year average. Herefords
I	nil	44·0	6·0	nil	19 363	+3·1	+10.98	
J*	nil	44·0	16·0	nil	19 298	+2·7	+7.95	Brigalow R.S. 1975 Worst result 60% replacement
K	nil	65·0	6·0	nil	18 626	−0·8	−3.00	Undocumented property report using Simmental sires
L	nil	65·0	6·0	10·0	18 074	−3·8	−13.92	

* At 50% replacements this herd would fail to maintain stocking intensity after the first 6 years.
At 60% replacements herd numbers are maintained.

When the 24 month group is sold in year 1, the property takes 8 to 9 years to reach its maximum stocking rate. This time could be shortened by over-mating in the initial years.

Conclusion

A number of cattlemen have successfully yearling mated in Central Queensland mainly with Brahman-cross herds. Others have struck many problems. Whether losses are high or low seems to be associated with breed, nutrition, sexual maturity, body condition, pelvic size and calf birthweight. The analysis shows that there are considerable benefits to be gained from reducing the age of mating heifers (either from 24 months to 15 months or from 36 months to 24 months). This is providing losses do not get too high.

Appendix

The economic data in this article is based on a beef breeding and fattening property in the Beaudesert district. With the aid of a computer programme, the parameters were manipulated to determine the consequences of various management actions, such as raising branding percentages, lowering the age of first mating, crossbreeding and so on.

1. Carrying capacity

Assuming that average seasonal conditions prevail, the property carries cattle totalling 650 adult equivalents.

The adult equivalents calculations are in table A.

TABLE A

ADULT EQUIVALENTS (A.E.)

Average Age (Years)	½	1½	2½	3½ or greater
Cows ..			0·8	1·00
Heifers ..	0·4	0·5	0·8	1·00
Steers ..	0·4	0·5	0·8	1·00
Bulls ..			1·20	1·20

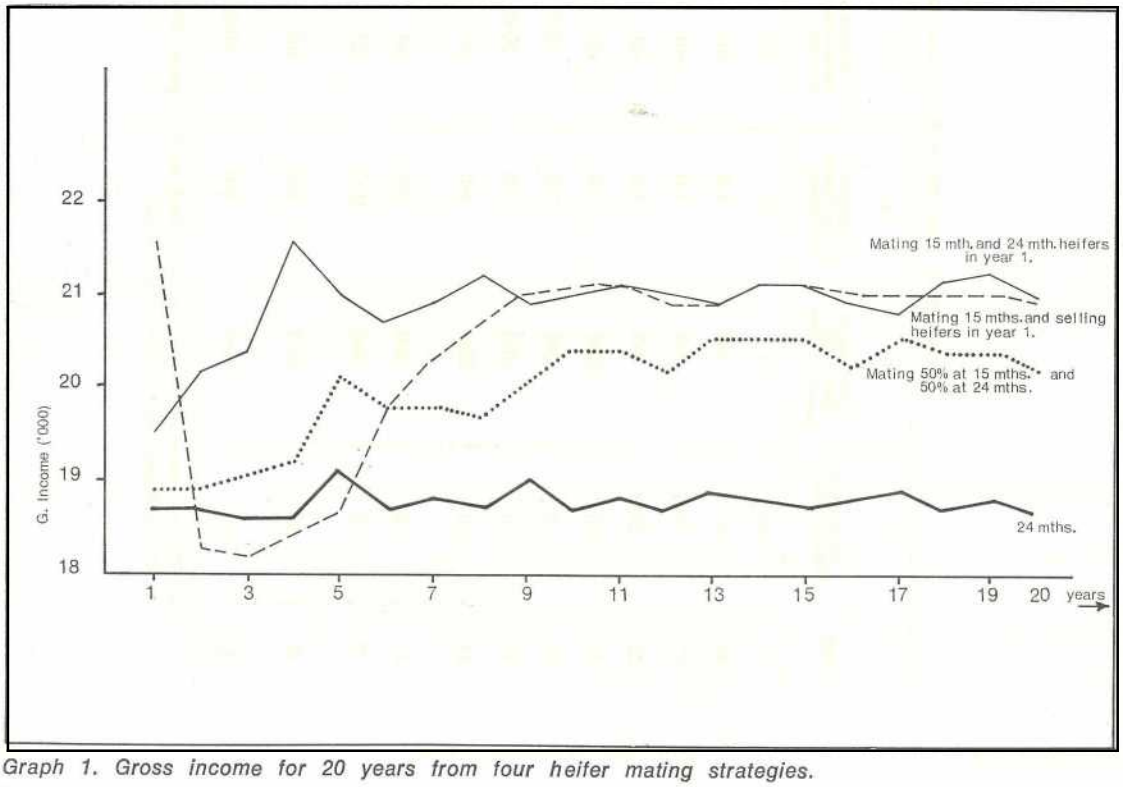
2. Livestock numbers

The actual numbers were based on the Jubarra herd and are outlined in table B.

TABLE B

LIVESTOCK NUMBERS

Average Age (Years)	½	1½	2½	3½	4½	5½	6½	7½	8½	9½	10½	11½
Cows	0	0	0	49	43	42	41	38	29	22	6	0
Heifers	109	107	104									
Steers	110	107	102									
Bulls			3	3	3	2						



Graph 1. Gross income for 20 years from four heifer mating strategies.

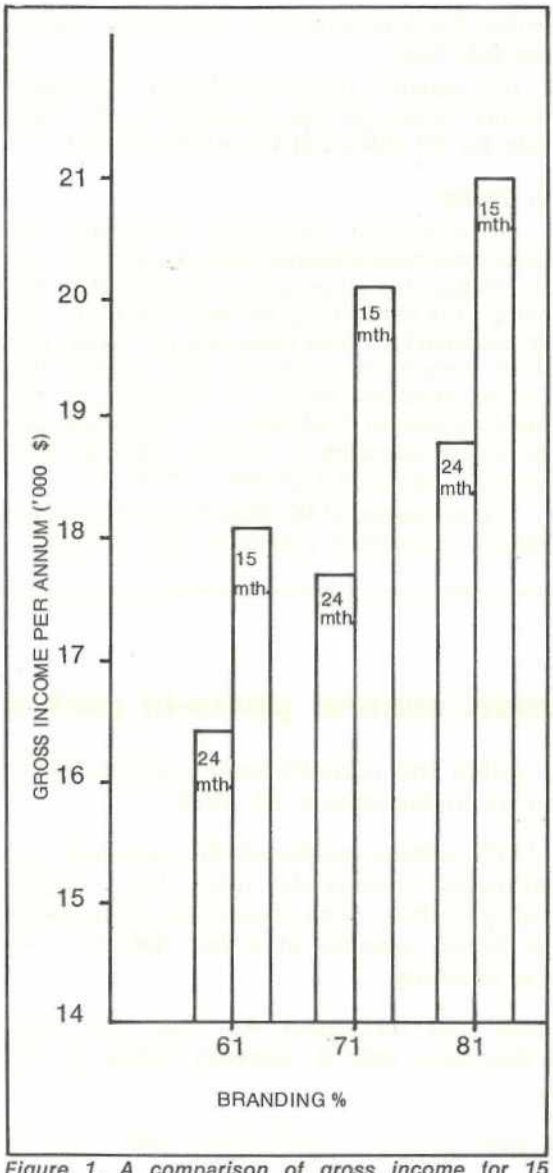


Figure 1. A comparison of gross income for 15 month and 24 month mating at three branding rates.

In this case 4% bulls were used. Producers may adjust the results of the analysis to suit their own particular herd numbers.

3. Losses

Again, losses were based on the results of the Beaudesert herd (table C). Small differences in losses make little difference to the analysis.

TABLE C

ANNUAL LOSSES (%)

Average Age (Years)	½	1½	2½	3½	4½	5½	6½	7½	8½	9½	10½	11½
Cows				3	3	3	3	3	10	10	10	
Heifers	4	2	2									
Steers	4	3	3									

4. Prices

The prices used were based on 20 cents per lb. d.w. (steer), 15 cents per lb. d.w. (cows), 17 cents per lb. d.w. (heifers spayed). All cattle are sold as fats and the dressed weights used were based on local results.

In most of the analysis, price variation has a minimal effect on the PERCENTAGE increase to be gained from improved management practices.

TABLE D

PRICES $ PER HEAD

Average Age (Years)	½	1½	2½	3½ or greater
Cows ..				77
Heifers ..	26	57	88	
Steers ..	34	75	116	
Bulls ..	0	400	350	—Cull value 150

Effect of changes in price

If the price of cattle changes absolutely (that is, price of all classes of cattle rises proportionally) the percentage difference in gross income between the strategies does not alter significantly. Because there is little change in the percentage break-up of annual sale cattle (column 3, table 1) as the age of first mating is lowered, relative price changes (for example, price of cow rises while price of bullock remains static) also have little effect on the monetary advantages of lowering the age of first mating.

5. Selling strategy

The selling strategy differentiates normal and forced sales. Normal sales are those which are part of an annual programme and do not vary from year to year.

Forced sales, on the other hand, are determined by the ceiling on stocking capacity; that is, the degree to which property numbers (in terms of adult equivalents) exceed the ceiling of 650 A.E.

Normal sales

Steers and spayed heifers are sold at varying ages of turn-off as nominated in specific cases.

Annual strategic culling of cows is carried out at three levels:

5%—of each year group for ages 4½ to 7½ (inclusive)

10%—of each year group for ages 8½ to 10½ (inclusive)

100%—at 11½ years of age

Forced sales

In addition, should property numbers (in terms of adult equivalents) exceed the prescribed ceiling, the property may be forced to sell more than normal sales. In this case, females are sold—the number being determined entirely by the degree to which the stocking ceiling has been exceeded. The oldest females are sold first.

For example, if the introduction of yearling mating results in over-stocking by 50 A.E. then the 50 oldest females would be sold.

6. Costs

As mentioned previously, additional bull costs have been deducted from total cattle sales to produce the gross income from cattle. Any extra costs of reducing the age of mating, such as veterinary or feed costs will obviously vary from property to property. The amount that can be profitably spent on each heifer is outlined in column 7 of table 2. There will also be small increases in selling costs as herd turnover increases (column 2, table 1).

The assistance of W. Moorhouse, Economics Services Branch, is gratefully acknowledged.

Extension of brucellosis movement control phase-in period

THE phase-in period for movement control within the recently-extended brucellosis protected area has been extended from July 31 to September 30, 1978.

The Minister for Primary Industries, Mr V. B. Sullivan, explained that seasonal conditions, including drought in the north-west and heavy rains in the south, had disrupted mustering of cattle for brucellosis testing on many properties. This meant that classification of holdings for movement control purposes was behind schedule in a few districts. An extension of the phase-in period beyond July 31 was necessary.

Following consideration of reports from field staff throughout the State and representations from producer bodies it was agreed that more time is necessary before the full movement restrictions are imposed on the industry.

During this additional period of 2 months, most cattlemen should have ample time to complete testing.

The extension of time will also coincide with the end of the busy cattle season.

Mr Sullivan said the whole programme, despite climatic difficulties, had progressed more rapidly than planned. This had caused some problems at laboratories and at centres such as the Taroom Shire, but steps have now been taken to overcome them. Mr Sullivan was confident that, with the continued co-operation of producers, agents and veterinarians, the excellent progress with brucellosis eradication over a wide area of the State would be sustained.

Economic aspects of beef breeder management

THE Queensland branding percentage is 64% (Australian Bureau of Statistics). However, the number of cattle slaughtered suggests it might even be lower.

Many cattlemen do achieve much better than average results—many must be achieving worse.

Individual property results

In table 1, the branding percentages of herds that have been closely monitored by D.P.I. officers are compared with the district average. In most cases, these results were not achieved by high cost practices. They were achieved by the use of practical animal management and husbandry techniques such as controlled mating, herd segregation and strategic weaning. It is clear that improved management can lift production. The purpose of this article is to outline the economic importance to cattlemen of increasing branding percentages.

Calculating the branding percentage

The individual property results in table 1 define the branding percentage as the number of calves branded as a percentage of the number of females joined in a particular year. Guestimates of the possible calves from cull cows increase the inaccuracies of assessing branding percentages. All heifers over 12 months of age with access to a bull should be included.

Accurate calculations often show big differences between the real branding percentage and the often quoted apparent percentage (the number of calves branded to the number of cows in the paddock at the time of branding). These apparent percentages are illusory. They lull the manager into a false sense of success and mask the need to try for better results.

It is even more difficult to determine an accurate branding percentage when mating is uncontrolled (that is, when the bulls are in with the breeders all the year).

by W. J. A. Hall, Beef Cattle, Husbandry Branch.

Increasing the branding percentage need not involve high costs—merely changes in management. Strategic weaning, controlled mating and culling on reproductive performance are all in this category. To the majority of producers an extra dollar earned for the same outlay is equal to a dollar saved by cutting costs. Understandably perhaps, in times of depression, there is a tendency to concentrate on the latter strategy but opportunities to cut costs are often limited.

Attention to the former strategy (that is, increasing production at the same costs or increasing income at a greater rate than increasing costs) often offers more profitable opportunities for the individual producer. (What is best for each individual producer of course, may not be best for the industry).

Gross income from various branding percentages and age of turn-off

Table 2 shows the variation in gross income resulting from three branding percentages (61%, 71%, 81%) and four ages of turn-off, that is, selling at 0 to 12 months, (Yr. 1) 12 to 24 months (Yr. 2), 24 to 36 months (Yr. 3) and 36 to 48 months (Yr. 4). Age of turn-off applies to age of sale of steers and cull heifers.

The model and assumptions on which these figures are based are given in the appendix to this series (see 'Economic aspects of managing beef cattle' in this issue).

Table 2 can be seen as a comparison of 12 properties, identical in size, stocking rate, climatic conditions, prices and saleweights. The only difference between properties are branding percentages and age of turn-off. Corrections have been made to equalize heifer replacement levels for all properties.

Column (4) shows how the increase in branding percentage lowers the percentage of breeders to total cattle carried on the property. (At the same time of course, the proportion of lactating breeders to total breeders rises). As the age of turn-off increases, the percentage of breeders to total cattle decreases.

TABLE 1

**

COMPARISON OF INDIVIDUAL PROPERTY AND REGIONAL BRANDING PERCENTAGE

Property	Years	Branding % (or weaning)	Vegetation/pasture	Remarks	Shire	Shire branding % for same years
Eskdale ..	1970–74	83·0	Granite, forest	Pregnancy rate in excess of 90%	Esk	77·6
Yandarlo ..	1965–69	76·8	Brigalow, belah, wilga and myall	89·6% pregnancy rate less 12·8% losses to weaning	Murilla	65·1
Woodlawn ..	1968–72	83·6	Box, Sandalwood, Ironbark, Wilga	Includes 5·9% losses pregnancy to weaning	Balonne	60·7
Moombidary ..	1972–74	77·3	Mulga, Bloodwood, Beefwood	Portion of mature cow herd only. (weaning %)	Bulloo	61·7
Mount Eugene	1965–69	82·0	Ironbark, Bloodwood, Moreton Bay Ash	90% pregnancy rate less 8% losses to branding	Banana	70·1
Kairoo ..	1964–69	78·0	Mixed: Forest—Alluvial—Brigalow	86% pregnancy rate less 8% losses to branding	Duaringa	62·8
Memooloo ..	1964-70	86·0	Mainly improved brigalow	94% pregnancy rate less 8% losses to branding	Bauhinia	53·9
Gregory Falls	1971–73	72·6	Fertilized tropical pasture		Johnstone	50·9‡
Katandra ..	1973–75	81·4	Mitchell Grass Downs		Flinders	61·4

* The comparison between individual properties and shire averages may be marginally constrained by variation in land types, etc.

† Australian Bureau of Statistics.

‡ Small numbers only.

** Source: individual D.P.I. trial reports.

TABLE 2

EFFECT OF VARIOUS BRANDING RATES AND AGE OF TURN-OFF ON HERD COMPOSITION, SALE BREAK-UP AND GROSS INCOME*

(1) Herd	(2) Branding	(3) Age of Turn-off	(4) Herd Structure % Breeders: Calves: Dry Cattle: Bulls	(5) % Turn-off Sale Cattle: Total Herd	(6) % Break-up of Annual Sale Cattle Breeders: Heifers: Steers: Bulls	(7) Gross Income per Breeder	(8) Gross Income per Property	(9) % Increase on 61% Branding at the same Age of Turn-off
						$	$	
A	61	1	48 : 30 : 20 : 2	27·6	27 : 18 : 54 : 1	23.34	9 524	
B	71	1	44 : 34 : 21 : 2	29·9	28 : 18 : 53 : 1	28.55	11 047	+16·0
C	81	1	41 : 35 : 22 : 2	32·3	29 : 17 : 52 : 1	33.22	12 258	+28·7
D	61	2	40 : 26 : 33 : 2	23·0	28 : 18 : 52 : 2	38.99	14 036	
E	71	2	36 : 27 : 35 : 2	24·5	29 : 18 : 52 : 1	45.90	15 514	+10·5
F	81	2	34 : 28 : 36 : 1	26·1	30 : 17 : 51 : 1	53.53	17 131	+22·0
G	61	3	34 : 22 : 42 : 1	19·6	28 : 18 : 52 : 2	53.91	16 388	
H	71	3	31 : 23 : 44 : 1	20·7	30 : 18 : 51 : 2	62.60	17 715	+8·1
I	81	3	29 : 24 : 46 : 1	21·6	31 : 17 : 50 : 1	71.56	18 893	+15·3
J	61	4	30 : 19 : 49 : 1	16·6	27 : 19 : 52 : 1	62.00	15 935	
K	71	4	27 : 20 : 51 : 1	17·8	28 : 19 : 52 : 1	73.36	17 314	+8·6
L	81	4	25 : 21 : 53 : 1	18·7	30 : 18 : 50 : 1	83.56	18 300	+14·0

* Adjusted to 66% Heifer Replacement.

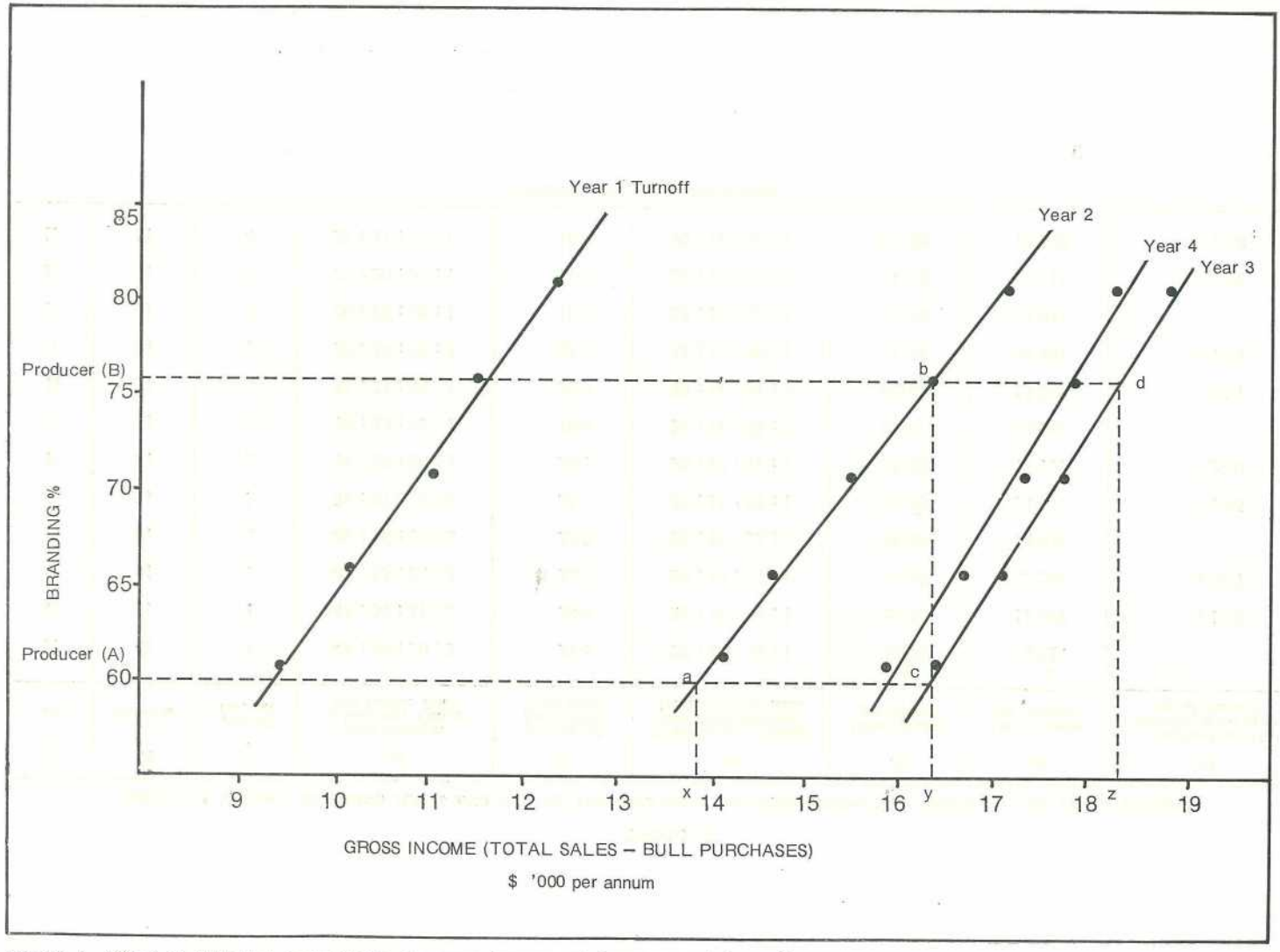


Figure 1. Effect of branding percentage on gross income at four ages of turn-off.

Column (5) shows herd turn-over. Increases in branding percentages increase turn-over, while increases in age of turn-off decrease turn-over. This is important in regions where transport and selling costs are high.

The importance of column (6) is that there are only small changes in annual sale break-up. Absolute and relative (for example, price of cows rises while steers are static) price changes will not alter the financial significance of increasing branding percentage (see appendix).

Columns (7) and (8) outline gross income (total income from sales of cattle less bull purchases) per breeder and per property. Although gross income per breeder is highest at the year 4 age of turn-off, gross income per property is highest selling in year 3.

The most useful section is column (9) and underlines the economic importance of increasing branding percentages. For each age of turn-off, the value of increasing branding percentage from 61% to 71% to 81% is shown.

For example, given a year 1 turn-off, an increase of 20 percentage points in branding percentage (from 61% to 81%) yields a 28·7% increase in gross income. As the age of turn-off increases, the incentive to improve branding percentage declines. A 20 point increase at year 4 turn-off yields only 14·8% extra gross income.

This is more dramatically demonstrated in figure I. Each solid black line represents a different age of turn-off. Movements in branding percentage are reflected in movements along the black line. For example, producer (A) brands 60% calves at year 2 turn-off (point a) resulting in a gross income of $13 850 (point x on the horizontal axis). If he increases his branding percentage by 16 points, that is, to 76% he reaches point b on the black line; a gross income of $16 300 (point y on the horizontal axis). He could achieve the same increase in income by switching to year 3 turn-off (point c on the year 3 black line and point y on the horizontal axis).

Changes in price may alter the absolute gross income but the slope of the black line is unlikely to alter significantly. An improvement in seasonal conditions (that is, nutrition) or an expansion of the property or herd may lead to a rightward shift of the black line but the slope will remain much the same. The steeper the slope of each black line, the less the benefit from increasing branding percentage.

As mentioned earlier, the reader interested in the assumptions behind the model should refer to the appendix to this series, published in 'Economic aspects of managing beef cattle' in this issue.

Summary

Queensland's average branding percentage is not high. However, individual properties achieve consistently better results using improved management practices. Branding percentage is the critical factor in determining gross income on most beef breeding properties.

If increases in branding percentage are achieved via the correct adoption of improved management practices—such as strategic weaning, controlled mating and so on—then any extra costs should be minimized.

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.

Tomato spotted wilt virus in Duboisia

by G. J. P. McCarthy and R. S. Greber, Plant Pathology Branch.

DUBOISIA *(D. leichhardtii* and *D. leichhardtii* x *D. myoporoides* hybrids), commonly known as corkwood, is grown commercially in Queensland's Burnett district.

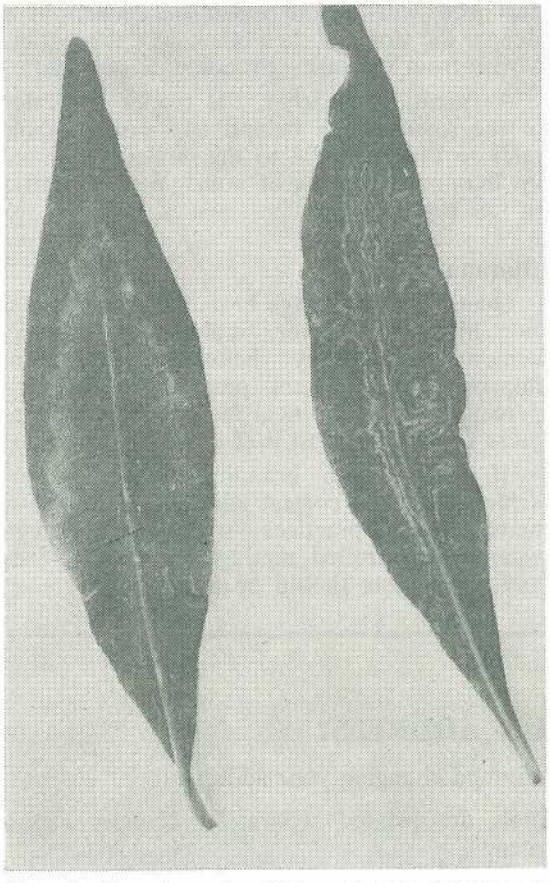


Plate 1. Fine, irregular lines and ring patterns on leaves of a Duboisia plant naturally infected with tomato spotted wilt virus in the field. Virus was transmitted from specimens with symptoms similar to those shown in plates 1, 2 and 3 to other plant species susceptible to TSWV and back to Duboisia seedlings.

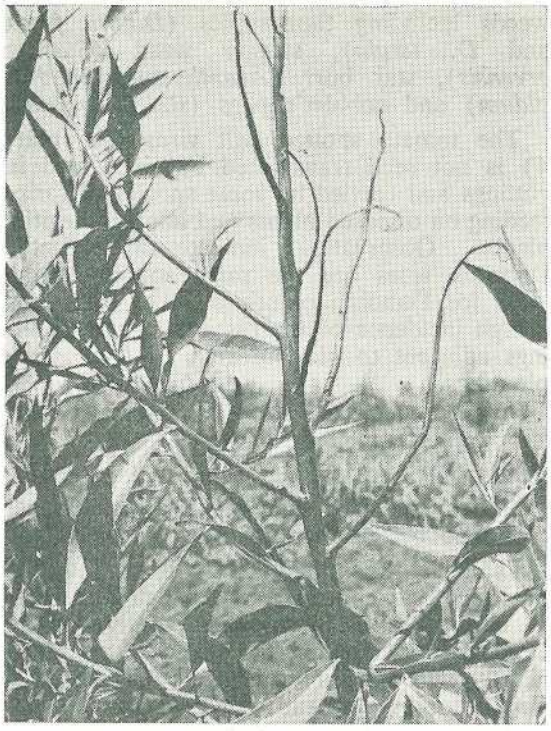
The leaves are a valuable source of alkaloids the most important of which are scopolamine (hyoscine) and hyoscyamine.

Large numbers of trees in many plantings have been affected by occasional epidemics of a wilt and dieback resulting from infection by tomato spotted wilt virus (TSWV).

Disease symptoms

The most severe symptoms appear in the first season and some trees die but others recover to some extent although the virus persists in the tissues and symptoms reappear from time to time.

Plate 2. Duboisia plant affected by tomato spotted wilt virus. Lower stems have collapsed and infection has caused a number of small and distorted leaves.

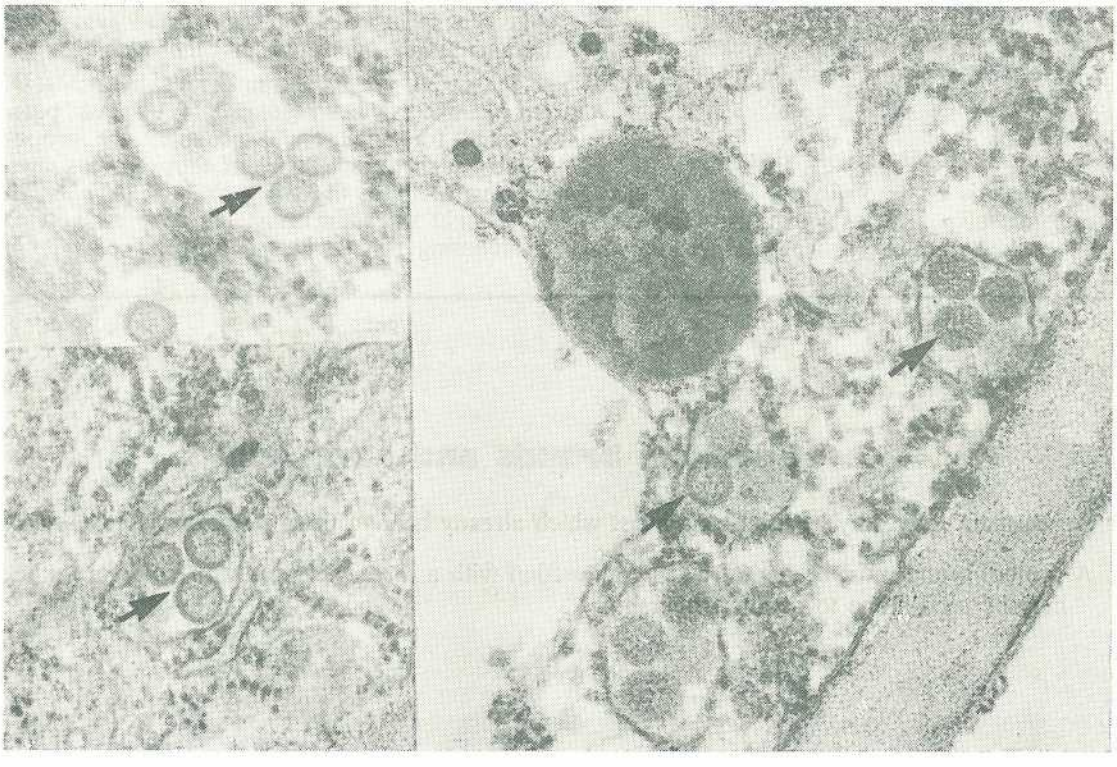


Affected trees show some or all of the following symptoms.

- FINE, IRREGULAR LINES ON THE LEAVES. The lines may be in the form of rings or may be parallel to the midrib and main veins producing a 'herringbone' pattern (see plate 1). Such symptoms may be present on only a few leaves and subsequent growth may be normal. While, on some occasions, lines and ring-spots may appear on few infected plants, on other occasions they may be seen on more than half the trees in a field. Small leaves often develop on such trees.

ABOVE LEFT. Plate 3. Duboisia plant with dieback of the main stem and side shoots after infection with tomato spotted wilt virus.

BELOW. Plate 4. Particles of tomato spotted wilt virus (arrows) in thin sections of a naturally infected Duboisia leaf. Photographed with an electron microscope at a magnification of approximately 40 000.



31—63696

- VEIN BANDING. The leaf tissue adjacent to the main vein, particularly at the base of the leaf, remains dark green while the rest of the leaf is much paler. Affected leaves are frequently distorted.
- COLLAPSE OF LOWER BRANCHES. Often the lower branches of affected trees collapse on to the ground except for the ends which become erect again (see plate 2). The leaves do not wilt immediately. However, the base of the side stem is usually constricted and the bark there deteriorates and is lost. A swelling often develops on the side stem just above the constriction and the leaves on new growth are often small.
- APICAL DIEBACK. Apical dieback of the main stem and/or some of the branches is the commonest symptom shown by affected plants (see plate 3). Purple discolouration, purple line patterns or brown cork may develop on the stems behind the dead tip.
- LEAF FALL AND WILTING. Leaf fall or wilting may occur as shock reactions soon after infection.
- STUNTING OF THE MAIN LEADER. If the tree survives, the main stem may grow more slowly than the side branches.

The tomato spotted wilt virus

The virus is common in the Burnett district where it also affects peanuts, tomatoes, potatoes, peas, many ornamental plants and weeds including thornapples (*Datura ferox* and *D. tatula*), stagger weed (*Stachys arvensis*), star burr (*Acanthospermum hispidum*) and cobbler's pegs (*Bidens pilosa*).

The tomato spotted wilt virus (see plate 4) is not seed transmitted but is spread in cuttings and carried by some species of thrips feeding on diseased plants and later on healthy plants. Observations indicate that affected Duboisia trees are the main source of the virus for Duboisia plantings. There is often a high incidence of the disease in new plantings adjacent to old, infected *D. leichhardtii* plantings.

Control

Destroy old plantings which are no longer economic before planting adjacent areas.

Establish the nursery away from Duboisia plantings and control weeds which are liable to carry TSWV by mowing, cultivation or weedicides. Spraying the nursery trees fortnightly with dimethoate will control thrips and may reduce the spread of the virus.

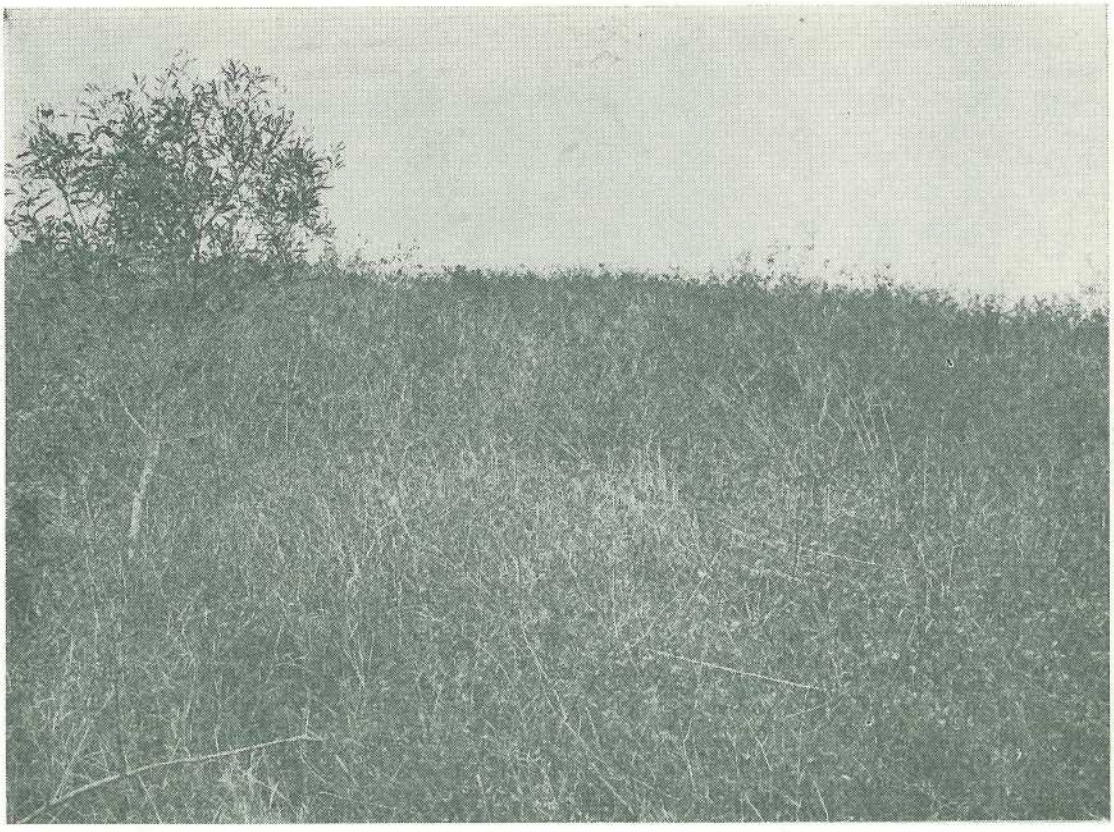
There is evidence to indicate that plantings made in spring develop less severe symptoms than summer and autumn plantings.

In recent years, a number of hybrids (*D. leichhardtii* x *D. myoporoides*) have been selected for commercial use and are propagated by cuttings. Some of these have shown greater tolerance to TSWV than *D. leichhardtii* and might offer the most effective method of overcoming this serious problem.

Use of symbol brands and earmarks

- An earmark may only be used on a beast which already bears a three piece or symbol brand.
- A symbol brand must be registered in conjunction with a three piece brand. However, either may be used alone to denote ownership.

A new look at lantana control



Untreated lantana.

by B. L. Bartholomew, Agriculture Branch and T. R. Armstrong, Lands Department (Sir Alan Fletcher Research Station).

A PLANNED programme of lantana control has proved to be effective on hilly country in the Lockyer Valley.

This programme involves burning or clearing, followed by the immediate establishment of a green panic/Siratro pasture, spot spraying of regrowth with 'D.P. 60' and subsequent annual burning and spraying.

Lantana (*Lantana camara*) was originally introduced to Australia as an ornamental plant. The different types are usually identified by the flower colour and/or locality of occurrence. Known types are 'Helidon White', 'Townsville Orange', 'Red' and 'Pink'.

Lantana now occurs as a weed of pastures, creeks, gullies, steep hillsides, roads and forests in the coastal and subcoastal areas stretching from central New South Wales to Cooktown.

It grows on any well-drained soil with an annual rainfall above 650 mm, and is relatively drought-resistant and somewhat shade tolerant. It does not grow well under cold, frosty conditions.

In general, lantana infestations which are uncontrolled take over and render areas useless for grazing purposes. Lantana can also be poisonous to cattle, particularly those introduced from lantana-free areas.

Control is difficult because lantana seeds profusely and the seeds are readily spread by birds.

Lantana burnt and sown to green panic and Siratro pasture. Regrowth sprayed with 2,4-D amine.

Biological control using introduced lantana eating insects has had some success in the wetter parts of Queensland but has had relatively little effect in the drier areas.

Recent research

In the Lockyer Valley, recent research has shown that various combinations of cultural controls and chemical sprays are capable of returning lantana-infested pasture land to full production.

The lantana variety treated in this work was 'Helidon White' growing on steep grazing country in the Helidon district. The soil types were scrub and better class forest.

The initial control measures tried were clearing of lantana by bulldozer on accessible slopes and burning of lantana on steep slopes.

In addition, half of the bulldozed area was disced. Then a pasture mixture of green panic (*Panicum maximum* var. *trichoglume*) and Siratro (*Macroptilium atropurpureum*) was hand broadcast over half the disced and burnt area.

On top of this again, some areas were sprayed with herbicides over a 2-year period while others were left unsprayed.

Individual details of control measures tried are shown in table I.

Results

The results of this work emphasize the following important points:

- Mechanical clearing and discing is superior to burning but is limited to accessible country.
- Immediate establishment of a competitive pasture following either clearing or burning is most important.
- Spot spraying of regrowth is necessary to control lantana fully.

The sprayed strips stood out clearly after 12 months. Siratro persisted despite a short setback due to spraying. Some thinning of stand occurred and it may be preferable, in some instances, to plant Siratro after the first spraying.

Pasture establishment important

The basis of all lantana control should be the establishment of a vigorous pasture. The pasture species selected must be able to compete with lantana. Native species generally are poor competitors and, in the Lockyer Valley, the most suitable pasture is a combination of green panic and Siratro.

In northern areas of the State guinea grass (*Panicum maximum*) can be substituted for green panic. Both grasses are shade tolerant, which enables them to grow through the lantana which has been thinned by burning or spraying. They also provide a bulk of fuel for subsequent burning. Siratro scores in two ways. First it will grow over the lantana, thereby smothering it. Equally important is its ability to supply nitrogen to the grass. This nitrogen is necessary to keep an improved grass growing vigorously.

Siratro on its own is inadequate as the lack of winter and spring growth leaves too many bare patches. This does not happen in mixed green panic/Siratro or guinea grass/Siratro pastures.

Thus, both the shade tolerant grass and the climbing legume are necessary for the system to be successful.

The pasture should be established following a burn of standing lantana in the spring, or, alternatively, following bulldozing and discing on accessible country.

The seeding rate should be higher than normal so as to ensure a rapid pasture establishment. Rates of around 6 kg of green panic plus 2 kg of Siratro per hectare have proved satisfactory.

The pasture should be given every opportunity to establish. Cattle should be locked out of the area for 4 to 5 months following sowing and it should be only lightly grazed for the next 12 to 18 months. Where the soil is deficient in phosphorus, superphosphate at 250 kg per hectare will speed up pasture growth.

Chemical control

The use of chemical sprays on lantana regrowth, following burning or clearing and planting pasture, has proved quite effective and more economical than spraying mature, standing lantana.

The lantana regrowth should be growing vigorously and about 30 cm to 1 metre long at the time of spraying. Generally, autumn spraying or spraying after general rain when the lantana is actively growing gives the best kill.

Chemicals and rates to use

Either of two herbicides can be used—namely, dichlorprop and 2,4,-D amine. Dichlorprop is available only as 'D.P. 60', which contains 60% of active constituent. Several commercial preparations of 2,4-D amine are available, most of which contain 50% of 2,4-D.

Water is used as the carrier for both herbicides. Dilution rates are 1 part of D.P. 60 to 200 parts of water, or 1 part of 2,4-D amine (50% product) to 250 parts of water.

ABOVE. Lantana burnt and sown to green panic and Siratro pasture. Regrowth sprayed with D.P. 60.

BELOW. Lantana bulldozed. Existing green panic oversown with Siratro. Regrowth sprayed with D.P. 60.

Care must be taken using these chemicals as both can cause damage to crops from spray drift.

Application methods

Spot spraying of regrowth using a power spray fitted with a long high pressure hose equipped with an adjustable trigger type nozzle (brush gun) has proved quite effective.

High volumes of spray are required as the lantana regrowth must be thoroughly wet.

The adjustable nozzle allows the operator to spray regrowth at some distance from him which is a considerable advantage.

Misting machines have not given consistent control in the open pasture type situation as they do not put out enough liquid. The fine droplets are also more likely to cause spray drift damage to crops.

Follow-up treatment

Follow-up treatment is usually necessary within 12 months to control seedlings and regrowth of original plants. The best system is to burn once again in the spring, and then spot spray regrowth as before. About 60% reduction in the lantana stand can be expected following the original spray, and progressively more on follow-up sprays.

Costs

The expense of mechanical clearing is offset to some degree by lower spray costs due to less immediate regrowth than that experienced following a burn.

Costs will vary according to the degree of lantana infestation. Approximate costs of the various control measures (seed, chemicals, hire of bulldozer, no labour) tried at Helidon, are shown in table 1.

TABLE 1

HELIDON LANTANA CONTROL METHODS AND COSTS

Control Method	Cost per hectare $ Oct. 1975–Dec. 1977
Lantana cleared by bulldozer and green panic (already present) allowed to regrow ..	20.00
Lantana cleared by bulldozer and disced	25.00
Lantana cleared by bulldozer, disced and planted to green panic and Siratro	48.00
Lantana cleared by bulldozer, disced, planted to green panic and Siratro followed by herbicide sprays.	
D.P. 60	64.65
2, 4-D amine 50%	59.68
Lantana cleared by bulldozer, planted to Siratro followed by herbicide sprays. (green panic is already present).	
D.P. 60	52.96
2, 4-D amine 50%	46.20
Lantana burnt and natural vegetation allowed to regrow	Labour to burn only
Lantana burnt and natural vegetation allowed to regrow plus herbicide	
D.P. 60	35.16
2, 4-D amine 50%	28.35
Lantana burnt and planted to green panic and Siratro	23.00
Lantana burnt and planted to green panic and Siratro plus herbicide sprays	
D.P. 60	51.38
2, 4-D amine 50%	46.07

NOTE: Clearing consisted of pushing lantana into heaps by means of a bulldozer. These heaps were subsequently burnt when dry enough.

Herbicide sprays were applied to regrowth in the first year after either clearing or burning and in each of the 2 following years after burning (3 sprayings in total).

The type of country treated was mixed scrub and better type forest; before treatment the area was virtually useless for grazing purposes.

D.P. 60 costs about 60% more than 2,4-D amine 50. However, in this trial D.P. 60 gave a 10% better kill. Other trials conducted by the Sir Alan Fletcher Research Station on different types of lantana, have given more consistent and much higher percentage kills with D.P. 60 than with 2,4-D.

Overall, D.P. 60 has proved to be the most consistent and effective herbicide for lantana control. The better original kill results in less chemical usage and less labour in follow-up spot sprays.

Other methods of control

Burning and sowing to green panic/Siratro with reburning in the following year has reduced the coverage of lantana and encouraged the pasture to thicken up. Annual burning has thus improved the grazing value of these areas and, over a period of time, could be quite advantageous. Some reduction in lantana plant numbers has occurred.

A warning needs to be stressed against continuation of annual burning indefinitely. This can result in loss of soil organic matter and soil erosion. Once the density of lantana reaches a sufficiently low level that it can be controlled by hand grubbing or chemical treatment, regular burning could be discontinued.

Hand grubbing is still as effective as ever but has to be balanced against the high cost of labour.

Basal bark spraying can be used effectively on scattered, exposed, large-stemmed lantana plants. Spray right around the lantana trunk from ground level up to 30 cm height using a mixture of 1 part 2,4,5-T ester (80% product) with 79 parts of diesel oil.

Cut stump treatment can be used in situations where multiple stems can be brushed, slashed or otherwise cut. The cut stump should be swabbed immediately with a solution of 1 part of 2,4-D amine (50%) mixed with 49 parts of parts of water.

Recommendations

Experience shows that the steps to successfully control lantana are as follows:

- Either burn or bulldoze to reduce original bulk of lantana.
- Next sow a competitive pasture consisting of a shade tolerant grass and a climbing legume.
- Lock up the paddock from stock for 4 to 5 months to allow pasture to establish.
- Spot spray lantana regrowth with 1 part of D.P. 60 to 200 parts of water when regrowth is 30 cm to 1 metre in length.
- Reburn annually in spring or early summer for the first few years to reduce the lantana seedlings and bush size.
- Follow-up each burn with a spot spray of D.P. 60 before lantana regrowth is 1 metre high, to clean-up remaining scattered surviving plants and seedlings.

The part played by pasture establishment to compete with lantana by controlled grazing is the key to long term lantana control. It is better to attack small areas of lantana where stock movement can be controlled at any given time rather than attempt large areas under an open grazing situation.

The need to maintain the pasture in a vigorous condition is important to prevent re-invasion by lantana. When tempted to overgraze pasture where lantana is being controlled, think of how unproductive the area was when taken over by lantana.

D.P. 60 is available as a direct purchase from the Lands Department railed freight free to the nearest railhead in Queensland. Orders should be addressed to:

The Secretary,
Lands Administration Commission,
P.O. Box 168,
North Quay, Brisbane, Qld., 4000.

Alternatively D.P. 60 can be obtained from Shire Councils or through District Land Offices. 2,4-D herbicides can be purchased from the same sources or commercially.

Strawberry crimp

by Janet S. McCulloch, Plant Pathology Branch.

STRAWBERRY crimp was first identified in Queensland on the cultivar Redlands Crimson at Palmwoods in 1970.

The disease was common in commercial plantings throughout south-eastern Queensland in the 1974 and 1975 seasons when up to 25% of some plantings were affected. It has been less important in the 1976 and 1977 seasons probably because of improved runner selection.

Causal organism

Crimp is caused by the bud nematode *Aphelenchoides besseyi* which lives in the crown of the strawberry plant and feeds (by means of a hollow mouth spear or stylet) on the small, undeveloped leaves and flowers. Nematodes have also been found around the seeds on the outside of the fruit. Unlike root-knot nematodes, they do not feed on roots. The life cycle is relatively short, being completed in about 8 days at 25°C.

Ratoon strawberry plant showing severe symptoms of crimp.

Distorted strawberry runners from a mother plant infested with bud nematodes. Runners like this should be destroyed.

Strawberry plants infested with bud nematodes produce a larger proportion of distorted fruit often with short stalks.

Symptoms

Diseased plants are more compact than healthy plants and leaves are darker green in colour, deformed, and sometimes strap-like, particularly those in the crown. Flowering is delayed and there is an increase in the number of mis-shapen berries, many of which have a short stalk. Symptoms are readily seen early in the growing season, disappear by early August and reappear when runners are produced in November–December. The disappearance of symptoms coincides with a period when the numbers of nematodes in the buds decrease because of the effects of low temperatures on reproduction.

Effect on yield

In field experiments, runners with disease symptoms at the time of planting flowered up to 1 month later than healthy plants. Yield to the end of August was reduced by 50% but mean fruit size was not reduced. Diseased plants yielded heavily in the latter part of the season and yields for the whole season from both diseased and healthy plants were approximately the same. However, as strawberries fetch much higher prices at the start of the season than after the end of August, nematode infestation, by delaying cropping can be of considerable economic importance.

Cultivar resistance

In field experiments, bud nematodes had comparable effects on the early cropping of the cultivars Majestic, Phenomenal, Redlands Crimson and Earlisweet. Symptoms on the crown leaves of Majestic and Phenomenal were less obvious than on Redlands Crimson and Earlisweet which have a more upright habit and the older leaves cover the young crown leaves which show the most conspicuous symptoms.

Spread of the disease

The disease is spread by planting infested runners. These are usually from diseased mother plants although some may be infested by nematodes splashed from adjacent diseased plants.

Alternative hosts

The bud nematode *Aphelenchoides besseyi* is best known as the cause of the rice disease known as 'white tip'. In Queensland, it has been found in the seed-heads of many grasses including elastic grass (*Eragrostis tenuifolia*), green panic (*Panicum maximum* var. *trichoglume*) and blue couch (*Digitaria didactyla*).

Infested grasses often have withered leaf tips and distorted seed-heads. In glasshouse experiments, strawberry plants became affected with crimp when planted in soil to which infested grass seeds had been added. There is evidence to indicate that some infection from soil occurs in the field.

Control

Strawberry plantings to be kept as a source of runners should be inspected regularly and any plants with symptoms of crimp dug out and removed from the area. Runners with distorted leaves should not be planted.

Crimp can be controlled and early cropping improved by treating affected plants with fenamiphos (Nemacur 10G) within 1 month of planting. Place 1 gram of this granular formulation in the heart of each plant showing symptoms of the disease. A hand applicator for applying small doses of granules is now available commercially.

No distance restriction on drought cattle transport concession

THE Minister for Primary Industries, Mr V. B. Sullivan, announced that the restriction on the distance for which the road transport concession was payable relating to forced sales of store cattle from drought areas has been removed.

On May 16, he had approved provision of the road transport concession for stock being moved from declared drought areas, or declared individual properties for sale or slaughter, provided it was restricted to a distance no farther than that to the nearest of the major selling centres of Brisbane, Townsville and Rockhampton.

However, it had been decided to remove this restriction on distance to enable stockowners in the northern and western areas of the State to benefit from the upsurge in demand from southern States where beneficial rain had recently fallen.

This would be in line with the conditions applying to the north-south movement of store sheep to sale where there was no restriction on distance.

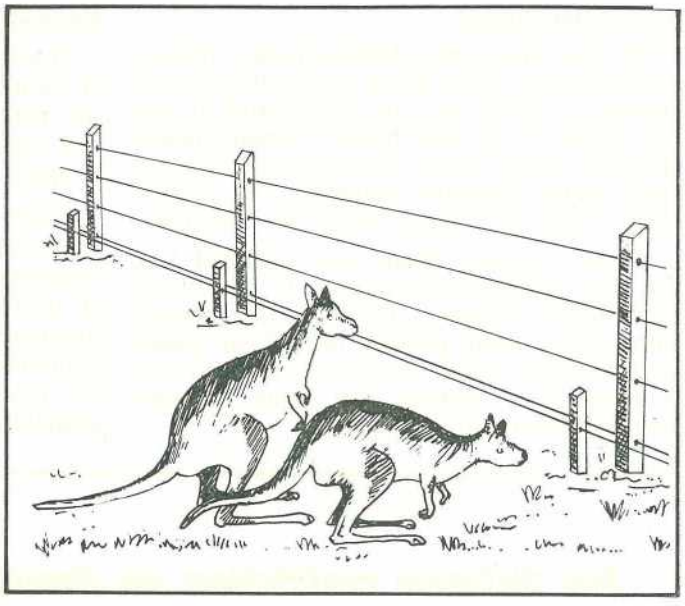
Officers of the Department of Primary Industries will be advised that this concession is subject to delivery of the stock at the point of destination so that the vendor, and not the buyer, receives the direct benefit of the subsidy.

From June 6, a road transport concession also has been payable on the interstate movement of stock and fodder for distances up to 500 km from the point of crossing the border.

The two concessions could make a southern sale an attractive proposition for North Queensland owners and give them an alternative outlet for their store stock.

Electric hopper stopper

by G. S. Wright, Beef Cattle Husbandry Branch.



A WHEAT grower on the western Darling Downs has dramatically reduced wallaby and kangaroo damage to his wheat crop by the use of a simple electric fence.

Mr Robert Upton of 'Bimbian Plains' in the Miles district says that his fence has almost completely stopped the nightly movement of wallabies and kangaroos on to his crop this season. In previous years, he has lost up to 10% of his crop.

Mr Upton's wheat crop adjoins an area of forest and despite his attempts to control the wallabies in the past they were becoming a major problem.

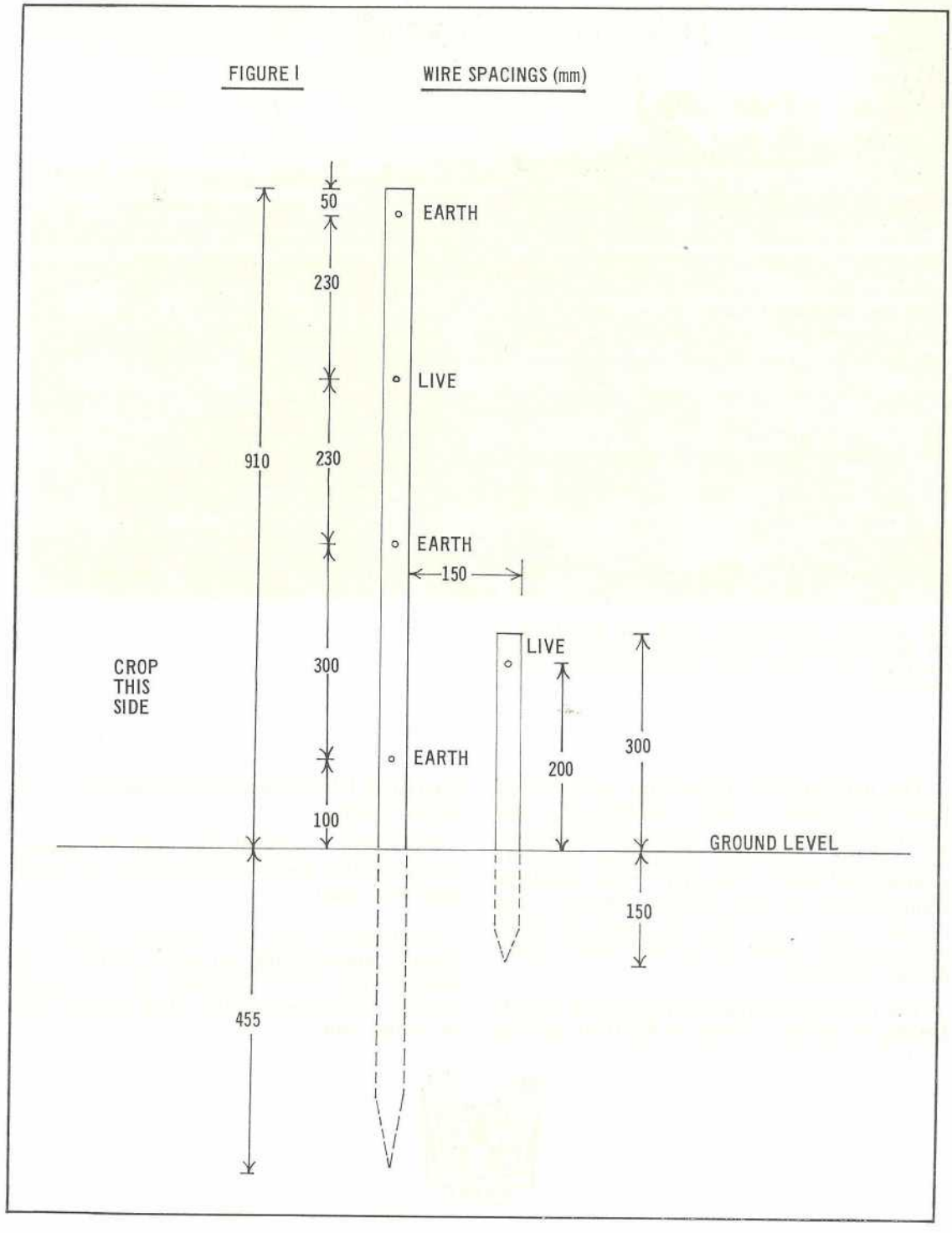
The fence that has been used so effectively on 'Bimbian Plains' is a basic four plain wire electric fence, one metre high, with the addition of a single electrified wire running parallel to but 150 mm away from the existing fence and 20 cm above the ground (see figure 1).

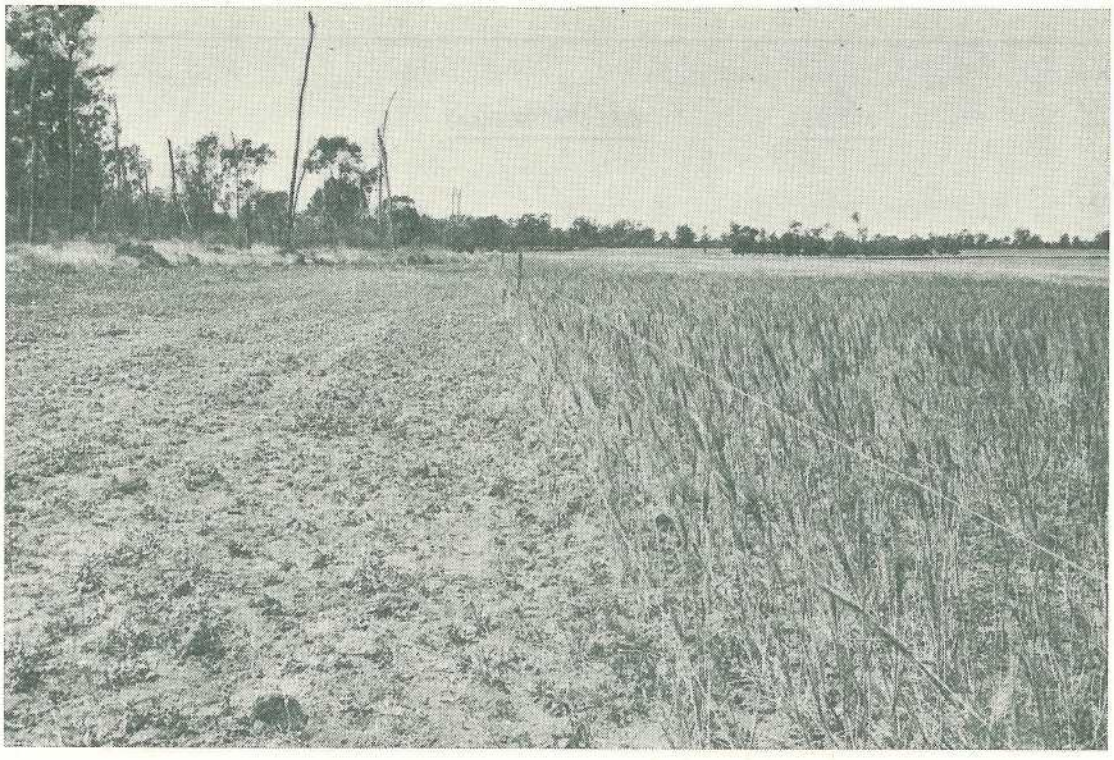
The electrified wire running outside the existing fence is designed to deliver a shock to any intruding animal before it actually attempts to pass through the four wire fence. This has the desired effect of forcing the intruder away from the fence rather than through it.

Mr Upton contributes the success of his fence to this additional deterrent.

As in all electric fencing, the principle is to force an intruding animal between a live and an earth wire to ensure that a maximum shock is delivered. In this fence, all wires excepting the third wire from the ground are earth wires. The third is live. This in effect means that an animal cannot force its way between any two wires without making contact with a live and an earth wire.

FIGURE I


WIRE SPACINGS (mm)
50
230
230
300
100
910
455
EARTH
LIVE
EARTH
150
LIVE
200
300
150
EARTH
CROP
THIS
SIDE
GROUND LEVEL



The wallabies have eaten all of the wheat up to the fence but have not attempted to graze through the fence. This crop was planted right up to the tree line.

The materials Mr Upton has used for his fence are typical of what is used in the construction of many electric fences in the district. The wire is 12½ g H.T. plain and posts are pointed and bored iron bark posts available commercially on the Darling Downs. The energizer used is a mains-operated unit which also supplies current to several other fences on the property.

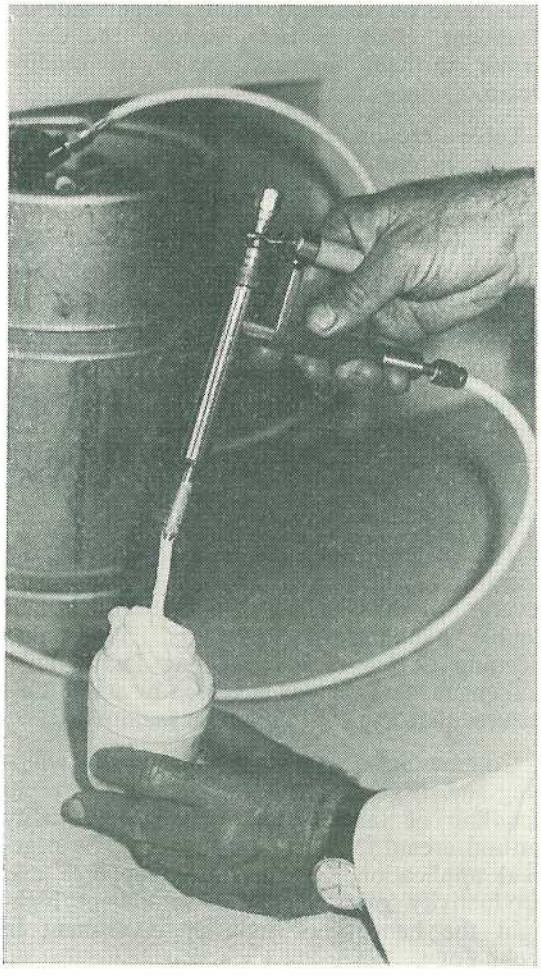
The cost of constructing this type of electric fencing is in the vicinity of $130.00 per km (excluding labour) when post spacings are 20 metres apart.

Mr Upton is very pleased with the success of his electric fence and has plans to use it again next year.

He suggests that the energizer should be checked almost daily for quick detection of shorts in the fence. Wallabies are very quick to take advantage of any fault to get back on to the crop.

More cream for less cost

by V. C. TUCKER, Dairy Research Branch.



AT the Sunshine Plantation near Nambour, whipped cream and cream mixes have been dispensed from beer guns on to delicious natural fruits.

This is a novel way to serve sundaes and tropical fruit parfaits. It is also a practical innovation.

The new cream whipping and dispensing equipment was developed by a team of technologists from the Otto Madsen Dairy Research Laboratory. Their task involved identifying a problem and satisfying a need in the market place to produce and hygienically dispense large quantities of whipped cream rapidly with minimal labour.

Planning the project

To develop neat, convenient cream whipping and dispensing equipment to operate economically in view of the consumer the project involved:

- Appraisal of the problem in the light of existing scientific knowledge and experience.
- Conducting experiments in the laboratory to fill gaps in our knowledge on the physical properties of cream.
- Designing and fabricating equipment in our pilot plant workshop.
- Conducting experimental trials in the pilot plant to determine the method for operating and control of the cream whipping equipment.
- Developing a simple, convenient method for effectively cleaning and sanitizing the equipment.

Development of equipment

Plate 1 shows cream being dispensed from a beer gun in pilot plant trials. The equipment that was developed for whipping and dispensing cream is contained in a refrigerated bench unit also fabricated in the pilot plant workshop (shown in plate 2). The equipment comprises four units:

- Gas injection system

Left. Plate 1. Dispensing whipped cream through a beer gun.

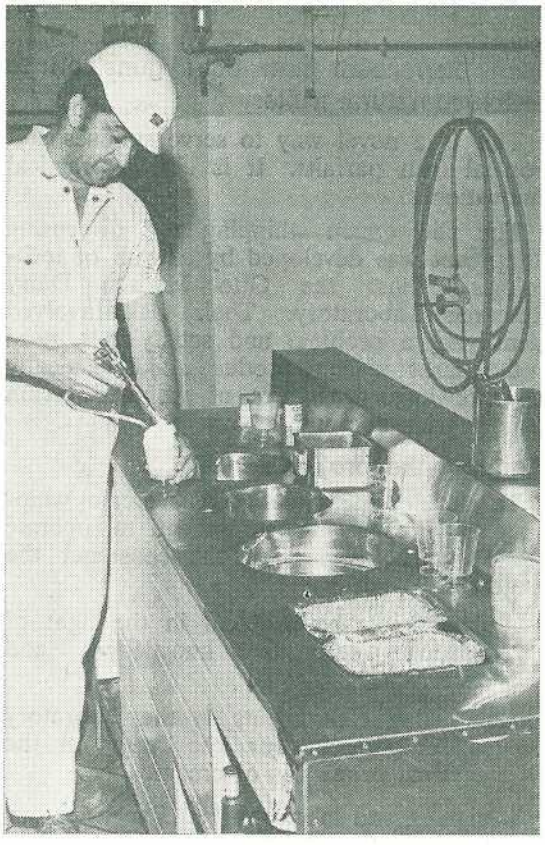


Plate 2. Refrigerated bench unit for cream whipping equipment.

- Pressurized mixing and storage vessel
- Dispensing unit
- Cleaning system

The equipment operates with natural cream under pressure. The cream whips as it ejects from a stainless steel ejection gun similar to the type used for beer. The dispensing guns are fitted with flexible tubing. They are easy to operate by means of a trigger control valve which responds with an instantaneous flow of cream.

The cleaning system is effective and easy to apply. The cream dispensing unit clips on to a specially designed tube fitted in the main water pipeline. While hot water circulates, detergent solution is drawn through a side arm to aid cleaning.

Practical application

The equipment was displayed at the International Catering Trade Fair in Sydney and the first commercial unit commenced operation at the Sunshine Plantation in 1976. Units are now used in each state of Australia.

Interest in the equipment from both the catering and cooking industries is keen and there are many enquiries from overseas.

Benefits

The new equipment allows the catering industry to conveniently handle large amounts of cream. This, in turn, benefits the dairy farmer through increased sales of quality cream.

Table cream provides higher potential returns to the farmer than do most manufactured dairy products. In Queensland, 10 million litres of milk are used to supply the table cream market. The amount increases each year. Quality of product and convenience of handling influence the volume of sales.

The whipped cream dispenser is a major breakthrough for the catering industry. It reduces labour. There is a continual supply of whipped cream at the counter for dispensing at the point of sale. There is reduced effort for staff, and dispensing units may be readily charged with cream.

The flexible dispensing lines also enable the operator to manoeuvre the gun and dispense several parfaits in one operation without double handling of containers. The inline cleaning device makes cleaning less tedious and encourages regular attention by staff. This ensures that hygienic quality is maintained.

Commercial acceptance of the cream whipping and dispensing equipment simplifies rapid handling of large amounts of good quality natural cream in the market place. The practical application, commercial acceptance and productivity gains of the development highlight the benefits of industry investment in technology.

The macadamia nut borer

by D. A. Ironside, Entomology Branch

THE larvae of the macadamia nut borer *(Cryptophlebia ombrodelta* (Lower); Family Tortricidae) tunnel into the nuts of cultivated varieties of *Macadamia (M. integrifolia* and *M. tetraphylla*) and frequently cause severe reduction in yields.

Attacks during the December–February period usually cause the greatest losses.

Host plants and distribution

In addition to being a serious pest of macadamias, the insect also attacks the cultivated litchii, *Litchii chinensis,* and a range of ornamental plants including Bauhinia, Bird of Paradise tree, Cupania, Easter Cassia, Golden Rain-tree, Minosa bush, Poinciana, Schotia and Tamarind.

The macadamia nut borer occurs widely in eastern Queensland. It is sporadically distributed-mainly in areas where host plants are in abundance. The insect appears to be sedentary and slow to disperse to new plantings as little as 5 km away. In south-eastern Queensland, it is an unimportant pest in areas with elevations above 300 m such as the Blackall Range.

Seasonal incidence

The seasonal pattern of moth activity in an orchard in south-eastern Queensland was monitored for four seasons during 1971 to 75 with a mercury vapour light trap (see figure 1). Damage to the crop was severe in the first three seasons but not in the last. Populations began to increase noticeably in November and December for the 1971 to 1974 seasons. However, during the 1974–75 season, moth activity remained low until February. By this time, the crop was almost mature and damage was largely confined to the outer husk.

Larvae of the pest can be found throughout the year in some 'everbearing' *M. integrifolia* seedling orchards as nuts suitable for food are usually present.

Damage

The greatest yield loss occurs when attacks on the immature nuts cause premature nut fall. Early-maturing varieties can often avoid much of this loss.

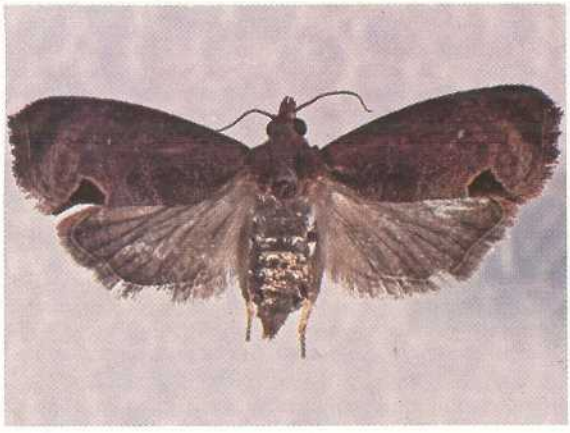
Husk damage to the mature nuts may cause some reduction in kernel quality and this could become more important as the industry expands.

Larvae may also penetrate the kernels of a small percentage of mature nuts, particularly thin-shelled varieties or nuts with shells weakened by previous attacks by insects such as the fruit-spotting bug.

Life history and habits

- ADULT—The adult female has a wing span of up to 25 mm. It is reddish-brown in colour with a distinctive black triangular mark on the hind margin of each forewing. The males are smaller and lighter in colour with tufts of fine hair on the hind legs.
- EGG—The scale-like eggs are oval, approximately 1·0 x 0·8 mm in size, and vary in colour from ivory-white when first laid, to red prior to hatching. Eggs are laid singly on the surface of the green husk (preferably on nuts already infested with larvae), on the raceme stem, and sometimes on parts of the tree canopy.
- LARVA—While the shell is still soft, the larvae are able to tunnel through and feed on the kernel. Once the shell has hardened, tunnelling is usually confined to the husk. Survival of young larvae is lower on some

Macadamia

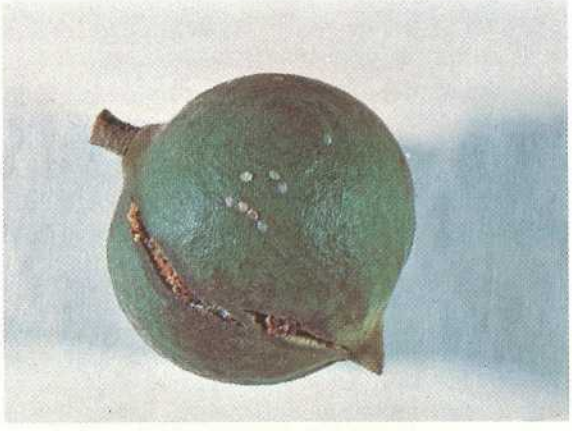


Adult female—wing span up to 25 mm.

Adult male.

Photographs by

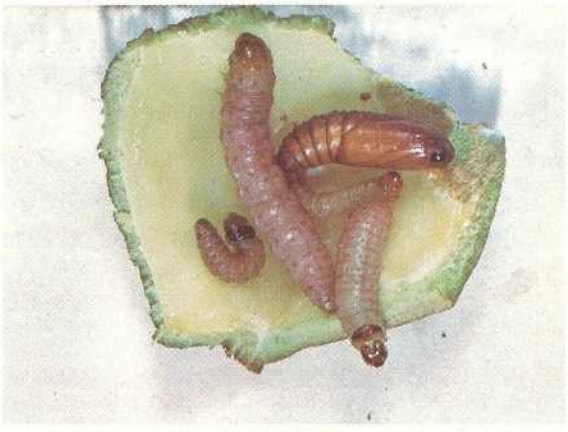
D. A. Ironside, Entomology Branch.



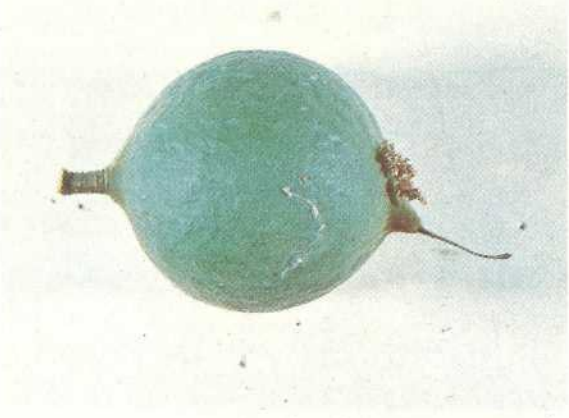
Eggs on damaged macadamia nut.

Eggs highly magnified, newly-laid and eggs before and after hatching.

nut borer

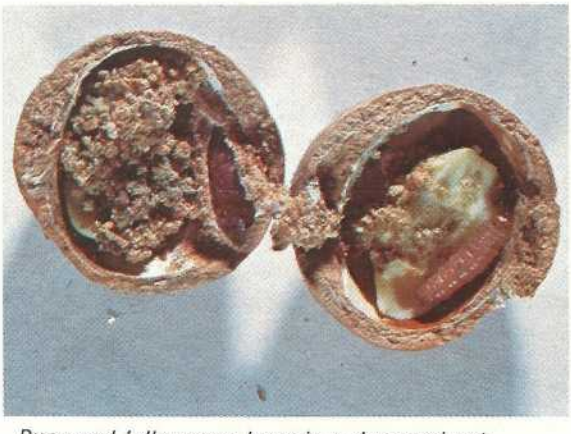


Larvae and pupa on a piece of nut husk.

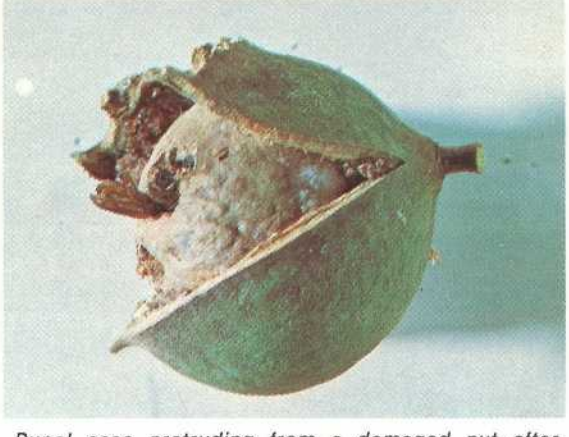


An infested nut showing larval excrement protruding from the entry hole.

An assassin bug and the remains of its prey—macadamia nut borer larva.



Pupa and fully-grown larva in a damaged nut.



Pupal case protruding from a damaged nut after the moth has emerged.

varieties than others, probably because of the resistance offered by the outer green husk to larval penetration. Newly-hatched larvae may search for a feeding site for as long as 24 hours before entering a nut, but they usually establish more quickly in nuts already damaged.

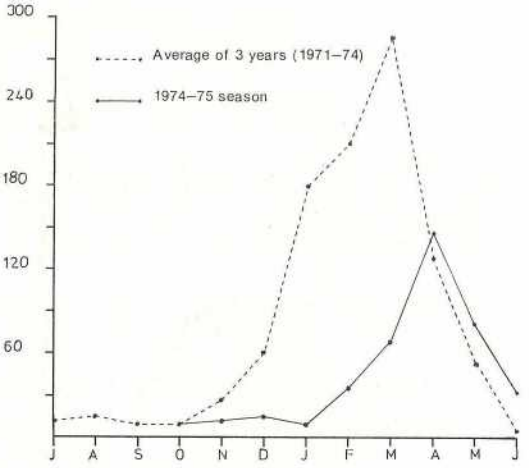
Fully-grown larvae are up to 20 mm long, pinkish in colour with discrete, dark-green spots. Usually not more than two or three reach maturity in the one nut. Three or four days before pupation they construct tightly-woven silken cocoons which are sealed with an unobstrusive flap at the exit hole. Pupation occurs in the damaged nuts or husks and also in sheltered sites in other parts of the tree or away from the tree.

- PUPA—The pupa is light-brown at first but darkens with age. At emergence it moves about-two thirds of the way out of the cocoon and the moth emerges leaving the pupal case protruding from the exit hole.

- DURATION OF THE LIFE CYCLE—From egg laying to moth emergence takes about 5 weeks in summer. The eggs hatch in 4 to 6 days, larval growth takes 3 to 4 weeks and moths emerge after a pupal period of 8 to 10 days. The life cycle, however, takes much longer at lower temperatures.

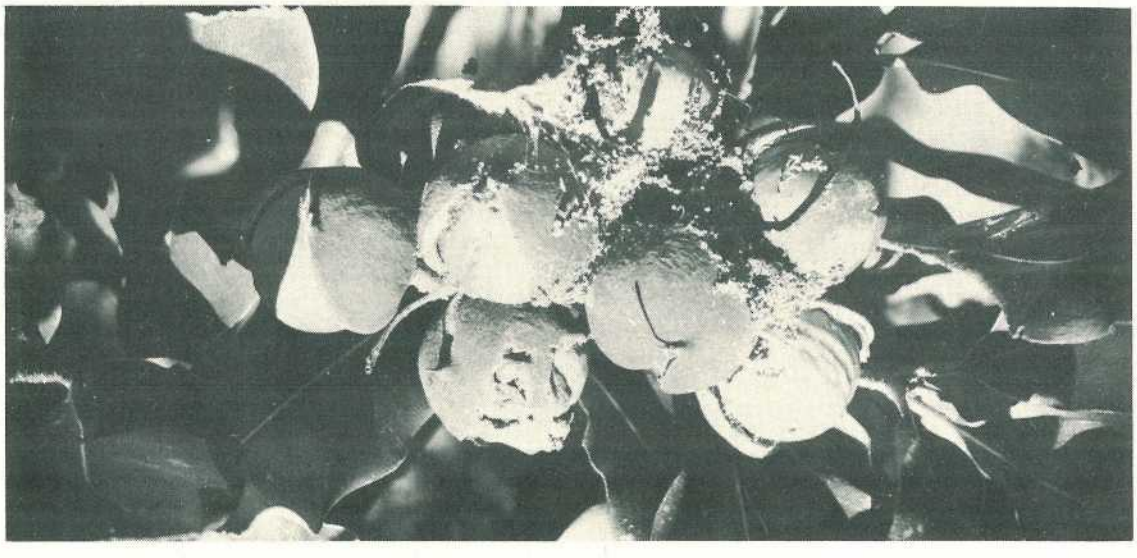
Natural enemies

In Queensland, ten insects are known to be enemies of the macadamia nut borer. The most important of these are the parasitic braconid wasps *Apanteles briareus* Nixon and *Bracon* sp., the ichneumonid wasp *Gotra bimaculatus* Cheesman and an unidentified tachinid fly parasite. Parasite activity increases when pest populations are high in late summer, however, this is usually too late to provide relief from crop damage.



ABOVE. Figure 1. Average weekly catch per month of macadamia nut borer moths from a light trap at Beerwah.

BELOW. A cluster of nuts damaged by macadamia nut borer.



Pastures in the Dalby district

by W. Bott, Agriculture Branch.

THE grazing industry has been important to the Wambo Shire since it was first settled in 1841.

Early development was based on pastoral pursuits but the Shire is now the chief grain-growing area of Queensland.

Location

This Shire of 575 000 hectares, located on the western slopes of the Great Dividing Range about 180 km north-west of Brisbane, comprises 1 075 rural holdings covering 493 000 ha. Of this total, 240 000 ha is cultivated, 20 000 is sown to improved pastures and 233 000 ha remains under native pastures.

Climate

Average annual rainfall at Dalby is 670 mm of which 450 mm occurs during the summer months (October to March) and 220 mm during the winter months (April to September). Summers are hot and winters cool to cold. The annual frost-free period is 246 days.

Table 1 sets out the average monthly daily maximum and minimum temperatures recorded at the Dalby Post Office.

Types of country

From the standpoint of production potential, the Shire falls readily into three major zones, (i) the vast central plain which is suited to agriculture, flanked on the north-east by (ii) an extensive upland tract with mixed farming potential, and on the south-west by (iii) an area of solodic soil with low pastoral value.

One of the few remaining pastures of Rhodes grass planted when the original scrub was cleared. Property of C. H. Hopper, Porters Gap.

TABLE 1

AVERAGE DAILY MAXIMUM AND MINIMUM TEMPERATURES—DALBY

Month	Daily Maximum	Daily Minimum
January	31·6	18·5
February	31·3	18·2
March	29·5	16·3
April	27·1	12·6
May	22·6	7·8
June	19·8	5·6
July	18·8	3·9
August	20·6	5·4
September	24·1	8·3
October	27·5	12·7
November	30·1	15·4
December	31·3	17·4
Year	26·2	11·8

Soil fertility and water-holding capacity are variable. Most of the plain soils are well endowed in both attributes; the uplands are fertile but mediocre in water-holding capacity, while the solodics are poor in both respects. Of course, after over a century of grazing and half a century of grain-growing, the fertility of some soils (particularly with regard to nitrogen) has been reduced to the level where fertilizers are needed.

Land type	Original vegetation	Carrying capacity (ha/beast)
1. Plain	Open grassland	1·5—2·0
2. Undulating brigalow	Brigalow—belah—softwood scrub	2·0—2·5
3. Brigalow plain	Brigalow—belah—wilga—tea-tree scrub	2·0—2·5
9. Basaltic uplands	(a) Softwood scrub	2·0—2·5
	(b) Mountain coolibah	3·0—4·0
5. Box plain	Poplar box woodland	4·0—5·0
6. Solodics	Mixed forest and woodland	10–20

From the pasture standpoint, the Shire can be divided into six broad land types. These are listed above in descending order of carrying capacity when developed for or reverted to native pasture. Such development involves clearing of scrubs, judicious thinning of woodlands, and provision of appropriate fencing and stock water.

Annual liveweight gain ranges from more than 100 kg per ha on the plain down to 10 kg per ha on solodic forest and woodland.

The soils within these land types can be quite variable, being capable of subdivision into many types. Moreover, the transition from one type to another is seldom as clear-cut as the accompanying map indicates.

Plain

The plain is treeless with freely self-mulching, dark-grey, clay soil of great depth. The original grass vegetation was dominated by the excellent Queensland blue grasses (*Dichanthium sericeum* and *D. affine*). Other grasses present include Yabila grass (*Panicum queenslandicum*), paddock love grass (*Eragrostis leptostachya*), tall chloris (*Chloris ventricosa*), tall oat grass (*Themeda avenacea*), wallaby grass (*Danthonia linkii*), satin-top grass (*Bothriochloa erianthoides*) and common wheat grass (*Agropyron scabrum*). Nearly all of the plain is now cultivated.

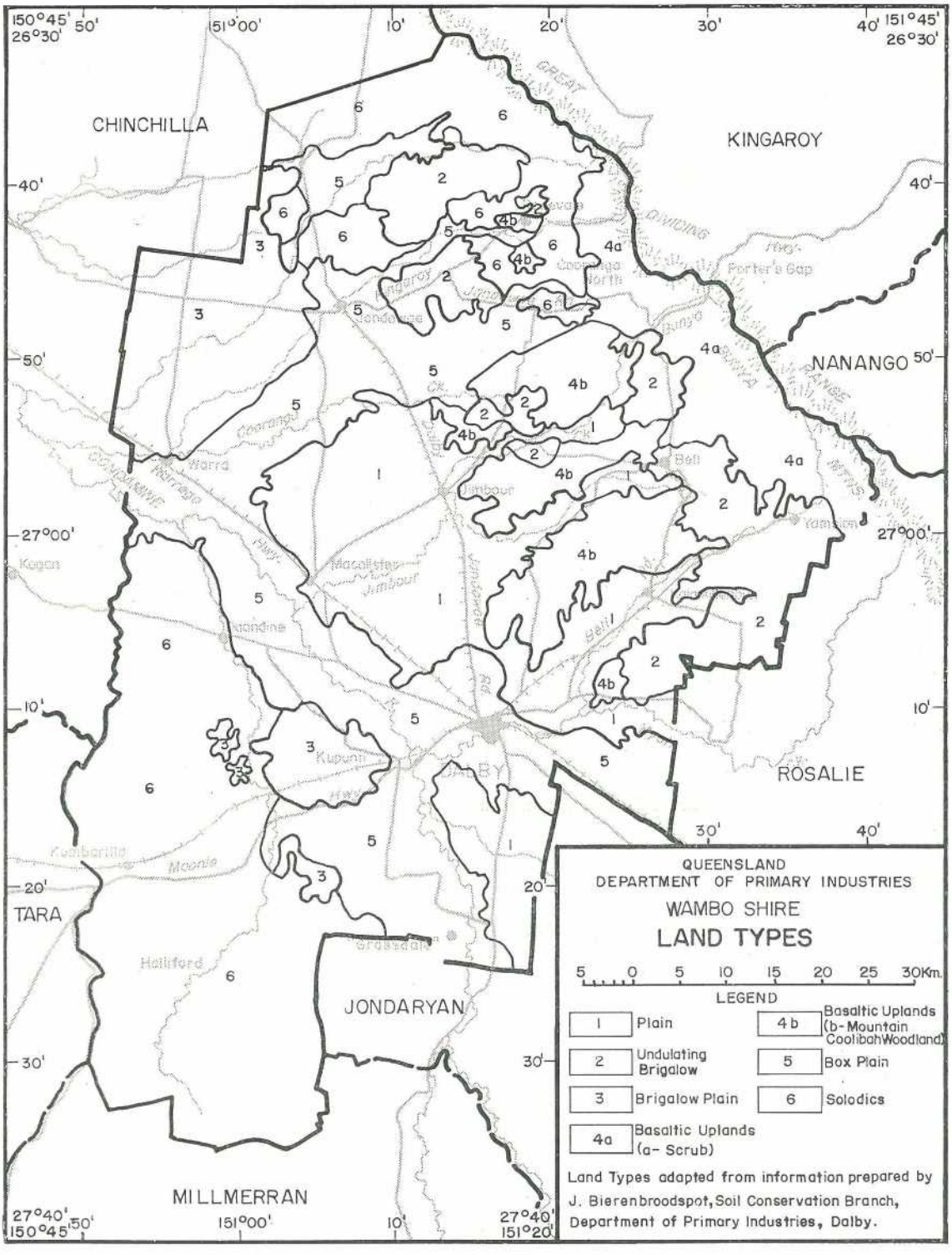
Continuous cropping appears to have had little adverse effect on the physical condition of this soil, and a stable cropping system involving the use of fertilizers without the need for pasture leys has developed. Few pasture plantings have been attempted except for grazing lucerne. While a short lucerne phase has a dramatic and lasting effect on soil nitrogen status, the practice is uneconomical at present.

Undulating brigalow

This land type generally occupies the lower foothills between the plain and the basaltic uplands. Soils are mainly clay loams to loams overlying red and brown clay subsoils.

Original vegetation was brigalow (*Acacia harpophylla*)—belah (*Casuarina cristata*) and brigalow-softwood scrub with narrow-leaf bottle tree (*Brachychiton rupestre*), black tea-tree (*Melaleuca lanceolata*), limebush (*Eremocitrus glauca*), scrub wilga (*Geijera muelleri* and *G. salicifolia*) and sandalwood (*Santalum lanceolatum*).

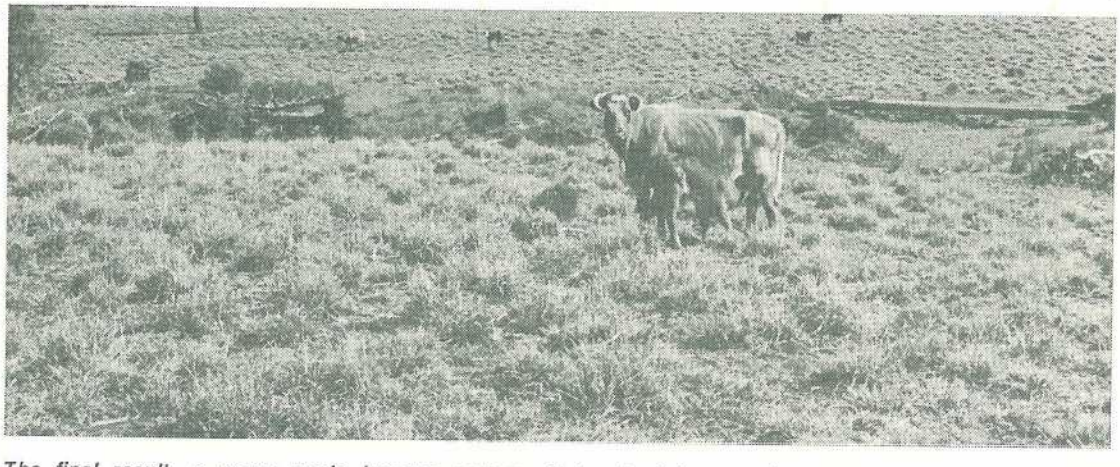
On lighter soils and at higher elevations, scrub gives way to mixed woodland of poplar box (*Eucalyptus populnea*), narrow-leaved iron-bark (*E. crebra*) and cypress pine (*Callitris columellaris*).


150°45'
26°30'
50'
151°00'
10'
20'
30'
40'
151°45'
CHINCHILLA
KINGAROY
NANANGO
ROSALIE
TARA
JONDARYAN
MILLMERRAN
27°00'
27°40'
150°45'
151°00'
151°20'
QUEENSLAND
DEPARTMENT OF PRIMARY INDUSTRIES
WAMBO SHIRE
LAND TYPES
5 0 5 10 15 20 25 30Km.
LEGEND
1 Plain
2 Undulating Brigalow
3 Brigalow Plain
4a Basaltic Uplands (a- Scrub)
4b Basaltic Uplands (b- Mountain Coolibah Woodland)
5 Box Plain
6 Solodics
Land Types adapted from information prepared by J. Bierenbroodspot, Soil Conservation Branch, Department of Primary Industries, Dalby.

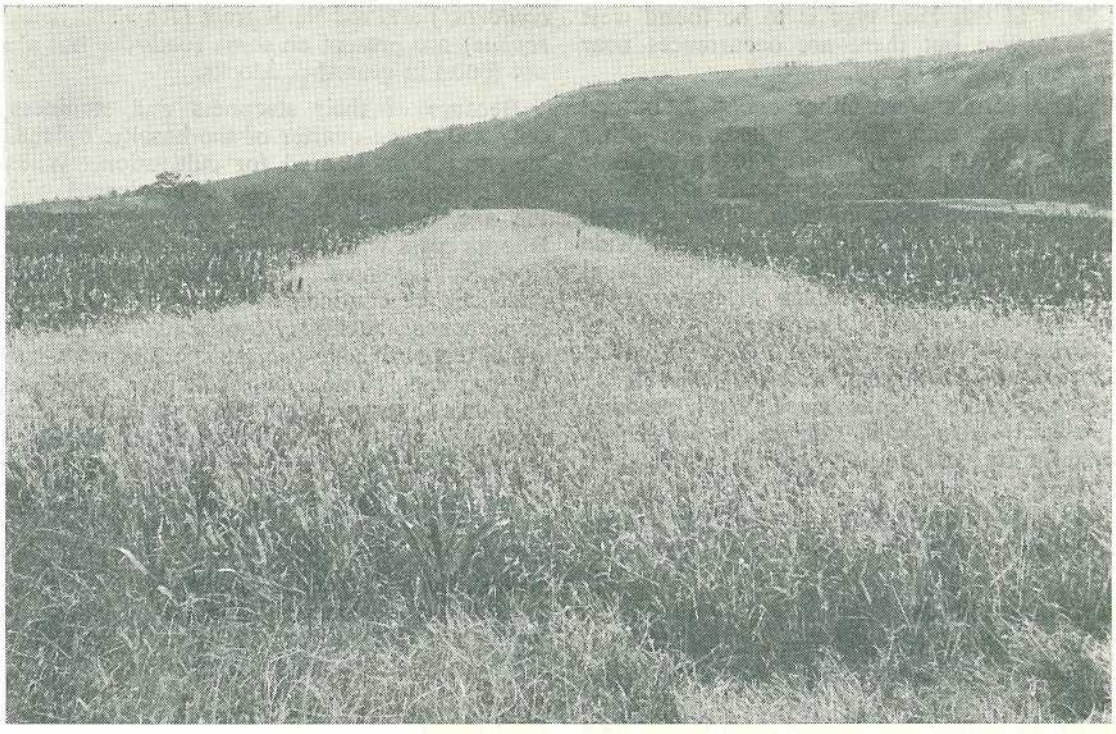
Three stages in pasture development on basaltic uplands regrowth scrub at Cooranga North.

Dry timber and regrowth raked into windrows on the contour. D. G. Hopper's property.

Green panic and lucerne sown with a companion crop of Zulu forage sorghum. D. G. Hopper's property.



The final result—a green panic lucerne pasture. Naturalized burr medic is also present. K. J. O'Brien's property.



Contour strips of Gayndah buffel grass on C. H. Hopper's basaltic upland farm at Porters Gap.

In their virgin state, these scrubs support only sparse ground cover including brigalow grass (*Paspalidium caespitosum*), green summer grass (*Brachiaria miliiformis*), blown grass (*Agrostis avenacea*) and minor *Chloris* species on the heavier-textured brigalow soils. The lighter-textured softwood scrub soils maintain a light cover of slender bamboo grass (*Stipa verticillata*) with some species of *Chloris* and *Aristida*.

Much of this scrub land was planted with Rhodes grass (*Chloris gayana*) when it was cleared early this century and gave 40 to 50 years of excellent grazing. Where this was not done, or where Rhodes grass has subsequently disappeared, native grasses including Queensland blue grasses, pitted blue grass (*Bothriochloa decipiens*), curly windmill grass (*Enteropogon acicularis*), windmill grass (*C. truncata*) and slender chloris (*C. divaricata*) have gradually taken over.

About two-thirds of this land type area is now cultivated and the remainder offers considerable scope for pasture improvement.

Brigalow plain

Brigalow plain consists of virtually flat country with minor to moderate gilgai formation. Soils are grey to brown clay loams overlying deep grey to brown clays.

Original vegetation was mainly brigalow and belah with some wilga (*Geijera parviflora*), limebush and, in poorly-drained areas, black tea-tree. Poplar box and some narrow-leaved grey box (*E. pilligaensis*) occur along the fringes. In its undeveloped state, the scrub supported only a sparse grass cover of gilgai panic (*Panicum subxerophyllum*), green summer grass, cane grass (*Leptochloa digitata*), blown grass and minor *Chloris* species.

Most of this land type is to be found west of Jandowae but there are occurrences near Kupunn, west of Dalby.

These scrubs were either chopped, burned and planted with Rhodes grass like other scrubs in the district or, where a major brigalow sucker problem was anticipated, ring-barked and allowed to grass-up with native species. Where cleared for native pastures, a wide range of grasses is found including Queensland blue and pitted blue, Yabila, brigalow grass, tall chloris (*C. ventricosa*), rats-tail (*Sporobolus elongatus* and *S. mitchellii*), forest blue, weeping love grass (*Eragrostis parviflora*) and wire grass. Cane grass, green summer grass and water couch (*Paspalum distichum*) occur in deep melon-holes and along drainage lines.

Some 18 000 ha of the estimated 26 000 ha total area of this land type are cultivated.

Basaltic uplands

Topography ranges from mountainous to undulating. Soils vary from red and brown stony loams and clay loams on the upper slopes, to deeper and darker clays where they merge into the plain soils on the valley floors.

Vegetation changes from rain-forest (high in the Bunya Mountains) to bottle-tree and softwood scrubs with mountain coolibah (*E. orgadophila*) woodland covering spurs running out from the mountains.

In their natural state, rain-forests and softwood scrubs support little grass. Species present in undisturbed mountain coolibah woodland at higher elevations include kangaroo grass (*Themeda australis*), tussock grass (*Poa labillardieri*), fine-leaved tussock grass (*P. sieberana*) and *Carex appressa*. Further down the slopes, wire grasses (*Aristida* spp.), rats-tail grasses, barbed-wire grass (*Cymbopogon refractus*), golden-beard grass (*Chrysopogon fallax*), tall chloris, pitted blue grass and Queensland blue grasses appear.

Where the ridges merge into the heavier soils of the valley floors, the grasses of the plain are found. Botanical composition of woodland pastures can also be influenced by grazing pressure and degree of timber treatment. Over-clearing of slopes should be avoided as this can lead to salt problems on lower areas. Black speargrass (*Heteropogon contortus*) and red Natal grass (*Rhynchelytrum repens*) are present on some roadsides but are not found in grazed paddocks.

Because of their steepness and stoniness, only about one-quarter of the basaltic uplands area has been cleared for cultivation. When first developed, the scrubs were cleared with the axe, burned, and the ashes seeded with Rhodes grass with little regard to the degree of slope or stoniness. Future pasture development will be confined to the lower, less stony slopes where machinery can be used to remove scrub regrowth and prepare a rough seed-bed for pastures. Trials conducted by chemical companies some years ago indicated that regrowth from most softwood scrub species is not amenable to control by herbicides.

The mountain coolibah soils are generally less fertile than the scrub soils and have similar problems of steepness and stoniness. Nevertheless, they offer considerable scope for pasture improvement. While establishment of tropical grasses is less reliable, weeds and scrub regrowth are less troublesome.

Box plain

Box country is mainly flat with levees and depressions associated with major watercourses. Soils are a complex of cracking and hard-setting grey to black clays, often with surface crusting problems. The levee soils are generally mixed alluvial clays and sands over clays.

Tree cover is mainly poplar box with some Queensland blue gum (*E. tereticornis*), river red gum (*E. camaldulensis*), coolibah (*E. microtheca*) and patches of yarran (*Acacia homalophylla*), mainly along the watercourses. Narrow-leaved ironbark, narrow-leaved grey box and bull oak (*Casuarina luehmannii*) begin to appear where the box plain merges with the solodic soils.

The grass complex associated with poplar box woodland includes a wide range of species of varying nutritive value such as Queensland blue grasses, pitted blue grass, windmill grass, kangaroo grass, white spear grass (*Aristida leptopoda*) weeping love grass, early spring grass (*Eriochloa pseudoacrotricha*) and wire grass, with forest blue grass (*B. bladhii*), silky brown-top (*Eulalia fulva*), western nut-grass (*Cyperus bifax*) and nardoo (*Marsilea*

drummondii) in low-lying areas. The proportion of better grasses such as Queensland blue is often higher where the box is interspersed with gum (mainly along frontage country) and where the box plain merges with the basaltic alluvium.

Like the mountain coolibah forest, the box woodland has been thinned by ringbarking, and more recently by 'Tordon' injection, to provide a judicious balance between grass and tree cover. Timber treatment increases carrying capacity, but does not appear to greatly affect the botanical composition of the pasture.

With the reduction in sheep numbers in recent years, lippia or carpetweed (*Phyla nodiflora*) has become a problem over much of the Condamine River frontage country. Despite its dense prostrate growth, the plant appears to have lower soil binding value than the grasses it chokes out in areas subject to frequent flooding.

About three-quarters of this land type area is currently devoted to grain growing. These heavy clay soils, with some surface crusting problems and often subject to waterlogging, provided little opportunity for pasture improvement until the advent of Bambatsi panic (*P. coloratum* var. *makarikariense*). This grass is now finding favour for planting on some regularly flooded levees of the Condamine River, where it has proved capable of surviving flooding.

Solodics

Topography of this land type ranges from quite hilly in occurrences north and east of Jandowae, to gently undulating in areas west of Daandine and Kupunn, to flat in the area south of Halliford.

Soils vary from shallow, stony, skeletal sands on hill tops, to deeper sandy and loamy soils overlying deep, hard, impenetrable clays on the flatter areas. The depth of sand overlying the clay generally determines the productivity, and is usually indicated by the tree species present.

Spotted gum (*Eucalyptus maculata*) is sometimes found on redder, rocky ridges, while narrow-leaved ironbark (*E. crebra*), dusky-leaved ironbark (*E. nubile*) and wattles, mainly black wattle (*A. cunninghamii*), occur on other ridges. Poplar box solodics are the most useful, being capable of limited fodder and grain cropping. Dominance by cypress pine (*Callitris columellaris*) with some apples (*Angophora* spp.) along watercourses indicates a deeper surface horizon with limited development potential, while bull oak and ironbark groups offer least scope for development.

Solodic woodland normally grows harsh, low-yielding grasses with pitted blue grass on the poplar box types giving way to wiregrasses, including many-headed wiregrass (*A. caput-medusae*), paddock love grass, clustered love grass (*E. elongata*), ridge grass (*Enneapogon avenaceus*), wanderri grass (*Eriachne mucronata*) and reed grass (*Arundinella nepalensis*) as the bull oak soils are encountered. The poorest soil types provide meagre winter grazing because of the inferior grasses and the absence of winter herbage. Cattle or breeding sheep cannot be successfully run on a year round basis without winter grazing crops or other supplementary feed.

Half of the solodic woodland within the Shire is held as State Forest reserves. This land is leased at low rental because of its low carrying capacity and the restrictions imposed on management and development. Such limitations may be eased where the land carries no commercial timber and has no prospects for reafforestation.

Little pasture development has taken place on these soils because of the cost of timber treatment and regrowth control, poor productivity and, in undulating situations, the soil erosion hazard. The surface layer can be easily lost and the underlying clay is dispersible and prone to deep gullying.

The C.S.I.R.O. is currently investigating the pasture improvement potential of this soil group with regard to introduced species and the fertilizers needed to grow them.

Sown pasture areas

A summary of the sown pasture situation in the Shire over the last 30 years is given in table 2. This table shows that the area under improved pasture has remained static for almost 30 years, though there has been some increase in recent years. This is attributed to a run of better summers and high beef prices in the early 1970s rather than to any technical breakthrough or extension effort. During the same 30 year period, the area under cultivation increased three-fold to 240 000 ha.

TABLE 2

SOWN PASTURES IN WAMBO SHIRE

Year	Pure Lucerne	Grasses and Grass-Legume Mixtures
1944–45	940 ha	13 980 ha
1949–50	1 008 ha	13 700 ha
1954–55	894 ha	16 630 ha
1959–60	2 170 ha	13 910 ha
1969–70	5 160 ha	11 180 ha
1971–72	2 200 ha	13 240 ha
1972–73	1 590 ha	16 560 ha
1973–74	1 798 ha	16 470 ha
1974–75	1 781 ha	18 261 ha
1975–76	1 608 ha	17 142 ha

Dairy Pasture Subsidy Scheme

This Scheme, introduced in 1966, gave pasture improvement in the district the only real boost it has had since Rhodes grass was first planted into scrub burns.

During the first few years of the Scheme, plantings of pure lucerne accounted for two-thirds of the area for which subsidy was first claimed. This was due to establishment problems with grasses during a run of dry summers when most pasture failures reported involved the grass component. Also, lucerne can provide high quality feed when it is most needed. A run of above-average summer rainfall seasons which commenced in the 1970s encouraged planting of mixed pastures. Some 2 560 ha of pasture was planted, with an average claim of $23.00 per ha during the 11-year term of the Scheme.

The recent declaration of the Shire as an area of soil erosion hazard, with consequent restrictions on regular cultivation of steeper slopes, could provide impetus for increased future pasture plantings.

Species

Grasses

RHODES GRASS. Rhodes grass was the first introduced species to be widely planted when a serious attempt at closer settlement, based on dairying, was made early this century.

When hand-sown into the ashes of brigalow and softwood scrub burns, Rhodes grass flourished on the initial flush of soil fertility. As fertility declined with time and exploitive use, productivity fell, and, in later years, the situation was aggravated by droughts and depredations of pasture grubs (*Othnonius batesii* Oliff). As a result, Rhodes grass has now disappeared from much of the area originally planted.

Oddly, in view of its preference for high fertility, Rhodes grass has found favour lately with landholders developing pastures on the solodic soils. This preference is due to the ability of Rhodes grass to tolerate the high levels of sodium present in some of these soils.

Some of the scrub burns in the Cooranga North area were planted with Johnson grass (*Sorghum halepense*) instead of Rhodes grass and this left the district with a serious weed problem as agriculture developed. The problem has been complicated by the more recent introduction of the perennial grazing sorghum, Columbus grass (*S. almum*), which at times can be difficult to distinguish from Johnson grass.

Columbus grass can be readily and cheaply established, gives good first year production, and is easily ploughed out when the land is returned to crop. However, it cannot be recommended in the district because of its similarity to Johnson grass.

GREEN PANIC (*Panicum maximum* var. *trichoglume* cv. Petrie). Green panic has now supplanted Rhodes grass as the main sown species. While this grass establishes best on softwood scrub loams, it is adaptable to a wide range of soil textures. It is most productive on the fertile scrub soils but also performs well on forest soils when grazing is carefully managed and fertility is maintained with legumes. Green panic is more drought tolerant than Rhodes grass and gives better production on light (but not solodic) soils. Little is known of its longevity under local conditions except that some paddocks have survived for 20 years.

BUFFEL GRASS (*Cenchrus ciliaris*). Some cultivars of buffel grass have been tried on all soil types except the plain, but their performance has generally been inferior to that of green panic except on mountain coolibah woodland soil.

BAMBATSI PANIC. This is the currently recommended grass for heavier soils such as the plain, box woodland and low-lying or gilgaied phases of the brigalow plain. Tolerance of both flooding and drought are its main attributes, while high seed cost and poor competitive ability of seedlings are drawbacks. Bambatsi panic is not yet widely grown in

the district but its recent performance under repeated flooding has impressed landholders along the Condamine River who are faced with the prospect of having to withdraw some low-lying paddocks from cultivation.

PRIEBE PRAIRIE GRASS (*Bromus unioloides*). This short-lived, perennial, winter-growing grass found some early favour in undulating brigalow softwood scrubs around Kaimkillenbun where this particular strain originated. It is, however, not widely planted except in irrigated pastures.

Legumes

LUCERNE (*Medicago sativa*). Despite the bloat problem, lucerne has been the popular pasture legume for many years. It makes up about 10% of the sown pasture area, as well as being the main legume component of mixed pastures. Recent advances in bloat control centred on anti-bloat agents have not resulted in increased interest in pure stands of lucerne.

A management technique based on intensive rotational grazing of closely subdivided pure stands of lucerne was introduced a few years ago. Known as 'crash grazing', it caught the interest of landholders. The system was very productive during the year of establishment while the lucerne exploited deep subsoil moisture, and bloat losses were held to a tolerable 5% per annum. Productivity declined after the first year and the system has since fallen from favour.

This valuable legume is not subject to the same establishment problems as grasses, and it is adapted to most district soils except in waterlogged situations. Lucerne has a life of from 2 to 4 years in a pasture mixture and attempts at re-establishment have not been successful to date.

Bambatsi panic colonizing the flood scoured banks of the Condamine River in competition with lippia. G. Buckler's property, 'Bon Accord', near Dalby.

A good stand of snail medic on brigalow plain soil at Kupunn. B. Von Pein's property.

ANNUAL MEDICS (*Medicago* spp.) Burr medic (*M. polymorpha*) and woolly burr medic (*M. minima*) have been naturalized in the Shire for many years and regularly make useful contributions to the winter feed situation, especially when good winters follow dry summers. However, like most *Medicago* species, they can cause bloat.

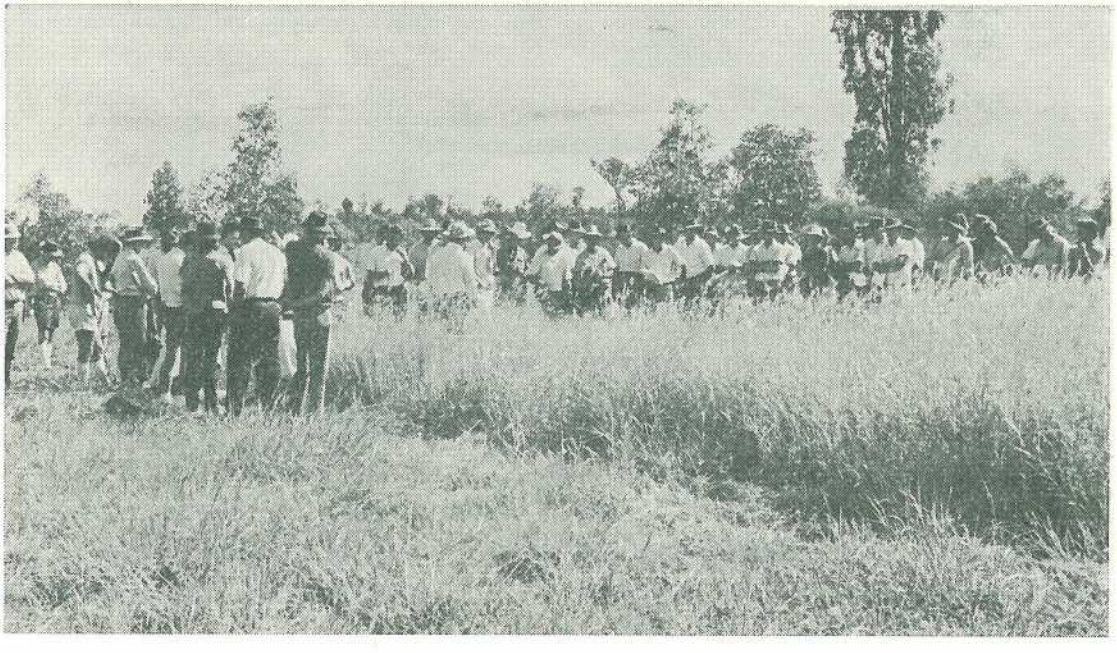
The Jemalong and Cypress cultivars of barrel medic (*M. truncatula*) and also snail medic (*M. scutellata*) have been under limited trial for some years. While giving a comparable performance to burr medic, they show little tendency to spread beyond the area in which they were planted; snail medic is a possible exception.

SIRATRO (*Macroptilium atropurpureum*). The potential for this legume appears to be limited to the deep, sandy phase of the solodic soils.

Productivity

In the first few years after planting, the productivity of sown pastures ranges from two to four times that of native pastures growing on the same soil with the advantage most pronounced on lighter soil types. Production then declines but stabilizes at a level of 50 to 100% above that of native pastures.

Field day inspection of C.S.I.R.O. pasture trials on solodic land type, 'Tong Park', Warra.



The decline in pasture productivity is often linked with the life of the legume (lucerne) component in mixed pastures and highlights the need for a permanent legume if district pastures are to maintain their production.

The matter of decline in productivity of grass pastures with time is currently under investigation by the Queensland Wheat Research Institute. One of the experimental sites is at Kaimkillenbun.

Since most improved pastures are now established on arable land, their production must be compared with that of grazing crops. In this light, pastures usually compare unfavourably with grazing crops in both quality and quantity of feed produced. When costs are considered, however, sown pastures are often superior. The integrated use of feed resources is the key to management.

Pasture establishment

Establishment difficulties are still the biggest obstacle to the wider use of improved pastures in the district. Factors responsible for this situation include:

- Relatively poor germination characteristics of grass seeds compared with crop seeds.
- The need for shallow planting of grass seeds.
- The weed burden often present in the lighter-textured soils where most pastures are grown.
- Grass establishment problems in the heavy, cracking clay soils of the plain.

Germination

To illustrate the relatively poor germination characteristics of grass seeds by comparison with crop seeds, the following germination percentages of good seed samples are tabulated:

GERMINATION OF CROP AND GRASS SEEDS

Sample	Min. prescribed germination %	First count (3–5 days)	Final count (10–28 days)
Sorghum ..	80%	90%	91%
Shirohie millet ..	75%	94%	94%
Wheat	80%	98%	98%
Rhodes grass ..	20%	9%	32%
Buffel grass ..	20%	2%	27%
Bambatsi panic	20%	3%	59%
Green panic ..	20%	8%	36%

While final germination counts for grass seeds are quite acceptable, most fail badly in speed of germination which can be critical at shallow planting depths in hot weather. Therefore, while 60 to 80% of crop seeds could be expected to produce plants, a realistic expectation for grasses would probably be 5 to 10%.

Planting

The vast difference between seed size of crops and pastures necessitates completely different planting techniques (wheat 32 000 seeds per kg, green panic 1 666 000 seeds per kg).

Crops are planted into a moist seedbed at a depth of 5 to 8 cm after a fall of rain, using a combine which cultivates out emerging weed seedlings as it drills in the crop seed.

Grass seeds must be planted on a firm, fine seedbed at a depth of not more than 2 cm to germinate on the next rain, very often with a mass of weed seedlings.

Because of the need for shallow planting and the high evaporation rate during summer, it follows that any planting, whether into a wet or dry seedbed is, in fact, a dry planting. Moreover, during the heat of summer, single falls of rain regardless of amount will rarely keep the soil surface (where the seed is planted) wet long enough for establishment.

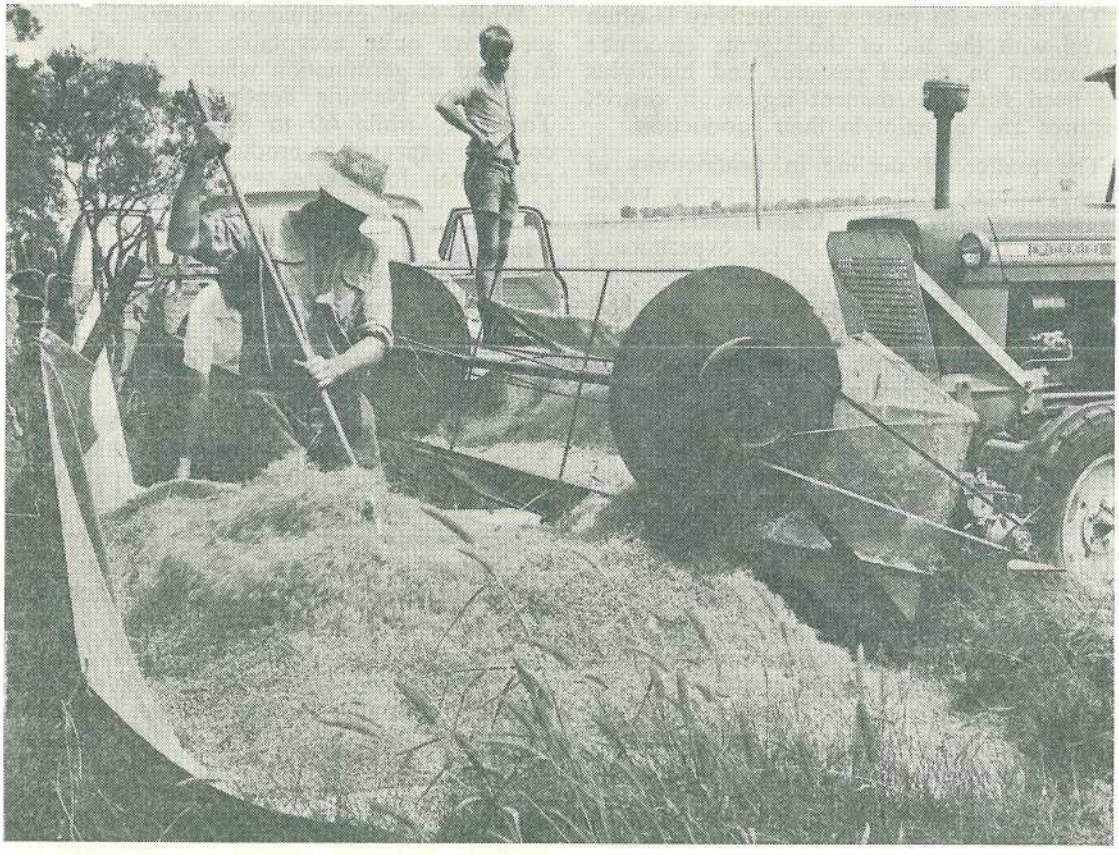
Planting of pasture is best deferred until after mid January, when there is a better chance of receiving follow-up rain.

Weed competition

Inadequate weed control is responsible for more pasture failures than any other cause. The problem is most pronounced on the lighter-textured soils where weeds are most troublesome and where pasture establishment is more frequently attempted. It is accentuated by the poorer competitive ability of seedlings of perennial pasture species compared with the quick-growing annual weeds including liverseed grass (*Urochloa panicoides*), stink grass (*Eragrostis cilianensis*) and mintweed (*Salvia reflexa*), which are the main offenders.

Seedbed preparation

This is the most important step in establishing a pasture. With few exceptions, the success of a planting varies proportionately to the thoroughness of seedbed preparation.



Mr Phil Hoare heading seed of buffel grass with a home-made stripper on Glenmoriston, Jandowae.

The hard-setting box soils, and the freely self-mulching plain soils, present particular problems to grass establishment due to their coarse surface mulch. This can result in the soil surface drying before germination of the seed takes place. As well, penetration of light between the large soil surface crumbs can cause premature seedling development below the surface. Many of these seedlings fail to emerge. Surface crusting, especially on non-mulching soils, can also prevent seedling emergence.

A pasture which is planted on land which has been fallowed for 10 months or more has good reliability of establishment. On the other hand, roughed-in plantings often fail.

However, a long fallow can seldom be justified, as it poses too great a risk of soil loss on sloping country. Furthermore, farmers consider that loss of a full year's production from the area is too high a price to pay for reliability of establishment.

A compromise is recommended, involving an autumn break-up with planting in September in weed-free situations or an early summer fallow with February planting where weed problems are expected.

Natural weathering of self-mulching soils can produce very suitable seedbeds with little or no tillage or fallowing. Opportunist use of such seedbeds can allow reliable establishment in stubble ground with little delay following a previous crop. The important criteria are fine, friable surface conditions and again good subsoil moisture reserves.

The ideal pasture seed-bed should be weed-free, have a firm, fine surface and be wet to at least 30 cm and preferably 50 cm at planting time.

Although weeds are less troublesome on the heavy plain and box woodland this advantage is offset by pasture seed emergence problems on these cracking soils and surface crusting can pose additional hazards. To date, the only species which has proved its ability to cope with these problems and endure the alternating very wet to very dry conditions which follow is Bambatsi panic.

Species and planting rates

Grasses

The pasture studies currently in progress by the Queensland Wheat Research Institute at Kaimkillenbun have confirmed the district farmers' choice of green panic as the introduced species best adapted to the local conditions.

Exceptions to this generalisation include:

- Solodic soils where Rhodes grass is best adapted.
- Plain, box woodland and low-lying phases of the brigalow plain where Bambatsi panic is superior.
- Mountain coolibah woodland where buffel grass (Gayndah and Biloela cultivars) may be more productive than green panic.

Planting rates recommended for grasses vary little between species. A range of 2 to 4 kg per ha, with the heavier rate applied when germination is only marginally above the prescribed minimum, generally proves adequate. This rate can be halved when Bambatsi panic is row planted. Row planting of this grass has more to commend it than the more economical use of expensive seed; it allows inter-row cultivation should the stand be threatened by weed growth, and facilitates later establishment of lucerne or medics.

A knowledge of the purity and germination percentages of seed intended for sowing is essential for selecting the required seeding rate.

Although mixing of grass species is often practised this practice has little to commend it except where soil types overlap.

Legumes

Lucerne at 1 to 2 kg per ha is recommended in all pasture plantings, except on solodic soils and in waterlogged situations. Where lucerne cannot be readily grown, a mixture of annual medics at the rate of 1 kg snail, 0·5 kg Jemalong and 0·5 kg Cyprus per hectare is suggested.

Planting methods

Ideally, seed should be planted at about 1·5 cm below the surface but in practice the depth generally varies between nil and 2·5 cm.

A range of equipment can be used for planting. Lucerne boxes, which attach to the back of the combine seedbox and handle green panic, Bambatsi panic, lucerne and medics well, are not widely available in the district.

Grain combines are widely used for pasture planting, using crushed or heat-killed crop seed for dilution of pasture seed to enable appropriate seeding rates to be achieved. Seed tubes should be removed from planting boots and directed behind the back row of tines to avoid burying seed.

Alan Adair checks pasture grub damage to his green panic pasture at Cooranga North.

Companion crops of grazing or grain crops are sometimes used at light seeding rates when planting pastures. Indeed, the district's biggest growers of improved pasture, Messrs. G. A. Greenup and Co., with over 1 000 ha on their 'Rosevale' Santa Gertrudis stud property north-east of Jandowae, plant their pastures with winter grazing crops early in autumn. Seeding rates are: green panic 4 kg, lucerne 2 kg, together with 20 to 25 kg of oats or wheat per hectare. The crop is planted at the grass depth and failures are reported to be rare.

Special equipment, both home-made or commercially produced, is available for particular purposes such as planting buffel grass.

The precision, row planting 'Triad' planter, developed at the Queensland Wheat Research Institute, is available on hire from a Toowoomba seed merchant. Use of this machine is justified when large areas of Bambatsi panic are to be planted, or where the application of a narrow band of gypsum over the row is required to prevent soil crusting.

Grazing management

If the stand is thick enough, a light grazing as soon as secondary roots are established will do no harm. If the strike is poor it is better to defer grazing until some seed is set. Also, it is vital not to have young grass plants too closely grazed going into winter.

A vigorous pasture depends on the continuing presence of an adequate legume component to provide nitrogen for the grass. This is the key to the long-term management of the pasture. Application of nitrogen fertilizer to rain-grown pastures in this district is uneconomic under present conditions.

Rotational grazing is preferable to continuous grazing. Occasional heavy grazings are not unduly harmful but continuous heavy grazing will be fatal to the pasture.

Lucerne in particular is very susceptible to continuous grazing, especially when grown in a mixture with grass. The standard recommendation is 2 weeks' grazing and a 6 to 8 week recovery period.

When weeds are particularly troublesome, slashing is recommended before the weeds set seed.

Seed production

Wambo Shire is a significant though erratic producer of grass seed. Green panic seed production has ranged from 12 tonnes in 1970 and again in 1971, down to none during 1975. Average seed production per year over the last 6 years has been: Priebe prairie grass, 2 500 kg; Rhodes grass, 1 200 kg; buffel grass, 1 400 kg; green panic, 6 000 kg; with much lesser amounts of Bambatsi panic and Gatton panic (*P. maximum cv. Gatton*).

Harvesting presents few problems to experienced district grain-growers. Seed, including buffel grass, is direct headed. However, drying is a problem with occasional big harvests as local landholders have few mechanical facilities for the job.

Irrigated pastures

Temperate pastures are grown in the district, mainly on box woodland soil adjacent to the Condamine River. Pastures were first irrigated commercially in 1954, when 6 ha were grown. The area increased slowly to reach the present figure of 200 ha, of which more than half is lucerne, mainly for hay. Hay production of 6 to 7 cuts yielding 2·5 t per ha per year is rather less than Lockyer Valley results.

Grazed pastures are commonly based on Ladino and Louisiana white clovers (*Trifolium repens*), Kangaroo Valley ryegrass (*Lolium perenne*) and Priebe prairie grass (*Bromus unioloides*). Phalaris (*Phalaris aquatica*), other ryegrass and clovers and medics are sometimes included.

Watering practice aims at keeping the top 30 cm of soil above wilting point. This requires 25 mm applications at 7 to 10 day intervals in summer and 14 days in winter. Nitrogenous fertilizer is occasionally applied in autumn to boost early winter production. Pastures that have been down for 10 years may respond to superphosphate applications.

Until recently, all pastures were spray irrigated, but there is a move towards furrow watering where slope permits. Surface application appeals, as it reduces the labour involved in the exacting watering schedule which must be maintained, especially in summer.

Irrigated pastures are mainly used to fatten store lambs with a stocking rate of up to 40 per ha being maintained year-round. A move towards stocking furrow-irrigated pasture with cattle had begun but was terminated by the current low beef prices. A large dairy venture based on furrow-irrigated pastures and forage crops has been established by Mr R. A. Commens of 'Grassdale', using a 'harvestore' type of silo to ensure continuity of feed.

Future pasture trends

Timber clearing in the Shire has already reached the judicious limit, except for regrowth treatment in some of the undulating brigalow plain and basaltic upland scrub soils. Future changes in land use are therefore expected to consist of steady increases in areas devoted to cultivation and improved pasture at the expense of native pastures.

Pasture improvement activity varies according to the relative prosperity of agricultural and pastoral pursuits and this influence must continue. Some excellent pastures have given way to grain during recent years of pastoral depression and buoyant grain prices. Conversely, a swing of the economic pendulum the other way could lead to renewed interest in improved pastures.

Seasonal conditions, particularly the summers, exert an over-riding influence on effective pasture establishment, as well as on productivity and even survival of sown pastures.

Landholders are gradually realising the need for control of weeds, especially of grassy weeds, in pasture establishment. They are also beginning to appreciate that sown pastures will not withstand the gross mismanagement often accorded native pastures, especially during droughts. Many sown pastures have been sacrificed for the sake of small forage yields when continuously grazed during dry weather. For this reason, the assertion that 'if they are any good they must be able to take it' is gradually disappearing. With this better understanding of their establishment and management needs, the future image of sown pastures in the district is expected to improve.

A departure from past practice of only attempting to establish sown pastures in ashes of scrub burns or on arable land, was developing prior to the downturn in animal enterprises. Areas of native pasture were partially cleared of timber or regrowth and sown to pasture with the minimum of soil disturbance consistent with adequate weed control, without a cropping phase.

Exponents of this technique include Messrs. D. G. Hopper of Cooranga North and C. H. Hopper of Porters Gap, who established green panic/lucerne pastures in what were old Rhodes grass stands in fairly steep, stony basaltic upland scrub soils. Fallen timber and scrub regrowth were pushed into windrows roughly on the contour and the cleared strips were cultivated as well as the stoniness would permit, before the pasture was planted with a cover crop of Zulu forage sorghum.

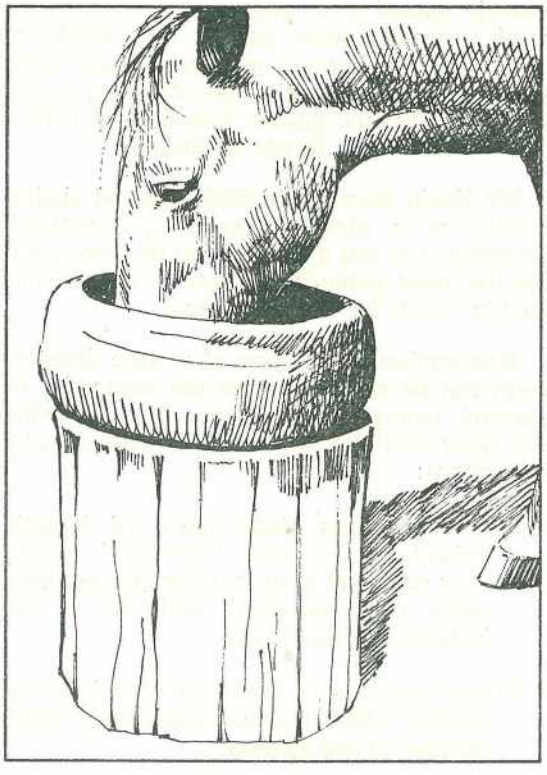
Mr Kevin Berwick of Bell achieved similar results on a mountain coolibah woodland. Regrowth was not a problem on this forest soil but the green panic/buffel pasture was dominated by weeds for the first 2 years.

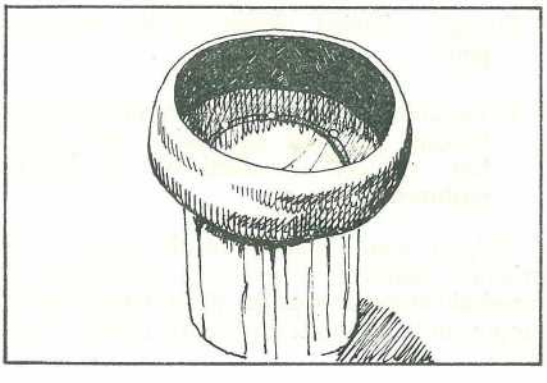
Resumption of this form of pasture development can be expected when the economics of pastoral enterprises improve. The following soil types could be targets for improvement by this means:

- The lower, less stony tracts of basaltic uplands where scrub regrowth is taking over or where poorer native grasses have taken over woodland soils as in the instances quoted above.
- Steeper sections of the undulating brigalow country where regular cultivation is risky because of soil erosion.
- Strongly gilgaied phases of the brigalow plain.
- Levee areas of the box plain where frequent flooding prevents cultivation and lippia has reduced productivity of native pastures.

Only a small increase in the area under irrigated pastures is expected regardless of economic climate, because of the limited water supply and the generally better returns from crops.

Build a cheap livestock feeder





INSTEAD of burning your well-worn car tyres, make a feeder for livestock.

Chaff, grain or licker blocks can be conveniently fed from this 'tyre feeder'.

Take a worn 12 in. or 13 in. recently used car tyre—radial or 4 ply. Cut out one rim beading—and place downward on a 38 x 38 cm block or tree trunk. Securely nail about 20 cm of the remaining rim beading from the outside of the tyre on to the top of the base wood with galvanized roofing nails.

Lift cut edge of tyre upwards to make the walls of the feeder.

Securely nail the rim edges to the base block and the construction is complete. The top of the block makes the bottom of the feeder.

This feeder will hold sufficient chaff and concentrate for a large animal or one of the normal supplement blocks.

It is durable, non-corrosive and safe for animals from an injury point of view.

---

by L. E. Walter, Veterinary Services Branch.

Power wool presses

POWER wool presses offer savings to growers through reduced costs for wool packs, pressing, branding, transport and warehousing; and they take the hard work out of pressing.

In the 1975-76 wool selling season, bales averaged 154 kg. Most of these would have been pressed with a manual press. Power presses are being used increasingly to produce bales up to the present maximum of 204 kg because heavier bales mean fewer bales and that means lower costs.

Presses range in price from $1 800 to $4 500 depending on the brand and options purchased. They are powered either by electric, petrol or diesel driven hydraulics or by motor winches attached to the original cable.

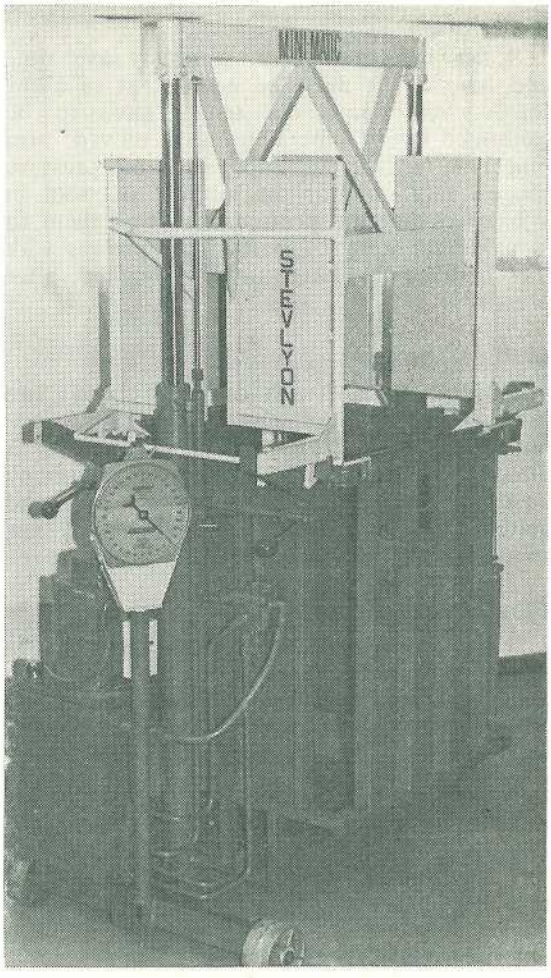
Electric motors of different voltages (240, 415, 480) in single or three phase are available. They are cleaner, quieter and less expensive to run and maintain than internal combustion engines.

There are several optional extras available with power presses.

Auto pinning

This is an automatic pinning device to hold the pressed wool in place while the monkey is on the upstroke. It allows faster filling and baling but costs about $700 extra.

by L. B. Dunlop, Sheep and Wool Branch.



A light weight press (516 kg with front and back fill, scales, a quick cycle time (18 sec.), and non-pack-piercing pins.

Pressers are more likely to press bales to their maximum weight if an auto-pinner is provided.

Non-pack-penetrating pins

These pins are a recent innovation in the field of power presses.

They are becoming more popular as mills complain of contamination of wool by synthetic pack fibre.

Scales

Scales incorporated in a press save time and labour. It must be noted that to allow for uneven floors, its scales have to be calibrated every time a press is moved; also that bale weight indicators and oil pressure gauges only monitor the amount of wool in a bale so that the presser can press them to a maximum weight. Bales from presses with these indicators have to be weighed after pressing.

Multiple boxes

Multiple boxes (with one ram head) are used to replace wool bins. The presser does no lifting of wool as the classer throws it directly into the box. In large sheds, many boxes are required to cope with the lines and volume of wool, therefore this idea seems best suited to small sheds of 2 or 3 shearers.

Flow through boxes

'Flow through' or 'back filling' boxes have a door on the side opposite to the wool bins. This facilitates the flow of wool toward the scales and stacking, and reduces the distance a bale travels in the shed.

Transportable presses

Most power presses are designed so they can be moved from bin to bin and shed to shed. Transportable power presses lend themselves to group ownership and to use in a number of sheds during the year.

Most weigh less than 0·8 tonnes and can be carried on a 6 cyl. utility with a tare weight of up to 1·4 tonnes. To support the press's weight during transportation, the wheels can be placed in some lengths of 'mild steel channel' on the floor of the utility. Other lengths of channel could be used to facilitate on and off loading.

Savings

On November 1977 awards, charges and prices, power pressing wool to 190 kg as against manual pressing to 150 kg saves approximately $922 or $7.80 per bale on a 150 bale clip (22 500 g of wool).

This was worked out after considering the following:

Wool packs at $2.87 each.

Pressing rates—power $3.40, manual $5.14.

Weighing and branding at 5·833 cents per bale.

Road transport from Charleville property to store at $6 per bale.

Warehousing which includes:

Sale by sample charges $6.35 per bale.

Core testing on four lots—one lot, $21 (more than 40 bales); three lots at $17 (fewer than 40 bales); plus 14 cents per bale.

Traditional sale of oddments at $7.37 per bale.

This comparison was done on 150 bales from a manual press and 118 bales from a power press on an objectively classed clip which delivered a ratio of 3 bales of fleece to 1 of oddments.

On the prices quoted, a press could be paid for in 2 to 5 years depending on the volume of wool pressed.

Savings are higher if the grower pays the presser on a per bale basis.

Bales in excess of 204 kg at store attract a 'weight adjustment charge' of $2.60 per bale. There is also a charge for bales used for the surplus wool.

It should be noted that it is not safe to press bales in excess of 190 kg on the property. Bales of wool gain moisture in the humid coastal region.

Conclusion

Pressing heavy bales saves money for the grower, particularly as many of the charges levied are on a per bale basis.

An investment in a power press (with or without options) will more readily be repaid with a high bale output. Power presses lend themselves to the following situations:

- Property with a large clip (for example, 150 bales or approximately 5 000 sheep).
- Group ownership.
- Shearing contractor using his own press.
- Owner who wishes to press his own wool.

Aquatic plants of Queensland

Five common free-floating aquatics

AQUATIC plants are plants which live in water, either submerged, free-floating or attached to the bottom with emergent or floating leaves, or on marsh-land near the water.

These plants are entirely dependent on the presence of a body of water for their survival. While most require permanent or semi-permanent water, a few have adapted to life in temporary bodies of water.

Beneficial effects of water plants include oxygenation of the water and stabilization of stream banks. They also provide food and shelter for fish and other aquatic animals and for water birds.

Possible harmful effects of water plants include blocking pump inlets, impeding the flow of water in channels, tainting the water in farm dams and altering the pattern of siltation by acting as silt traps. Dense growths of water plants may interfere with boating and reduce light intensity in the water and, when rotting, may reduce oxygen levels.

Because of different uses for bodies of water an aquatic plant considered a weed in one situation may be considered harmless in another situation.

The first step in deciding whether a particular plant is useful or otherwise is to establish the identity of that plant. The increasing number of specimens of aquatic plants sent to Botany Branch for identification has shown that a series of articles which can be used as a guide to identify common aquatic plants in Queensland would be useful.

This article is the first in a series that aims to provide an illustrated text describing in simple terms the common water plants of this State. These articles should be of use to the farmer, irrigationist, naturalist, conservationist, in fact anyone interested in the identification of aquatic plants. Only aquatic angiosperms (flowering plants) and ferns will be considered; algae and liverworts will not be dealt with in this series.

The aquatic plants of Queensland can be sorted into one of four categories depending on their habit of growth.

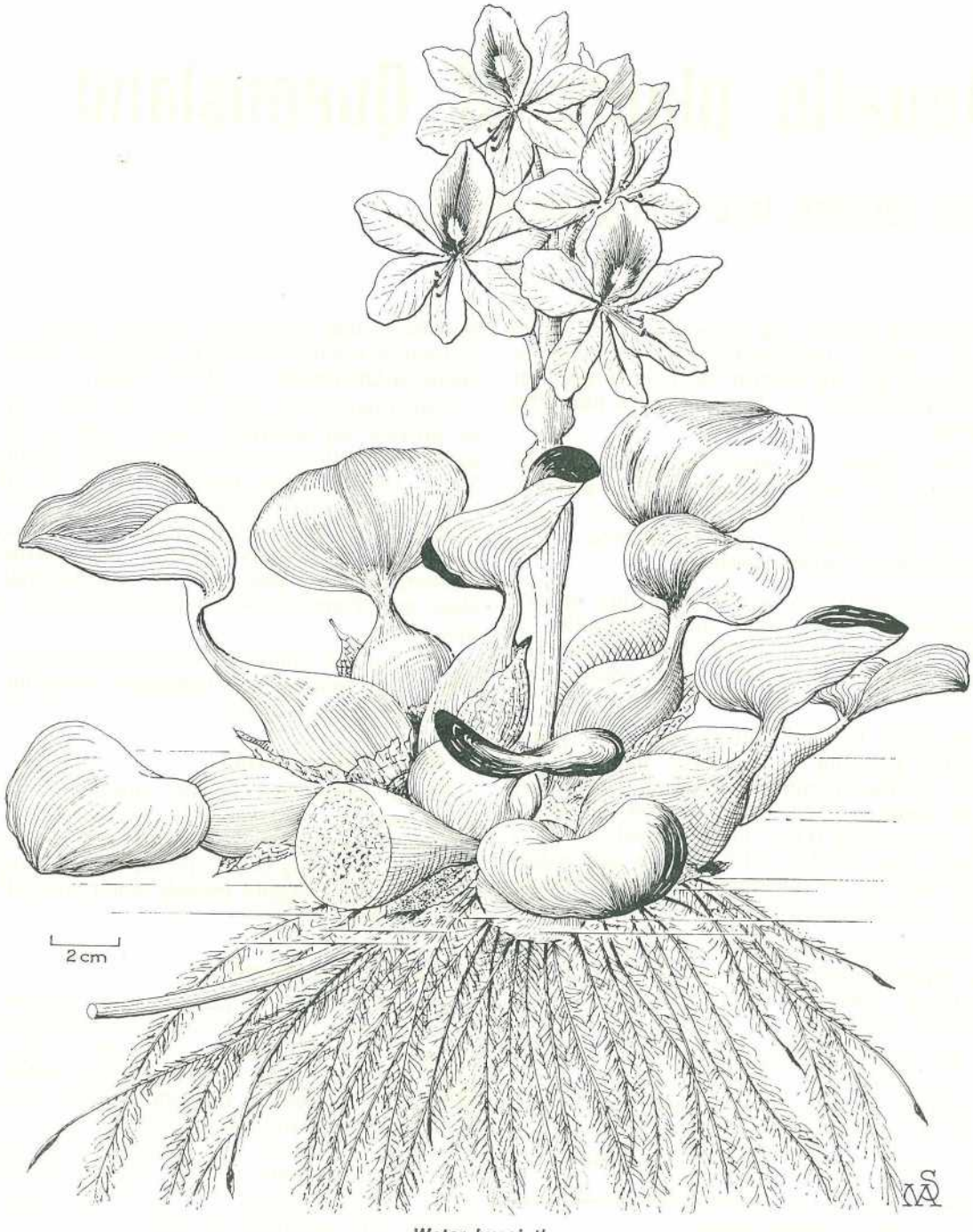
1. Free-floating plants

These plants float on the surface of the water and are not attached to the bottom though occasionally a few plants may root in the mud following a fall in the water level. Plants in this category include water hyacinth and salvinia.

2. Submerged plants

Vegetative parts of plants in this category do not appear above the water surface though sometimes the inflorescences may do so. They may or may not be attached to the bottom. If any portion (except the inflorescence where this is carried above the surface) does appear above the surface it is quickly dried by the sun. Plants in this category include ribbon weed and hydrilla and also the marine angiosperms, the so-called sea grasses.

by T. D. Stanley, Botany Branch



Water hyacinth

3. Rooted plants with surface-floating leaves

These plants have weak stems and leaf stalks that cannot support the leaves above the surface of the water. They are usually rooted to the bottom. After a rapid rise in the water level they may appear to be of the submerged type. However, their leaves are usually thick and waxy on the upper surface which distinguishes them from submerged plants which have thin, often translucent leaves. The water-lilies belong to this group.

4. Rooted emergent plants

The plants in this category are rooted in the mud and have their leaves held erect above the water surface. Most of the plants growing around the margins of the water are in this category.

Note that woody plants such as weeping bottle brush (*Callistemon viminalis*) and weeping willow (*Salix babylonica*) are not considered aquatic plants even though in some situations they may fit into category 4.

In this series of articles, species are grouped according to which of the above four groups they belong and not according to their botanical relationships. Included under each heading which is the recommended common name for the plants, is the scientific name of the species concerned and the botanical family to which the particular species belongs. Occasionally, alternative common names are also given. A short description of the species and its geographical distribution and habitat is given. Notes on the importance of the species are also included.

Five common free-floating aquatics are considered in this article.

Water hyacinth

Eichhornia crassipes

Family Pontederiaceae

Water hyacinth is a free-floating perennial easily identified by the bulbous leaf base, bright-green, shiny leaves and the attractive mauve to almost violet flowers.

DESCRIPTION: Each plant consists of a cluster of leaves which arise above the water surface, and many feathery roots. Individual plants can grow from about 10 cm to almost 1 m tall, and can be up to 40 cm across. The leaves are bright-green and shiny with a bulbous leaf base and a broadly ovate to orbicular blade that can be up to 25 cm across but is mostly 3 to 10 cm across. Flower spikes arise from amongst the leaf bases and are usually longer than the leaves. Each spike has several flowers that vary in colour from pale mauve to almost violet. Each flower is about 4 to 6 cm across with six petals, the upper petal is characterized by a central yellow blotch surrounded by a deep purple-blue margin. After flowering, the stalk of the inflorescence bends over, submerging the inflorescence. The fruits mature underwater.

Water hyacinth spreads rapidly by vegetative means. Each plant produces stolons, and new plantlets are formed at the ends of the stolons. This habit of growth allows this species to quickly cover extensive areas of the water surface.

DISTRIBUTION AND HABITAT: Water hyacinth is usually found on still or slow-moving fresh water in many rivers, streams and dams in eastern Queensland. Occasionally, plants may root in the mud after a fall in the water level and may persist in this way for some time. Frosts will kill the leaves but very often the crown will survive and shoot again. This species cannot tolerate brackish water.

Eichornia crassipes is native to South America but is now introduced and naturalized in many countries throughout the world. It is considered a pest in many tropical or warm countries.

The exact date of introduction of water hyacinth to Queensland is not known but by 1897 Queenslanders were being warned of its pest potential. By 1900 it was widespread in Queensland and by 1901 was a serious pest in many rivers and streams.

IMPORTANCE: In Queensland it is a declared noxious weed under the Local Government Acts 1936–1961 and in the Murilla and Waggamba Shires under the Stock Routes and Rural Lands Protection Acts. The species forms dense masses of vegetation and can be a serious pest of waterways by hampering water traffic and making access to the water difficult for stock and waterfowl. Rotting vegetation can foul creeks and stock tanks making the water unfit for both stock and humans.

Water lettuce

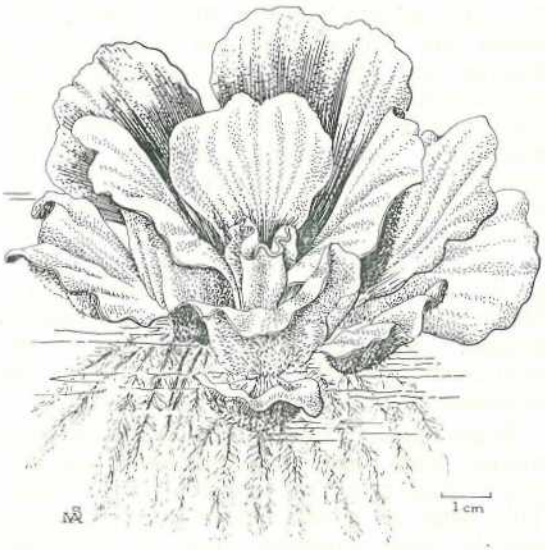
Pistia stratiotes

Family Araceae

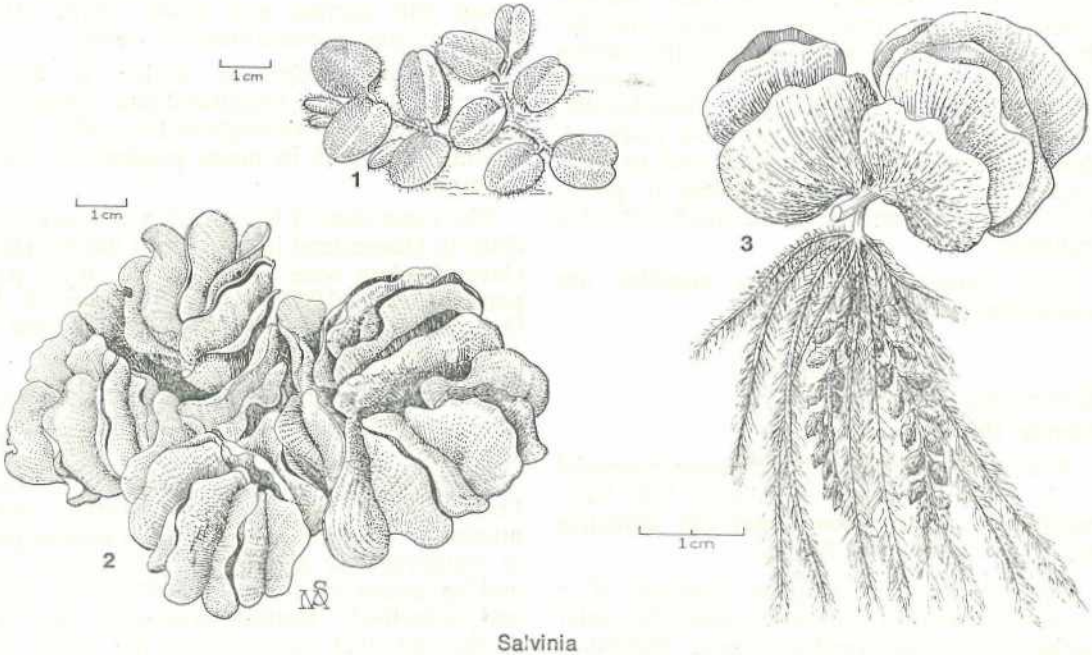
Water Lettuce is a free-floating perennial recognized by the rosette of ribbed, greyish-green, fan-shaped leaves that are thickened and spongy at the base.

DESCRIPTION: Plants consist of a rosette of leaves above the water and many feathery roots below. The roots may extend up to 1 m into the water but are usually much shorter. Individual plants are usually 10 to 20 cm across. The leaves are covered with short, white hairs with dense, woolly hairs near the base and are mostly 3 to 15 cm long and up to about 8 cm wide. Five or more ridges run the length of the leaf, and are usually more conspicuous on the lower surface. The flowers are small and inconspicuous and are enclosed in the rosette of leaves.

Like water hyacinth, each plant gives rise to short stolons which terminate in new plants. In warm conditions, growth and spread of the plant can be very rapid.



Pistia



Salvinia

1. Young plant, 2. congested plant, 3. plant showing sterile sporocarps

DISTRIBUTION AND HABITAT: Water lettuce is found in still or slow-moving fresh water of dams, streams and rivers along the eastern part of Queensland. It has also been reported from near Mt. Isa. Occasionally, it is found rooted in mud after a fall in the water level. It cannot tolerate frost or prolonged periods of cold weather.

The species is native to most tropical and subtropical areas of the Americas, Africa and Asia and was probably introduced into Australia for cultivation in garden ponds and aquariums.

IMPORTANCE: In Queensland it is a declared noxious weed under the Stock Routes and Rural Lands Protection Acts 1944 to 1967. It can cover large areas of water and interfere with water traffic, reduce the light penetration and also, when rotting, foul the water.

Infestations of this species in pest proportions have been reported in many ponds and dams in south-east Queensland and also in dams and streams near Theodore and Mackay.

Salvinia

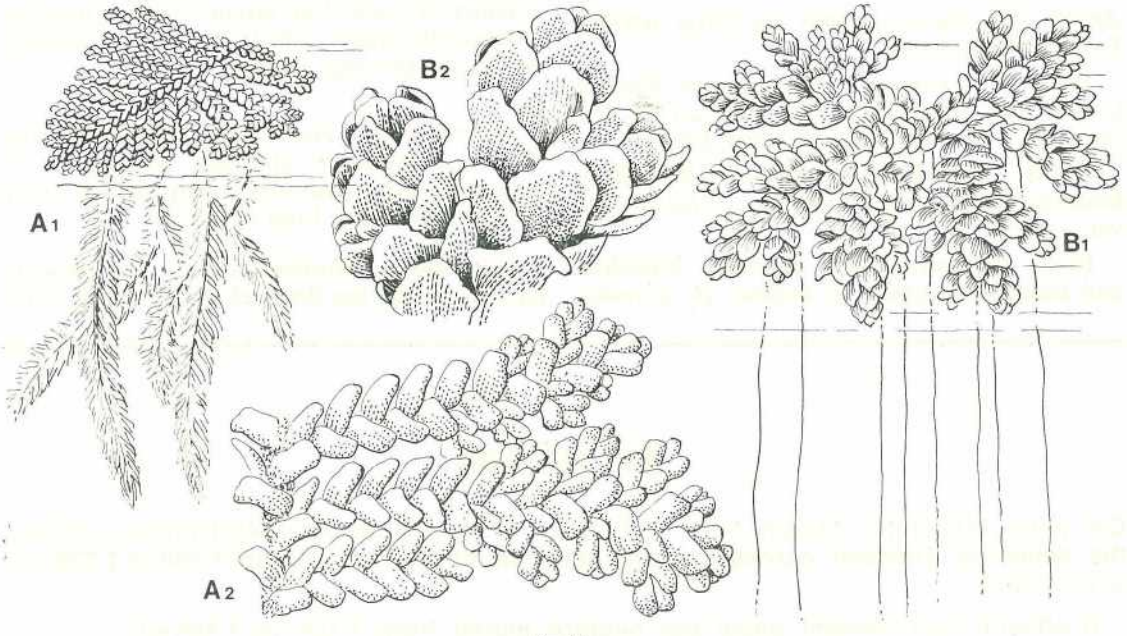
Salvinia molesta

Family Salviniaceae

(Previously included under *Salvinia auriculata*)

This plant is a free-floating fern with small, spongy, green leaves in two ranks along a common stem.

DESCRIPTION: A plant with horizontal branching stems bearing what appear to be pairs of opposite leaves and submerged feathery roots. The root-like structures are in fact finely divided submerged leaves, true roots being absent. The floating leaves may be densely crowded along the stem or in distant pairs depending on the crowding of the plants in the water. If the plants are densely crowded then the leaves are close together; if there is free water between plants than the leaves tend to be sparse along the stem. The leaves vary from about 1 cm to about 2·5 cm long, are shortly stalked, have a distinct midrib and the two leaf-halves are often partially folded together along the midrib.



Azolla

A1. *Azolla pinnata*—habit x 2, A2. *Azolla pinnata*—part of plant x 6, B1. *Azolla filiculoides* var *rubra*—habit x 2, B2. *Azolla filiculoides* var *rubra*—part of plant x 6.

This species is thought to be a sterile hybrid and propagation is by vegetative means. As older parts of a plant decompose, side branches are released which continue to grow as separate plants.

DISTRIBUTION AND IMPORTANCE: Salvinia is found in still or slow-moving fresh water along the eastern part of Queensland and has also been reported from near Mt. Isa.

The species was first described from Africa but is widespread in warm parts of the world. It was first recorded for Queensland in 1953 from Bulimba Creek in Brisbane.

IMPORTANCE: In warm water with a high nutrient content, growth is very rapid and in a short time a mat of vegetation can completely cover the water surface. Dense mats of salvinia interfere with boating and with access to the water for stock and wildlife. In shallow water, large amounts of rotting salvinia can reduce the oxygen levels thus leading to death of fish.

Azolla

Two species pass under this common name.

Azolla filiculoides var. *rubra* is known as Pacific azolla.

Azolla pinnata is known as ferny azolla. Family Azollaceae

Both are species of small, native floating ferns. They are very similar but can be distinguished by using the following key.

Roots thread-like. Plants irregularly branched and irregular in outline. *A. filiculoides* var. *rubra.*

Roots feathery. Plants regularly branched and usually triangular in outline. *A. pinnata.*

DESCRIPTION: Individual plants are usually about 1 to 1·25 cm long, but can be up to 4 cm long. Both species have small leaves about 1·55 mm long which overlap in a scale-like manner. The branches bearing the leaves grow from a central stem. The branches in turn may branch, usually regularly in ferny azolla or irregularly in Pacific azolla. The roots arise on the underside of the plants and are feathery in ferny azolla and thread-like in Pacific azolla.

Both species form spores in specialized bodies known as sporangia which are inconspicuous and arise between the leaves but they are rarely seen. Vegetative reproduction occurs by fragmentation of the plant body and this is its main means of reproduction.

Young or heavily shaded plants are usually green while older plants or plants in direct sunlight are usually reddish.

DISTRIBUTION AND HABITAT: These species are found on still or slow-moving fresh water throughout eastern Queensland with *Azolla pinnata* found as far west as Barcaldine. Azolla is often found in association with other floating aquatics or banked up around rubbish or other plants in the water. The two species are usually not found growing together.

IMPORTANCE: Azolla is usually not considered a nuisance although occasionally if present in large quantities it may block a pump inlet or deter stock from watering.

For more information on Queensland's aquatic plants, see the back cover of this issue.

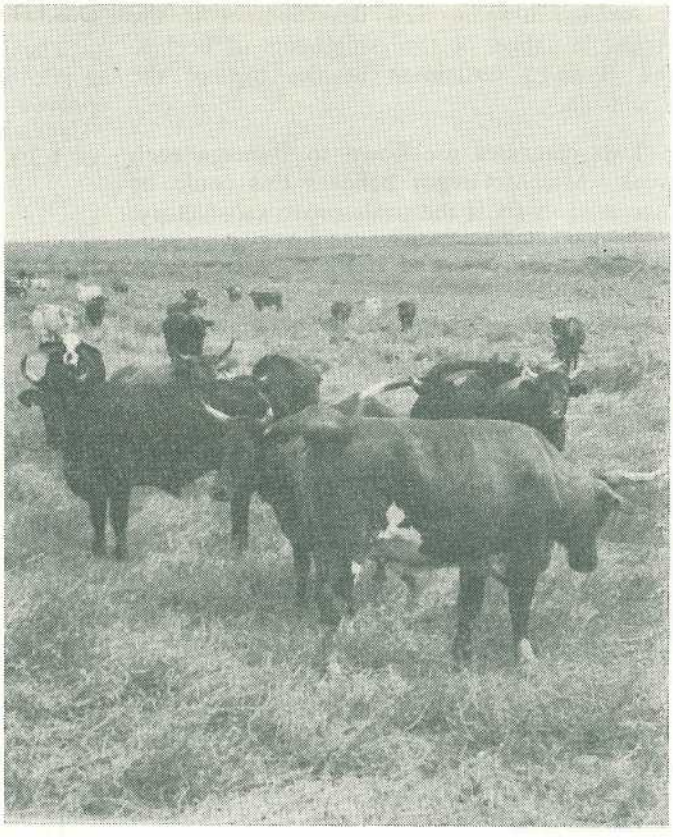
Erratum

ON page 116 of the March–April 1978 issue of the *Queensland Agricultural Journal,* the sentence 'Dressed carcass weight gains per hectare varied from 1 158 to 1 328 kg.' is incorrect.

It should read 'Weight gains per hectare varied from 1 158 to 1 328 kg.'

Peninsula beef for local consumption

by A. J. BOORMAN, Beef Cattle Husbandry Branch.



THE dawn of a new era appears to be breaking for cattlemen and their families at the top of Cape York Peninsula.

Once again, it appears that they will be able to supply a local market.

Comalco is taking the first tentative steps in the process of making their 'Capelands' lease a viable cattle fattening property.

A registered slaughterhouse has been established and cattle are being purchased from neighbouring properties for fattening and slaughter.

Currently, six head are slaughtered each week and the carcasses flown to the butcher shop at Weipa. This beef helps to feed the Weipa bauxite miners.

Mr Iain McGregor, who is presently in charge of the 'Capelands' project, expects that new cold storage rooms at Weipa will supply 20 carcasses weekly.

Photograph above. Purchased stores fatten in about 12 months on the rain-grown improved pastures on 'Capelands'.

An encouraging new development is the recent initiation of trial shipments of beef to the Bamaga settlement at the top of the Peninsula.

Two carcasses are flown to Bamaga each week. Mr. McGregor believes this could be increased to six if the trials prove satisfactory.

With other potential markets in Northern Australia, Mr. McGregor estimates that up to 50 head of cattle could be slaughtered at 'Capelands' each week in the near future.

Remote area

The beef industry in the top half of the Peninsula began shortly after the gold rush started on the Palmer River and serviced the miners until the gold fields were cleaned out.

From then until the U.S.A. market started to take Australian beef in quantity in 1959 the industry languished.

From 1959 to 1973, peninsula cattlemen enjoyed improving prices for their cattle. However, their remoteness from markets supplying the export trade has always been a disadvantage.

The small population in the area and the distance between properties means poor roads. As a consequence, freight rates are high. It costs $80 a tonne to get supplies to Coen from Cairns.

Freight adds 25 cents to the price of 3 kilograms of potatoes, 14 cents to the price of 2 kilograms of sugar, and $2.85 to the price of 45 litres of petrol.

Road transport costs for cattle coming out of the area are also high at $1.25 per semi-trailer kilometre. This means a freight cost to the cattleman of $28 for each fat bullock transported 400 kilometres. This road transport distance is not uncommon and some cattle travel even further.

However, that is only part of the cost. Some cattle spend up to a month walking from the station to where they are loaded on trucks.

C.S.I.R.O. Influence

The research which C.S.I.R.O. started with a pilot study in 1968 and continued until they proved the potential of the heath country on 'Capelands' has resulted in the establishment of 1 700 hectares of highly productive pasture.

And now that the potential of the area has been established, Comalco has been able to formulate definite plans for 'Capelands'.

Comalco decided to relinquish more than 1 300 square kilometres of its Occupation Licence and to advance the planned relinquishment of Special Bauxite Mining Lease No. 5 to enable the establishment of the Jardine National Park.

The pasture on 'Capelands' presently carries 800 cows and their progeny and 400 cattle bought in from neighbouring properties.

Cattle bred on 'Capelands' are normally slaughtered at about three and a half years of age when they produce a 270 kg carcass.

Bought cattle can normally be fattened in about 12 months.

The best pasture mixture has been shown to consist of common guinea grass, signal grass and the legumes Cook stylo and siratro.

To establish and maintain the pastures, it is necessary to fertilize with phosphorus, potash and the trace elements copper and zinc.

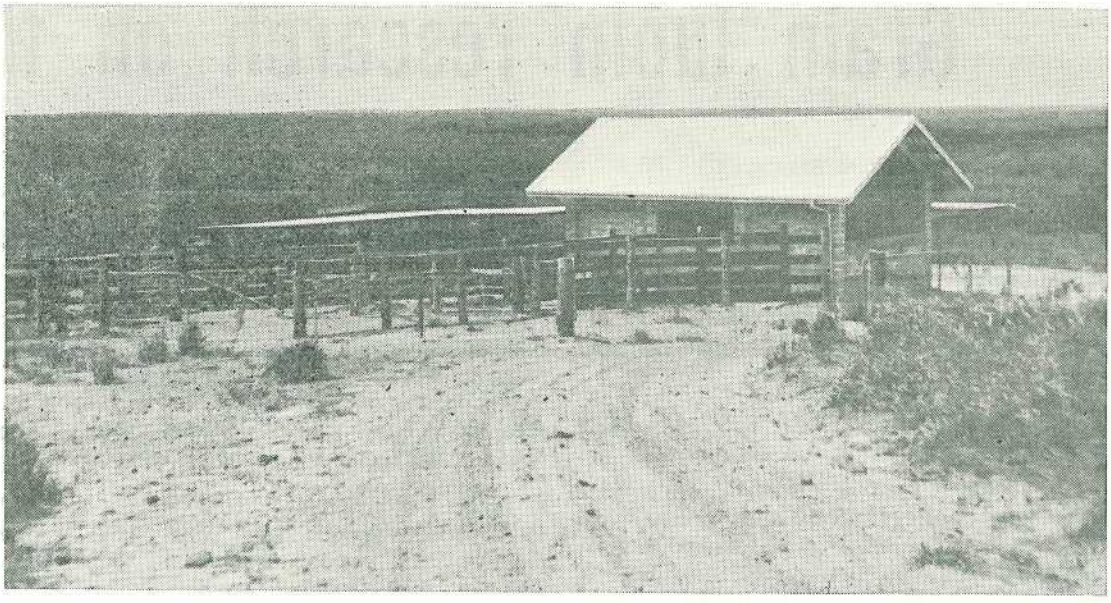
As with other local producers, Comalco face high freight rates in getting the fertilizer which is so necessary to the success of their enterprise. Fertilizer costs $280 a tonne landed at 'Capelands'. More than one-third of that cost is freight.

In addition to fertilizer, it is necessary to treat every animal on 'Capelands' with cobalt and to feed breeders a phosphorus supplement to maintain high levels of production.

In spite of the hardship of isolation, Mr McGregor expects the venture to be successful.

This will mean the cattlemen from Coen North will spend less time droving cattle and that they will not have to pay high freight charges in getting their animals to market.

With this venture, Comalco is also making a valuable contribution to the beef requirements of local population centres.



Above. The 'Capelands' slaughterhouse is surrounded by heath country in its natural state.

Below. The beef is airlifted from 'Capelands' to Bamaga and Weipa.

Grain lupin research on the

by B. D. HALL, Agriculture Branch.

GRAIN lupin is a high protein winter legume which has shown potential as an irrigated crop for the eastern Darling Downs.

Yields of 3 816 kg per ha have been recorded under experimental conditions.

Lupin grain is used as a protein supplement in pig and poultry rations and, unlike soybeans, it does not need to be cooked before being fed to animals. It may also be suited to human consumption, as the flour can be used in biscuit making.

Research has been conducted on the Purrawunda soils of the Wyreema and Nobby districts during the last 4 years. The four cultivars tested were Unicrop and Uniharvest (*Lupinus angustifolius*), WB1 and WB2 (*Lupinus albus*).

Uniharvest and Unicrop were bred in Western Australia by Dr J. S. Gladstones and carry genes for sweetness, non-shattering of pods and white flowers. The plants have narrow leaflets and produce small, round seeds.

WB1 and WB2 were selected by Dr Gladstones from overseas material and subsequent work with these lines has ensured their purity and freedom from poisonous alkaloids. They produce sturdy plants with broad leaflets and broad, flat seeds.

Trials were initiated at Wyreema in May 1972 and showed that WB2 was earlier maturing and yielded more grain than WB1. The *L. angustifolius* lines had better yields when grown at higher densities and Unicrop was earlier and yielded more grain than Uniharvest. The trial also suggested that Uniharvest requires a period of cold weather to induce flowering and indicated that the best way to increase yield of all varieties was to plant earlier so that cold weather would not slow vegetative development.

The author inspects WB1 lupins (left) and WB2 lupins (right) showing the different maturity and height. WB1 is in full primary flowering and WB2 in secondary flowering.

eastern Darling Downs

The four cultivars were again planted at Wyreema in April 1973. A mild winter ensured that crop growth was not reduced by cold weather and so development was vigorous. The varieties, except for Uniharvest with its cold requirement, flowered in times similar to those in the earlier trials.

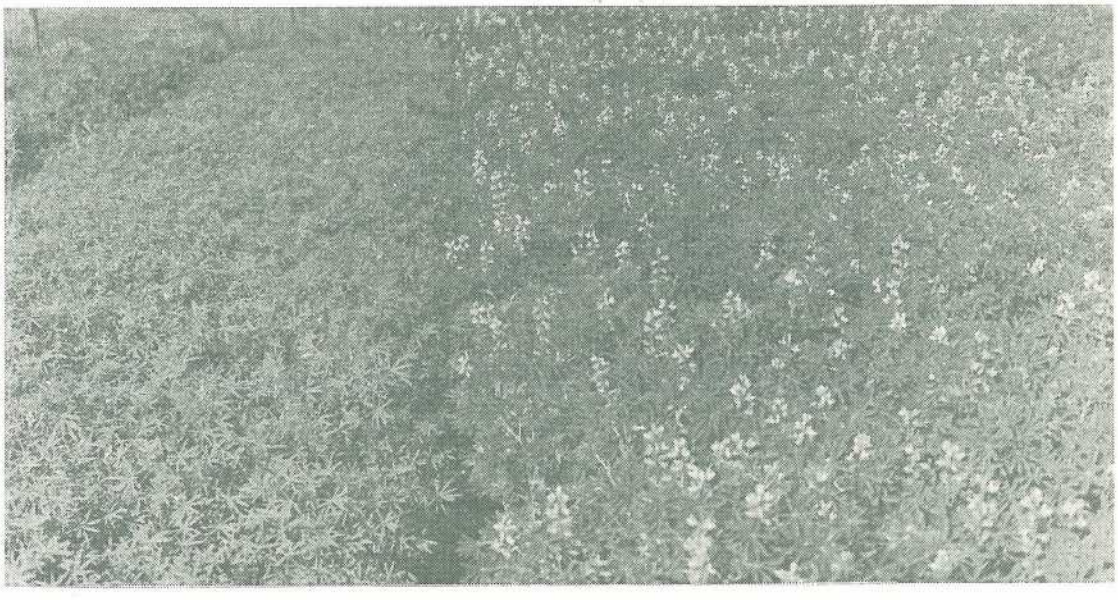
Again, the higher population yielded more. The *L. albus* strains were clearly superior to the *L. angustifolius* lines (table 1).

In April 1974, a trial was established at Nobby to look more closely at plant densities. The four strains were grown at four densities from 10 to 40 plants per m^2. Early, vigorous growth was followed by a severe frost, and damage was most evident in Unicrop and WB2 which were starting to flower. Uniharvest was unaffected as it was at an early stage of development when the frost hit, and thus it was the highest yielder. More plants died in the lower density treatments than in the higher density treatments.

Optimum plant densities for WB1 and WB2 appeared to be between 20 to 40 plants per m^2. Unicrop had an optimum plant density at 30 plants per m^2. Uniharvest showed a similar trend but the yield difference was not significant.

From work done so far, it appears that the *L. albus* cultivars are superior in yield (table 1) to the *L. angustifolius* lines. They appear to be superior also in standability, protein content and ability to withstand weathering after maturity. They also have the added advantage of a sturdy, upright habit which means that row cropping, weed control and furrow irrigation present no problems.

Planting time where early frosts are not a problem can be as early as April. In other areas, early May to early June is the best time to plant using the quicker maturing varieties. In cooler areas, such as the Granite Belt, plantings should not be made before mid May and later maturing varieties are recommended for these areas. This ensures that the first severe frosts do not coincide with flowering. However, planting in June or July causes very slow growth, smaller plants and flowering close to the ground which could present harvesting difficulties.



Unicrop lupins (left) and WB2 lupins (right) showing Unicrop having finished flowering and WB2 in secondary flowering.

Primary flower of WB2 (centre) with secondary bud (left).

In order to realize the full potential of the crop, it is best to sow in a well-drained, deep, acid to neutral soil and to maintain soil moisture at an adequate level. Water stress at flowering lowers pod set while stress at pod set increases the percentage of pod shedding. To overcome this, it is advisable to irrigate at flowering and, if possible, 3 weeks later.

Irrigated lupins, even at this early stage, seem to be a reasonable economic proposition for the Darling Downs. Most farmers in the area already have machinery necessary for lupin growing and costs should be similar to those of barley. Returns should also be comparable to those from barley. Further studies on the southern basaltic uplands and in other parts of southern Queensland are proposed to substantiate the conclusions presented here.

NOTE: Lupin lines WB1 and WB2 have now been named Hamburg and Ultra respectively.

Mature lupin plants ready for harvest. Unicrop (left) is shorter and has smaller pods, WB1 (right) is taller with larger pods.

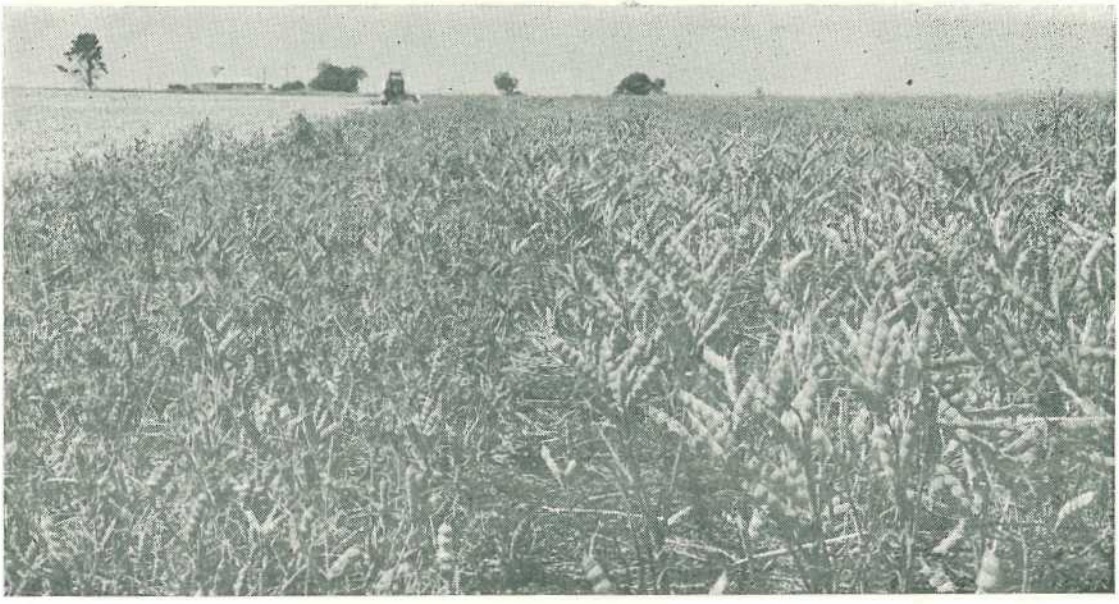


TABLE 1

GRAIN YIELDS FROM DIFFERENT PLANT POPULATIONS OF FOUR VARIETIES OF LUPIN AT WYREEMA (kg per ha)

Varieties	1972 Planted 17 May Plant population per ha		1973 Planted 18 April Plant population per ha			
	370 000	250 000	200 000	300 000	370 000	500 000
Unicrop	2 398	2 000	..	..	2 725	3 026
Uniharvest	1 685	1 618	..	..	2 027	2 181
W.B. 1	2 261	..	3 088	3 325	..	..
W.B. 2	3 154	..	3 543	3 816	..	..

TABLE 2

GRAIN YIELDS FROM DIFFERENT PLANT POPULATIONS OF FOUR VARIETIES OF LUPIN AT NOBBY IN 1974 (kg per ha). PLANTED 11 APRIL.

Varieties	Plant population per ha			
	100 000	200 000	300 000	400 000
Unicrop	1 657	1 778	1 905	1 694
Uniharvest	2 667	2 516	2 722	2 472
W.B. 1	1 368	1 924	2 049	1 933
W.B. 2	648	1 292	1 204	1 296

Unicrop and W.B. 2 were severely frosted and W.B. 1 slightly frosted.

Good yolk colour–how it can be achieved

DURING the early 1960s, poultry farmers were troubled by pale egg yolks that were the result of changed feeding practices such as the feeding of low fibre diets without green feed.

This brought complaints from housewives who reacted against yolks that were very pale in colour. Experiments were conducted at the Poultry Research Farm at Rocklea to investigate the problem.

As a result of these experiments, recommendations were made regarding the amounts of pigment rich feed ingredients and the concentrated sources of natural pigments then coming on to the market necessary in layer diets to give acceptable yolk colour.

The Queensland Egg Marketing Board has realized the importance of yolk colour and applies a penalty of five cents per dozen on all eggs that do not meet the standard required. The Board requires yolks to be between scores of 7 and 10 on the Roche yolk colour fan with no significant departure from the hue of the fan.

Approximately 18 months ago some flocks began to produce eggs with yolks having an apricot hue (a pinkish-coloured yolk) which was not acceptable either to the consumer or the Egg Board. The cause of this apricot hue was not immediately evident. Diets being fed to affected flocks contained little pigment from sources such as maize and lucerne meal and depended almost entirely on added pigment concentrates to maintain yolk colour.

Experiments were conducted by two other institutions as well as the Department of Primary Industries to determine the cause of these off-coloured yolks. The results suggested that the unacceptable colour was produced by a commonly used egg pigmenter 'Hi-gold' when fed in diets with little or no pigment from maize or lucerne. Where a good supply of pigment from these sources was available, an acceptable colour was produced. Hi-gold consisted of a blend of carophyll yellow and carophyll red in the ratio of 1.28:1.

Good quality lucerne meal is usually the only economical feed ingredient source of pigment in poultry diets in south and central Queensland but shortages do occur from time to time. During such periods, producers have to rely on added pigmenter to maintain yolk colour. It was clear that the use of Hi-gold under these circumstances produced unacceptable yolk colour therefore trial work was needed to find a pigment blend which would produce acceptable yolk colour.

With this in view, another experiment was conducted at the Department's Poultry Research Farm to examine the intensity and hue of yolks produced when a range of ratios and dietary levels of carophyll yellow and carophyll red were fed to laying hens.

A total of 336 Australorp pullets, 44 weeks of age, were housed in single laying cages and divided into 21 groups of 16. These pullets were then fed a properly balanced diet, low in natural pigment, for 2 weeks. This diet will be referred to as the control diet and is set out in table 1. A complete vitamin and mineral feed supplement was added to the diet.

TABLE 1

CONTROL DIET

Ingredients	Percentage
Wheat meal	31·8
Sorghum meal	31·8
Meat meal	10·0
Mill run	20·0
Limestone	6·0
Salt	0·3
D. L. methionine	0·1
Vitamins and minerals	+
	100·0

by H. W. BURTON, Husbandry Research Branch.

TABLE 2

(a) Ratio of yellow: red carophyll	(b²) Levels of inclusion in the diets
yellow: red	gm per tonne
1·25: 1	12·0
1·75: 1	15·0
2·25: 1	18·0
2·75: 1	21·0
3·25: 1	

TABLE 3

THE EFFECTS OF VARIOUS COLOUR COMBINATIONS AND LEVELS OF INCLUSION ON YOLK COLOUR SCORE

Primary treatment ratio (yellow : red)	Yolk colour score		
	Rocklea		S.Q.E.M.B.
	Intact yolks	Broken yolks	Intact yolks
1·25 : 1	4·7	7·7	9·4
1·75 : 1	4·8	7·7	7·9
2·25 : 1	4·6	7·5	8·3
2·75 : 1	4·6	7·3	7·9
3·25 : 1	5·0	7·5	8·9
Level (g/tonne)			
12	4·3	6·7	7·2
15	4·5	7·4	8·3
18	4·8	7·7	9·0
21	5·2	8·4	9·4

The remaining twenty treatments were obtained by adding the five different ratios of yellow and red carophyll to the control diet at the four levels of inclusion shown in table 2. During the experiment, a lighting programme giving 15 hours of light per day was used. Individual egg production and feed consumption figures were recorded.

Observations

- All eggs laid on the last day of the depletion period and on days 7, 14, 22, 23 and 24 of the experimental period were broken open and the intact yolk graded according to the 15 grade Roche Yolk Colour Fan by two observers. These yolks were graded under indirect natural daylight.

- All eggs laid on days 25, 26 and 27 of the experimental period were broken open, the yolk ruptured and graded according to the Roche Yolk Colour Fan. This operation was also carried out under indirect natural daylight.

- Four eggs from each treatment laid on day 21 of the experimental period were broken open and the intact yolk graded by two members of the quality control staff of the South Queensland Egg Marketing Board at the Board's egg quality laboratory. These yolks were examined under fluorescent light.

Observers in this trial assessed each yolk independently and some variation in colour grading did occur. This was overcome by expressing the observers' score as a mean. Lighting conditions did cause marked differences in gradings so when examining yolk colours on the farm, lighting conditions similar to those at the Egg Board should be adopted.

Results

In tables 3 and 4 results of the various colour combinations and levels of inclusion on intact and broken yolks indicate:

- As the ratio between yellow and red carophyll was increased there was no obvious increase in yolk colour. However, the degree and percentage of apricot yolks decreased significantly up to the 2·75:1 ratio and then there was no further decrease at the next level. This indicates that the optimum ratio lies between the 2·75:1 and 3·25:1 levels.

- As the levels of pigment added to the diet were increased, the yolk colour was increased. This was expected and indicated that a level of inclusion approaching the top treatment of 21 gms per tonne should be adopted when diets low in natural pigments are used.

- The inclusion of pigment in diets in no way affected egg production, feed consumption or the general health of the hens under trial.

TABLE 4

THE INFLUENCE OF VARIOUS COLOUR COMBINATIONS ON THE INCIDENCE OF 'APRICOT' YOLKS

Ratio (yellow : red)	Percentage of 'apricot' yolks
1·25 : 1	56·4
1·75 : 1	19·2
2·25 : 1	24·9
2·75 : 1	11·5
3·25 : 1	13·6

- Where eggs were stored for 3 weeks at both ambient temperatures and 13 deg.C a decrease in visual yolk colour score resulted. Storage at 13 deg.C resulted in slightly lower pigment loss than those eggs stored at ambient temperatures. Retention of yolk colour, therefore, may be assisted by the use of cool rooms. When other eggs were oiled and stored for 12 weeks at 4 deg.C there was no loss or change in yolk colour.

Conclusions

A satisfactory yolk colour can be achieved from diets containing little or no pigment from maize or lucerne when a blend of carophyll yellow and caropyhll red in the ratio of approxmately 3:1 is incorporated at the level of 20 gms/per tonne.

Where on-farm mixing of diets is carried out, it is recommended that the pigments be stored in an air-tight container and held at less than 20 deg.C to reduce the risk of deterioration.

It is also recommended that eggs be held in a cool room on the farm, this will not only safeguard egg quality but will reduce the loss of yolk colour. By using a cool room, there is the added bonus of reduced weight loss of egg. Weight loss normally occurs because of evaporation of moisture from the egg through the shell.

Bovine tuberculosis free herds as at 31-5-78

C. P. Adams, Warwick Park, Pratten.	MG
J. H. Anderson and Sons, 'Inverary', Yandilla.	PH
Australian Estates, Eurella, Mitchell.	SG
Australian Estates, Wainui Station, Bowenville.	SG
W. H. Bowden, Brendale Braford Stud.	BF
Central Estates, 'Comet Downs', Comet.	SG
Cherokee Group, Tanby, via Yeppoon.	BM
B. L. and M. O. Christensen, 'Elavesor', Rosevale, via Rosewood.	PH
J. P. and M. M. Erbacher, Leafmore, Hodgsonvale.	GS
P. J. Evans, M.S. 28, Dragon Street, Warwick.	FS
B. Goddard, 'Inverell', Mt. Tyson.	AS
N. J. and H. M. Guppy, River Dell Friesian Stud, M.S. 852, Hodgsonvale.	FS
H. M. State Farm, Capricornia Stud, Etna Creek, via Rockhampton.	JS
H. M. State Farm, Numinbah.	AIS
H. M. State Farm, Palen Creek, via Rathdowney.	JS
G. T. and H. W. Hopper, Ellendean Guernsey Stud, Maleny.	GS
W. Leonard and Sons, Welltown, Goondiwindi.	PS
N. E. Lobley, Neloby, Mt. Pleasant, via Dayboro.	FS
R. G. McDonald, 'Buffelvale', M.S. 807, Mundubbera.	JS
C. R. and J. L. Marquardt, Cedar Valley A.I.S. Stud, Wondai.	AIS
W. H. C. Mayne and Sons, 'Gibraltar', Texas.	AG
H. J. and D. J. Morris, 'Gaiview' Stud, Clifton.	PH
E. I. and S. Pacholke, 'Sunnylawn', Braford Stud, M.S. 74, Clifton.	BF
R. S. and G. C. Postle, 'Yarallaside', Pittsworth.	JS
Q.A.C., Lawes.	AIS
Q.A.C., Lawes.	JS
Q.A.C., Lawes.	FS
Q.A.C., Lawes.	BM
D. G. Raff, Forres Angus Stud, Karara.	AG
H. N. Schelback and Co., Allanview A.I.S. Stud, Warwick.	AIS
J. N. Scott and Son, 'Auchen Eden', Ayrshire Stud, Camp Mountain.	AS
J. and S. C. Siebenhausen, 'Merriton', M.S. 195, Pittsworth.	AIS
E. J. Smith, 'Hillcrest', Borallon.	AS
Stanbroke Past. Co., Waverley Brahman Stud, St. Lawrence.	BM
N. L. Stiller, 'Vineveil', Guluguba.	PH, CN
University of Queensland, Veterinary School, St. Lucia.	DM
A. R. and D. G. Vonhoff, M.S. 918, Toowoomba.	FS
Westbrook Training Centre, Westbrook.	JS

KEY

Angus—AG
Ayrshire—AS
AIS—AIS
Braford—BF
Brahman—BM
Chianina—CN
Droughtmaster—DM
Friesian—FS
Guernsey—GS
Hereford—HF
Jersey—JS
Murray Grey—MG
Poll Hereford—PH
Poll Shorthorn—PS
Santa Gertrudis—SG

Food uses of barley

by D. J. MARTIN, Agricultural Chemistry Branch.

BARLEY is an important crop both in Queensland and in Australia generally.

From 1969 to 1973 Queensland produced an average 156 000 tonnes annually. Over the same period, Australian production averaged 2.2 million tonnes.

About half of Australia's barley crop is exported (figure 1). During the period 1969 to 1973, Japan imported more of our barley than any other nation, and shipments there and to Taiwan have increased rapidly in recent years. By contrast, the proportion of our exports going to E.E.C. countries decreased from 60% in 1969 to 7% in 1973.

In Australia, the brewing industry which uses barley in a malted form, takes most of our barley destined for food use. Minor uses of barley malt are in breakfast cereals, infant foods and confectionery—while unmalted barley is used in making soups and other food preparations. This article outlines some of the ways in which barley is used in the food industry.

Malt production

The purpose of malting is to produce, through seed growth, substances called enzymes which are able to break down starch and protein in the seed and so accomplish what is termed 'modification'. The maltster attempts to produce as much of the enzymes as possible while maintaining a desired level of modification and a minimum weight loss from seed respiration and root growth.

There are three processes involved in malting; steeping, germination and kilning. First, the grain is steeped or soaked in water and then germinated under carefully controlled conditions. The germinated grain is then dried by kilning to stop growth and to form a storable product of the desired colour and flavour.

A good malting barley is one which has (i) rapid and uniform germination, (ii) even enzymic breakdown of the starch and protein in the seed, (iii) an adequate amount of enzymes even after kilning, and (iv) a low nitrogen content.

- STEEPING. The steeping process is carried out so that sufficient moisture enters the grain to start germination. It is generally acceped that if seed growth and the processes of grain modification are to be maintained during the malting process, the moisture content of the barley must increase to 40 to 42% during the steeping process.

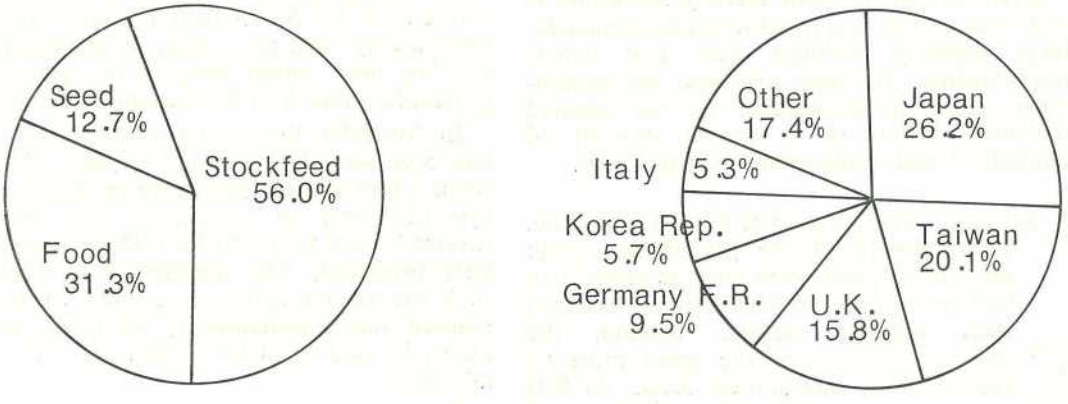


Figure 1. Utilisation of Australian Barley, 1969 to 1973.

The traditional practice of steeping was to soak the grain in a tank of water 2 to 3 days with daily changes of the steep liquor. This practice of steeping grain for long and uninterrupted periods was found to slow germination and cause uneven growth of the grain. This in turn reduced the yield of malt extract. It is therefore not surprising that some of the earliest technological developments in the malting process were in new steeping methods.

Two processes which result in more even germination have been adopted by many maltsters. The first involved a short period of exposure of the grain to air during steeping or in other words a short 'air-rest', while the second involved a short initial steep of up to 8 hours followed by an extended air-rest period for as long 16 hours.

- GERMINATION. This process is characterized by root growth and an increase in length of the first leaf-sheath along with 'modification' of the endosperm. To a certain extent, the germination and steeping processes overlap because at the end of steeping, many maltsters prefer the tip of the rootlet to be breaking through the husk.

Once germination has commenced in the traditional floor malting process, the grain is spread on a water-proof malting floor to a depth of about 10 cm. The grain is turned from time to time to equalize its temperature and to prevent the roots from matting.

Even though the floor malting procedure is still in use, there is a trend towards automated, large capacity maltings with low labour requirements. In these maltings, the germinating grain is maintained at the desired moisture content by a forced draught of humidified and temperature-controlled air.

- KILNING. The purpose of kilning is twofold. First, growth of the germinating grain must be stopped when enzyme production and endosperm modification have reached their optimum levels. Second, the moisture content of the grain must be reduced to a safe storage level. At first glance, this drying process might appear to be straightforward; however, in reality this is not the case.

The initial stage of kilning consists of drying, withering of the rootlets and a gradual reduction in the moisture content of the seed. During this process, there may be a minor production of enzymes which will cause additional modification of the endosperm. At a given moisture content these processes cease and further drying is carried out at low temperatures. The temperature is then raised to levels commonly used to finish brewer's malt. At this stage, complex chemical reactions take place which result in the development of the characteristic colour and flavour of malt. Consequently, the quality of the finished beer can depend in many respects on strict control of the kilning process.

Although the basic principles of kilning have not changed there have been considerable advances in the design of kilns. The most significant is the gradual phasing out of separate kilning vessels in favour of malting systems in which germination and kilning are carried out in the same vessel. This has led to considerable savings in both space and labour costs.

Beer production

The main use of malt is in the manufacture of beer, where all of its properties are needed: enzyme activity to convert the starch to sugars, proteins to feed the yeast and contribute to beer foam, and flavour components to form the characteristic flavour of the final product.

Barley was undoubtedly used in making beer long before the beginning of recorded history, especially in places where it was the chief cereal used for food. Beer is known to have been widely used as a drink in ancient Egypt and has been traced back to the age of the pyramids, some 4 to 5 thousand years B.C.

In Australia, the annual production of beer had been steadily increasing up until 1974/75 when 1 960 million litres were produced. This upward trend in production has recently reversed when in 1975/76 1 930 million litres were produced. The significance of barley in such production figures is evident when it is realised that approximately 80 g (3 oz) of barley is used to make 1 bottle of beer (740 ml size).

Between the finished malt and the bottle of beer there are four main production steps: mashing, wort processing, storage and bottling.

- MASHING. After grinding the malt, several methods can be used to obtain a satisfactory malt extract. Regardless of the system used, the chemical processes involved are essentially the same. The most important change taking place is the breakdown of starch to fermentable sugars.

The two basic methods of mashing are known as infusion and decoction mashing. Infusion mashing is a traditional and simple method in which the mash (that is, the mixture of ground malt and water) is heated to just below its boiling point. Decoction mashing which was devised in central Europe is the traditional method for preparing a malt extract for bottom fermentation beers or lagers. The process involves part of the mash being withdrawn, boiled and returned to the mashing tank with the result that the temperature of the whole mash is raised.

This system provided brewers with a simple means of changing the temperature of the mash during the process. Over the years, improved methods of extraction were developed until both mashing and extraction evolved into a highly sophisticated process where the choice of method has depended largely on the type of malt available and the type of beer required.

A variety of materials other than conventional malt can be added to the initial mixture of ingredients or grist. These types of materials, referred to as adjuncts, can be sugars (for example, cane sugar and glucose) or materials prepared from cereal grains such as wheat, barley, corn or rice. In Australia, 20 to 40% of the extract is derived from adjuncts, while in the U.S.A. an average of 35% of the extract is obtained from this source.

The most common source of adjunct in Australia is cane sugar while cereal adjuncts, in particular corn grits, are the most popular sources in the U.S.A. Adjuncts are used because they are cheap sources of carbohydrate and hence extract. Apart from the obvious advantage of a reduction in the cost of raw materials, the use of adjuncts may also contribute to an improvement in the quality of the beer.

- WORT PROCESSING. The liquid of the mixture of ground malt and hot water, which is referred to as the wort, is separated from the used grains and is then boiled with hops. The purpose of this is to (i) arrest further enzyme action, (ii) sterilize the wort, (iii) extract the bitter components from the hops, and (iv) hasten chemical changes.

The clear, hopped wort is then cooled and after yeast has been added it is transferred to fermentation tanks where it remains until the sugars have been fermented to produce beer. This process normally takes about 4 days. The beer is then chill-proofed, carbonated and bottled.

Other uses of malt

The distilling industry is second to the brewing industry in terms of malt usage. Normally, barley used for the manufacture of distilling malt is of smaller size and higher protein content than that used for brewing malts. Whisky can be made from malted barley alone (malt whisky) or from a mixture of malted and unmalted barley (grain whisky).

Other uses of malt, while large in number, account for only a small fraction of the total production. Examples of these are:

Product	Uses
Food malt	Breakfast cereals Malted milk concentrates Infant foods
Malt syrups ..	Baking Confectionery Medical preparations
Malt flour	Wheat flour supplements in bread, cracker and biscuit production
'Specialty' malts ..	Dark beers Non-alcoholic beverages Breakfast cereals

Non-malt useage of barley

Most of the barley that goes directly into human food is consumed as pot or pearl barley. A secondary product of the manufacture of pot and pearl barley is barley flour. Pot and pearl barley are made by gradually rubbing away the hull and outer portions of the barley kernel. Pearl barley is made from pot barley by continuing the pearling process; 100 kg of barley normally makes 65 kg of pot barley or 35 kg of pearl barley.

In Australia, pot and pearl barley are used in making soups and similar food preparations. Compared to the other food uses of barley the domestic market for pearl barley is almost insignificant. For example, during 1973 to 75 the amount of pear barley produced was only 0·4% of the total domestic consumption of barley for food purposes.

In Japan, the majority of our barley is used in a non-malted form to manufacture two types of food. One type is prepared by pearling and rolling the grain while the other type is a flaked product obtained by cutting the grain into halves. In both processes, the selected grains are polished and separated from any barley flour. Vitamin additives are then included before the barley is boiled and rolled. After drying and cooling, the products are stored ready for packaging. In Japan, the traditional meals using these two types of food are made from mixtures of either barley and yam or barley and rice. Such mixtures are prepared prior to cooking the meal.

The Japanese also use barley for making tea. This drink is the liquid obtained after soaking roasted barley in water.

Summary

The main food use of barley in Australia is in the malting and brewing industries.

Malting involves the following processes; steeping, germination and kilning. Its purpose is to form by seed growth, substances called enzymes which can be used to break down starch and protein.

Malt is germinated barley whose growth has been halted by drying. The main use of malt is in the manufacture of beer. Other uses are in the distilling industry and in the manufacture of a range of products including breakfast cereals, infant foods, confectionary and medicinal preparations.

Of the barley that goes directly into human food, the majority is consumed as pot or pearl barley. In Australia these products are used in making soups and similar food preparations.

Seed germination requirements raised

THE Minister for Primary Industries, Mr V. B. Sullivan, has announced higher minimum seed germination requirements for soybean, sunflower seed, sorghum almum and Sudan grass next year.

He said it had been approved that the germination percentage for soybean seed increase from the present 60 to 80, sunflower seed from 65 to 75, sorghum almum from 65 to 70 and Sudan grass from 65 to 70.

In addition, the minimum pure seed content for Gatton panic is to be raised from 40% to 70%, with a compensating reduction in the minimum germination requirement from 25% to 20%.

Mr Sullivan said the changes to the Agricultural Standards (Seeds) Regulations of 1969 had been agreed to by the Chief Seed Testing and Regulatory Officers' Committees, the seed industry and the Queensland Graingrowers' Association.

The objective was to maintain uniform standards between the States at quality levels adequate for seed users and reasonably attainable by seed producers.

Mr Sullivan said that the changes would come into force from January 1, 1979.

Raw milk storage

by H. S. JUFFS, Dairy Research Branch.

RAW milk is a very perishable product. Unless positive steps are taken to protect the milk during and after production, spoilage will soon occur.

Various protective measures have been introduced over the years and these now form an integral part of the procedures used in the production and storage of raw milk. Although these measures certainly extend the acceptedable storage life of raw milk, spoilage will still eventually occur. It is important, therefore, to recognize the limitations of the measures currently employed to protect the quality of raw milk.

Causes of spoilage

Bacteria, tiny single-celled micro-organisms about one-thousandth of one millmetre in diameter, are the most common cause of spoilage of raw milk. They gain entry to the milk mainly from equipment surfaces with which the milk comes in contact. However, some are also derived from the surfaces of the cow's teats, from within the teats and udder, and from dust and water residues that may gain entry to the milk.

Many different types of bacteria are found in raw milk. They vary in their growth rates at given temperatures, in the temperature range in which they can grow, and in their effects on milk quality.

Once in the milk, bacteria grow and multiply if the conditions are suitable. At warm temperatures, a population of many millions of bacteria per ml can be reached within a few hours. As they grow, the bacteria may produce lactic acid from the lactose in the milk. This causes the milk to sour and coagulate. Bacteria may also attack the proteins, fats, or other constituents, giving rise to a variety of defects.

Factors other than bacteria can also contribute off-flavours to milk during storage. These include absorption of strong-smelling substances in the atmosphere adjacent to the stored milk and the action of natural milk lipase, an enzyme that attacks the fats of milk under certain conditions causing rancidity.

Control of bacterial spoilage

Various measures are employed by the dairy industry to protect raw milk from bacterial spoilage. While each of these measures has a certain effect when used alone, the measures are much more effective when used in combination. The main protective measures in use are the following:

- Try to ensure that only milk from healthy cows is submitted for processing. Milk from diseased animals may be unsatisfactory initially, and may contain potential pathogens.
- Use hygienic production methods. The main points here involve a thorough washing and drying of the cow's udder before milking to remove dust and manure particles, and the use of sound milking equipment that has been properly cleansed immediately after milking and sanitized with an approved sanitizer just before milking.

  By paying strict attention to these points, the numbers of bacteria gaining entry to the milk will be minimized, but it is generally not possible to completely prevent contamination. Farm milk with a total bacterial count of only a few thousand per ml can be considered to be well produced.
- Apart from the farm equipment, it is of course very important that road tankers and factory storage and handling equipment be maintained in a hygienic condition to minimize further contamination.
- Cool milk immediately after production, and maintain it in a cool condition until pasteurized. The rate of growth of bacteria is greatly influenced by the temperature of the milk. The lower the temperature, the slower their growth rate and the longer the period before spoilage occurs.

With bacteria, the term 'growth' refers to increases in the number of cells rather than to changes in the individual organism. The way that this increase in number is brought about is by each of the bacterial cells simply dividing across the middle to give two new bacterial cells. These cells in turn divide, and so on, the population doubling with each division. The time taken for a newly-formed bacterial cell to re-divide ('the doubling time') determines the growth rate.

Most of the bacteria that commonly occur as contaminants in raw milk grow faster at warm to hot room temperatures (that is, 30 to 37°C). At these temperatures, the numbers of some types of bacteria can double every 15 or 20 minutes.

Many bacteria, including those that commonly cause souring in milk and pathogens, grow only very slowly or not at all if the temperature is below about 10°C. However, there are some spoilage bacteria, called psychrotrophs, that grow fairly rapidly at 10°C.

Psychrotrophic bacteria are invariably present in farm milk supplies, usually forming about 10 to 30% of the total bacterial population. To minimize proliferation of these bacteria, the storage temperature must be reduced to the 2 to 3°C recommended for bulk farm storage vats. Yet, even at this temperature, psychrotrophs still grow, fairly slowly at first, but becoming faster as the storage period is extended until a maximum rate is reached.

A typical psychrotroph, growing at its fastest rate, may double in numbers every 50 minutes at 25°C, every 2 hours at 15°C, every 6 hours at 5°C, and every 14 hours at 1°C. A doubling of numbers every 6 hours is equivalent to a 16-fold increase in 24 hours.

- Process raw milk within a reasonable period after production. The process of pasteurization destroys the common spoilage bacteria that occur in raw milk, including those that cause souring and those that grow at low temperatures.

It is recommended that on-farm storage does not exceed 48 hours and it is desirable that milk be processed by the factory within 24 hours of collection from the farm. In this way, the build-up of psychrotrophs in the milk is minimized.

Spoilage process at low temperatures

Spoilage of raw milk is a gradual process, the intensity of the off-flavours increasing as the bacterial numbers increase. Some people are much more sensitive to off-flavours than others. The first sign of spoilage at low temperatures is generally a stale flavour. As bacterial numbers increase, the stale flavour gives way to an unclean flavour, followed by putrefaction, rancidity and souring.

Development of even the slightest defect in the raw milk is undesirable, as these will persist after pasteurization. Also, some of the enzymes produced by the bacteria in the raw milk withstand the pasteurization process and continue to degrade milk constituents after pasteurization. Quality control schemes for raw milk being implemented by the Queensland Department of Primary Industries are aimed at preventing the development of any off-flavours resulting from bacterial action.

Since psychrotrophic bacteria can account for large increases in the bacterial numbers in raw milk during transport and factory storage prior to pasteurization, standards applied to milk as it leaves the farm must make allowance for possible increases during transport and factory storage.

As a general rule, defects become apparent when the bacterial population reaches about one million per ml. The way bacteria grow, every 10-fold increase in bacterial numbers takes the same time. For example, a bacterial culture growing at similar rates would take no longer to increase from 100 000 per ml to one million per ml than it does to increase from 100 per ml to 1 000 per ml. Thus, at a constant storage temperature (for example, 2 to 3°C), the lower the contamination level, the longer the bacterial population takes to reach a level where spoilage becomes evident.

Bovine brucellosis accredited-free stud herd scheme

The following list is the complete list of certified bovine brucellosis accredited-free herds as at 31-5-78.

Agar Pastoral Co., P.M.B. 3, Murgon.	SG
J. H. and B. J. Amor, 'Carinya', Dulacca.	BF
Anderson Pastoral Co., 'Inverary', Yandilla.	PH
Animal Husbandry Research Farm, Department of Primary Industries, Rocklea.	MIXED
F. R. B. Anning, 'Cardross Charolais Stud', 'Cardross', Grandchester.	CL
Australian Estates, Eurella, Mitchell.	SG
Australian Estates, 'Wainui', Bowenville.	SG
N. D. Bahnisch, 'Brafield' Stud, 'Orchard Vale', Guluguba.	BF
H. A. Balke, 'Balhaven', Westbrook.	JS
R. Barr, Eukey Murray Grey Stud, P.O. Box 194, Stanthorpe.	MG
A. V. Bauer, 'Warralea' Droughtmaster Stud, M.S. 825, Ipswich.	DM
D. J. and E. M. Beal, 'Tara Park', Gowrie Junction.	MG
G. W. Beck, 'Banbeck', Blenham Road, Laidley.	DM
C. H. Beckingham, Cosme Jersey & Hereford Stud, 'Bridgeman Downs', Darien Street, Aspley.	JS, HF
M. G. Bell, 'Heatherlea' Stud, Dulacca.	BF
T. G. and M. K. Black, 'Hazeldean' Stud, M.S. 692, Nanango.	SG
N. J. and E. B. Blumel, 'Willow Glen Farm' Stud, Farm Road, Bunya.	DM
A. R. and V. H. Bondfield, 'Palgrove', Dalveen.	CL
Estate of W. Bourke, 'College Green', M.S. 422, Clifton.	AIS
R. R. and I. A. Bowen, 'Pine Tree Farm', Roma.	HF
L. J. Breen, 'Tarrawatta', Eukey, via Stanthorpe.	AG
I. and D. J. Brimble Combe, 'Wyalong', Jimbour.	BF
Broadlea Partnership, 'Broadlea', Box 35, Theodore.	BM
C. E. Buchholz, 'Baron Downs', P.O. Box 175, Maryborough.	SG
Bundaberg Sugar Co., 'Avondale' Brahman Stud, Marlborough Station, Marlborough.	BM
Burnett Downs Pastoral Co., 'Burnett Downs', P.O. Box 11, Brigalow.	MG
J. A. T. A. W. Butler, 'Coochin', Old Gympie Road, Beerwah.	BF
R. B. and J. P. Cameron, 'Belconnen', McDougall Street, Warwick.	MG
J. D. and H. Campbell, 'Hilden', Burpengary Road, Narangba.	MG, LM
M. P. Campbell, Tiaro Park, Tiaro.	BM
B. L. and M. O. Christensen, 'Elavesor' Poll Hereford Stud, Rosevale, via Rosewood.	PH
G. E. Christensen 'Double E', Moorang, via Rosewood.	SG
L. T. and T. O. Christensen, 'Coolaroo Jersey Stud', Moorang, via Rosewood.	JS
T. and W. Christensen, 'Omaha', Tarome, via Kalbar.	PH
E. M., C., and G. W. Ciesiolka, 'Valley View', M.S. 212, Oakey.	AIS, SG
J. R. and H. M. Ciesiolka, 'Trebon' A.I.S. Stud, Taylor Street, Toowoomba.	AIS
R. B. Clarke, 'Allawah', care of P.O. Box 476, Theodore.	BM
I. S. Conochie, 'Brookland', M.S. 461, Kalbar.	JS
Mrs E. B. Corden, 'Currajong Angus Stud', 'Netherby', Warwick.	AG
R. T. and P. A. Craig, 'Dulong' Stud, M.S. 1096, Nambour.	MG
D. B. and E. Crane, 'Keglsugl', P.O. Box 7, Dayboro.	PH
V. R. and T. W. Crank, 'Gracelyn, Mount Tyson.	AIS
N. T. Crisp, Connor Street, Stanthorpe.	HF
Mrs M. Crombie, Old Hidden Vale Santa Gertrudis Stud, Old Hidden Vale, Grandchester.	SG
D. Dance, 'Double D' Murray Grey Stud, M.S. 720, Millmerran.	MG
S. H. and V. I. Davidson, 'Cedar Grove' Poll Hereford Stud, Cedar Creek Road, Wolfdene, via Beenleigh.	PH
J. J. E. Davies, 'Glenwyn Park Stud', Charker Street, Toowoomba.	HF
K. W. Davis, 'Walkah', Carpendale, via Helidon.	JS
W. D. Davis, Wambo A.I.S. Stud, M.S. 918, Toowoomba.	AIS
G. F. and A. M. Dean, 'Gadfield' Stud, Home Creek, Wooroolin.	CH, SM
L. De Landelles, 'Cherokee', Tanby, via Yeppoon.	BM
W. A. Dodd, Glengannon Stud, M.S. 435, Rosewood.	PH
C. M. and B. E. Dolding, 'Dilston', Gayndah.	DM
F. M. and G. Donovan, 'Ashby' Braford Stud, Jimbour.	BF
Doro Park Friesians, 'Doro Park', M.S. 918, Toowoomba.	FS
E. O. and L. A. Dorries and Son, 'Panorama', M.S. 212, Oakey.	AIS
F. R. and G. A. Dowe, 'Wahroonga', Tara.	PH
L. J. Drew, 'Bluevale' Stud, M.S. 1116, Haden.	AY
V. L. Duhs, Murray Grey Stud, Image Flat Road, Nambour.	MG
Eidsvold Station Holdings Pty. Ltd., 'Belvedere', Eidsvold, care of Douglas, Heck, & Burrell, G.P.O. Box 35, Brisbane.	SG
T. V. and P. M. A. Erbacher, 'Everush', M.S. 465, Cambooya.	JS
R. C. Fahl, 'Sandalwood', Meandarra.	PH
Dr E. S. P. Ferguson, 'Coonoona', Wellcamp.	PH
J. A. and D. P. Ferguson, 'Dorallah' Jersey Stud, Veresdale, via Beaudesert.	JS
G. C. Fisher, 'Karalee' Murray Grey Stud, 68 Hume Street, Pittsworth.	MG
M. J. and M. Fitzgerald, 'M-Jay' Stud, Tarooma, Texas.	HF
D. J. Fogg, 'Den-Dia' A.I.S. Stud, M.S. 336, Toogoolawah.	AIS
Ford Holdings, Maraja Stud, P.O. Box 238, Caloundra.	BM
F. and I. C. Fraser, 'Dundee' Brahman Stud, Richmond.	BM
W. A. Freeman, Trevlac Stud, Walloon Road, Rosewood.	CL
A. J. and Y. L. French, 'Wilston Park', M.S. 181, Pittsworth.	FS
A. W., E. M. and D. W. Frohloff, 'Trinity', M.S. 191, Cambooya.	FS
Garryowen Past. Co., 'Corolla' Stud, M.S. 29, Clifton.	HF
C. Gauld, 'Moongana', Brooweena.	SG
Gayway Pastoral Co., 'Gayway', Anduramba.	BM
M. and G. M. Geddes, 'Rhodavale', Hodgson Vale, via Toowoomba.	FS
J. S. and E. J. Genge, 'Carinya', P.O. Box 78, Miles.	SG
H. C., K. C. and I. E. Genrich, P.O. Box 10, East Cooyar.	CL
W. W. Gibson, 'Glencrest', Mooloo, via Gympie.	GS
Glenrae Pastoral Co. Pty. Ltd., 'Bowenfels', P.O. Box 54, Kingaroy.	PH
B. Goddard, 'Inverell', Mt. Tyson, via Pittsworth.	AY

Goondicum Past. Co., 'Goondicum', Gin Gin.	HF
H. A. Gordon, 46 Mellifont Street, Banyo.	MG
L. M. Graham, 'Glenmore' and 'Glenlea' Studs, P.S. 1494, Nanango.	BF, HF
R. N. and L. M. Graham, 'The Homestead' Stud, Couper's Road, Westbrook.	FS
L. R. Granzien, 'Caboonbah' Jersey Stud, Kalbar.	JS
G. W. and A. L. A. Green, 'Woodridge', M.S. 371, Greenmount.	GS
G. A. Greenup and Co., 'Benroy', Kingaroy, care of 'Rosevale', Jandowae.	SG
J. R. and R. Grieve, 'Invernaion', Yandilla.	PH
J. C. Grigg, 'Bethonga' Braford Stud, P.O. Box 4, Wamuran.	BF
D. H. and P. O. Guilford, 'Mooloolah' Stud, 'Richmond', Allora.	HF
S. K. Guppy, 'Lynstarr', M.S. 1096, Nambour.	FS
N. D. and A. V. Hams, 'Shandah', P.O. Box 89, Nanango.	SG
B. and M. Hannant, 'Croalah' Stud, M.S. 243, Kingaroy.	PS
C. R. Hardwick, 'Charlyn', Marlborough.	BM
E. and R. F. Harvey, 'Dumboy', M.S. 918, Toowoomba.	FS
B. E. Hayward, 'Denville' Stud, M.S. 465, Cambooya.	HF
M. F. Hemmings, 'Bileena', Canningvale Road, Warwick.	AIS
V. A. Henderson, Barkala Stud, Greenmount Road, Cambooya.	HF
K. Henry & Sons, 'Tara' Stud, M.S. 465, Cambooya.	AIS
W. G. Henschell, 'Yarranvale', M.S. 1444, Brookstead.	PH
H. M. Prisons, Etna Creek, via Rockhampton.	MIXED
H. M. State Farm, Palen Creek, Rathdowney.	JS
H. M. Prisons, 'Wolston' Stud, Station Road, Wacol.	FS
C. J. Hewitt, 'Judel' Friesian Stud, Delaney's Creek, D'Auguilar.	FS
G. F. and N. E. Hoey, 'Coolalinga Jersey Stud', M.S. 74, Clifton.	JS
N. T. and M. A. Hoey, 'Merrawah' Stud, M.S. 371, Greenmount.	JS
A. T. Holt & Son, 'Karowara Santa Gertrudis Stud', Hartley Road, Tamborine Mountain.	SG
L. R. and E. E. Hoopert, 'Happy Valley', M.S. 212, Oakey.	SG
H. W. Hopper, 'Ellendean' Guernsey Stud, P.O. Box 4, Maleny.	GS
M. E. and V. E. Hughes, 'Mi-Von', Hopelands, via Chinchilla.	HF
C. J. and M. E. Jackson, 'Jaffra', Fairy Bower Road, Gracemere.	BM
E. P. J. and M. Jackson, 'Rotherham' Stud, 'Ennismore', Nobby.	PH
G. D. and B. M. Jensen, 'Kuyura', Jimbour.	BF
F. M. and K. W. Jobling, 'Karalee' and 'Karanga' Studs, M.S. 979, Monto.	AIS, PS
R. W. Johnston, 'Wallum Hills' Santa Gertrudis Stud, Franks Lane, Wamuran.	SG
R. L. and S. S. Jones, 'Valley View' Stud, Samford Road, Samford.	AY
B. C. Juers, Mimosa B. J. Stud, 'Mimosa', Gayndah.	DM
C. and D. I. Kajewski, 'Glenroy', Glencoe, M.S. 1049, Gowrie.	AIS
L. K. Kath, 'Kathleigh', M.S. 1049, Gowrie Junction.	JS
J. T. and F. Kelman, 'Mount Tabor' Station, Warwick.	SH X CH
J. E. Kemph, 'Bunya Vale', M.S. 222, Oakey.	CL
R. and M. Kerr, 'Mary View', Miva.	BF
Kerwee Past. Co., 'Argyle', Kingsthorpe.	SG
A. J. Kinbacher, 'Garthowen', P.S. 1216, Biggenden.	DM
L. B. and M. Kirby, 'Kalanga' Stud, Wesley Road, Kallangur.	CL
S. G. Knight & Co., 'Baalgammon', Manumbar Road, Nanango.	AIS
S. S. Knitter, 'Charnu' Stud, M.S. 546, Forest Hill.	FS, JS
A. F. Krinke, 'Plain View', care of Box 92, Pittsworth.	HF
B. R. and J. H. Kummerfield, 'Lonley', care of P.O. Box 7, Goovigen.	GS
L. H. Kunst, 'Sunnyside', Miva.	BS
B. G. and R. M. Lamb, North Kolan, M.S. 311, Avondale.	BM
P. A. and J. L. Lange, 'Cerana', M.S. 222, Oakey.	AIS
F. Lax & Sons, 'Wyroona', M.S. 212, Oakey.	FS
K. J. and M. Lau, 'Rosallen', Goombungee.	JS
C. F. Leacy, Coominga Droughtmaster Stud, 93 Summit Road, Pomona.	DM
R. S. and R. I. Learmont, 'Scotlea', P.O. Box 102, Monto.	SG
Leonorco Past. Co., Pierce Avenue, P.O. Box 143, Caloundra.	CL
Lester Brothers, 'St. Andrews' Stud, M.S. 623, Warwick.	AIS
C. J. and W. T. Lewis, 'Medland', Toowoomba Road, Crows Nest.	HF
P. M. Lewis, 'Spring Glen', Kingsthorpe.	FS
C. P. and E. G. Liebke, 227B West Street, Toowoomba.	MG
K. D. and J. K. Little, 'Woodleigh' Stud, Beaudesert.	JS
Lobegeier & Co., Wallaville.	BF
G. L. and A. E. Lobegeiger, 'Sunny Grove' Jersey Stud, Moorang, via Rosewood.	JS
L. K. Lostroch, 'Shamrock Vale', M.S. 212, Oakey.	AIS
S. H. and R. L. Ludwig, 'Glenvale', Boyland, via Tamborine.	GS
Lynn-Eden Braford Stud, 'Warrigal', Columboola.	BF
D. J. and W. E. Macdonald 'Rosneth' Jersey Stud, Goombungee.	JS
J. R. and A. McCamley, 'Lancefield' Brahman Stud, Dululu.	BM
W. D. and M. M. McErlean, 29 Rowbotham Street, Toowoomba.	PH
D. D. and J. L. McGuckin and I. D. and B. J. Francis, 5 Mile Road, Tinana.	HF
F. A. Mallison, 'Ganbeer' A.I.S. Stud, M.S. 438, Boonah.	AIS
C. R. and J. L. Marquardt, 'Cedar Valley' Stud, Box 69, Wondai.	AIS
R. J. P. Martin, 'Jacaranda' Friesian Stud, M.S. 546, Forest Hill.	FS
V. and D. Mason, 'Deejay', M.S. 150, Pittsworth.	AIS
R. G. and M. Matheson, 'Mioko', Owanyilla, M.S. 221, Maryborough.	DM
R. G. and M. Matheson, 'Inabui', Eatonvale Road, Tinana.	DM
J. B. and J. M. Matthews, 'Mt. Moriah', P.O. Box 15, Jondaryan.	BM
R. F. and R. M. Maynard, 'Greenfields', Jambin.	BM, CL
W. H. C. Mayne & Sons, 'Gibraltar', Texas.	AG
F. D. and P. A. Mayo, 'Logan Park' Simmental Stud, Pacific Highway, Loganholme.	SM
B. J. and B. F. Melrose, 'Glen Eildon' Braford Stud, 'Glen Eildon', Highfields.	BF
S. J. and H. E. Miller, 'Nardoo', Miller Street, Warwick.	SM
Mimosa Stud and Cattle Co., 'Mimosa', Gayndah.	DM
Mindaribba Past. Co., care of W. H. Perkins, P.S. 1608, Nanango.	SG
R. C. Mogg, 'Raymount' Friesian Stud, Dulong, via Nambour.	FS

A. E. Morris, 'Hillsdale', Gowrie Junction.	JS
P. Mort, 'Franklyn Vale' Braford Stud, Franklyn Vale, Grandchester.	BF
K. B. and K. T. Muller, 'Lyndon', P.O. Box 69, Clifton.	CL
H. J. Murray, 'Greydale' Murray Grey Stud, Upper John Street, Rosewood.	MG
A. and K. Niethe, Lockrose, M.S. 546, Forest Hill.	DM
D. M. and M. T. Nolan, 'Maydan', M.S. 848, Warwick.	BF
L. and N. M. Ogden, 'Red Hill Brangus Stud', M.S. 1017, Biloela.	BS
G. and K. G. Orphant, 'Westbank', Paterson.	HF
J. D. O'Sullivan, Navilloween, M.S. 371, Greenmount.	PH
P. W. O'Sullivan, 'Navleigh', A.I.S. Stud, M.S. 371, Greenmount.	AIS
R. J. O'Sullivan, 'Beenbah' Stud, Killarney.	HF
E. I. and S. Pacholke, 'Sunnylawn', M.S. 74, Clifton.	BF
L. R. Pain, 'Cabandah', Jandowae.	BF
Dr and Mrs R. H. Parker, 'Little Sussex Charolais Stud', Charleville.	CL
P. A. and J. T. Paterson, 'Wheel Park', M.S. 852, Hodgsonvale, via Toowoomba.	FS
A. F. Paton, 'Warragah' Stud, M.S. 30, Millmerran.	SG
C. F. Paton, 'Glenroy' Stud, M.S. 30, Millmerran.	SG
E. A. Paton, 'Sherdale', M.S. 30, Millmerran.	SG
S. and S. M. Paulger, 'Adadale', Kenilworth.	JS
M. C., R. C. W. and I. M. Pearce, M.S. 582, Toowoomba.	JS
Pearson Bros., M.S. 1184, Murgon.	COMM
J. N. Penglis, 'Pendale' Poll Hereford Stud, Westbrook Road, Wellcamp.	PH
Perrett Grazing Partnership, P.O. Box 181, Kingaroy.	PH
A. V. Peters, Gladwyn Angus Cattle Co., M.S. 982, Meringandan.	AG
L. W., M. J. and G. F. Peters, 'Wilmington' A.I.S. Stud, M.S. 212, Oakey.	AIS
C. W. Phillips, 'Sunnyview Park', M.S. 623, Warwick.	AIS
R. J. Pontifex, Roburn Friesian Stud, M.S. 212, Oakey.	FS
N. R. Potter & Sons, 'Acton Vale' Stud, Wellcamp.	PH, AIS
W. T. and E. A. Potter, 'Derrymore', Texas.	CL
D. A. Price & Co., 'Deloraine', P.O. Box 7, Jimbour.	CL
C. and E. L. Prosser, 'Thuruna' Stud, Tara.	HF
H. D. N. and C. K. Quast, 'Lincolnfield', P.O. Box 150, Beaudesert.	SM
R. D. and G. R. Radunz, 'Cool Hill', Wooroolin.	SG
D. G. Raff, 'Forres', Karara.	AG
A. A. and M. I. Ranger, 'Glenoyra', M.S. 222, Oakey.	AIS
P. Rawson, 'Beenbah", P.O. Box 21, Killarney.	SG
K. R. and G. A. Reid, Goomeran, Thane, via Warwick.	HF
K. G. Reinhardt, 'Kenway' Red Poll Stud, M.S. 906, Mapleton.	RP
B. W. and R. A. Reisenleiter, 'Viscount', M.S. 149, Gatton.	HF
Research Station, Biloela.	FS
W. E. and R. M. Rose, 'Rosevale' Friesian Stud, M.S.I. 1184, Murgon.	FS
W. Ross & Co., 'Starview' Stud, M.S. 23, Rosewood.	AIS
L. D. Russell, 'Courtleigh' Brahman Stud, Woodford Road, Peachester.	BM
G. G. Savage, 'Ven Vale', Ramsay, via Cambooya.	AIS
Estate of W. T. Savage, 'White Park', M.S. 852, Toowoomba.	AIS
N. N. Schelbach, 'Allanview', M.S. 848, Warwick.	AIS
Mrs K. W. W. and V. J. Schlodfeldt, Wyandah', P.O. Box 212, Beaudesert.	SM
W., L. W. and D. J. Schossow, 'Teviot Brooke', M.S. 488, Boonah.	FS
B. and T. Schmidt, 'Bando', Wyandra.	BM
C. N. Scott, M.S. 1471, Manumbar Road, via Nanango.	FS
E. I. Scott and J. S. Edwards, 'Auchenflower', Glenore Grove, via Forest Hill.	AY, FS
L. Shaw, 'Padue' Stud, Kareelpa, via Nambour.	SM
N. K. and S. G. Shelton, 'Vuegon', Hivesville.	BF
J. and S. C. Siehenhausen, 'Merriton', M.S. 195, Pittsworth.	AIS
A. W. and M. J. Skerman, 'Ar-Dee' Braford Stud, 'Rossman Downs', M.S. 590, Wandoan.	BF
W. R. Slatter & Sons, Berryglen Murray Grey Stud, M.S. 1605, Killarney.	MG
E. J. Smith, 'Hillcrest' Ayrshire Stud, Borollon, via Ipswich.	AY
F. H. and E. Smith, Sommerville Brahman Stud, 'Brahmeadows', M.S. 1883, Rockhampton.	BM
F. J. and H. R. Smith & Sons, 'Rubyvale' Angus Stud, 'Bralea' Burnside Road, M.S. 1096, Nambour.	AG
J. Z. Smith, Alum Roacks, Amiens.	HF
L. W. and K. J. Smith, 'Judi-Jindi' Braford Stud, M.S. 501, Dalby.	BF
M. T. and B. R. Smith, 'Pamplyn' Friesians, Wellcamp.	FS
A. H. and B. J. Springall, 'Beralan' Braford Stud, Imbil.	BF
Dr J. A. Stephenson, 'Sahwalid Sahiwal Stud', 'Belli Downs', Kenilworth Road, Belli, via Eumundi.	SW
N. L. Stiller, 'Vine Veil', Guluguba.	PH, HF x CH
R. L. and V. M. Stumer, 'Lavron Nook' Friesian Stud, M.S. 484, Boonah.	FS
K. Sutton, 'Startwell', Basin Road, Wamuran.	BM
C. Thompson, 'Kingston', Dulacca.	BF
W. H. and D. M. Thompson, P.O. Box 20, Nanango.	AIS
J. R. Todd, 'Aberfoyle', Laravale, via Beaudesert.	JS
Mrs B. Tout, 'Berrima', Elbow Valley, Warwick.	AG
R. N. and C. M. Towner, Par Deux Droughtmaster Stud, Thornton, M.S. 182, Laidley.	DM
J. P. and V. Trier, 'Tamrookum Valley' Braford Stud, Rathdowney.	BF
D. C. Tunstall, 'Hi Valley', M.S. 692, Nanango.	SH
M. Vandoren, 'Glen-Aero' Stud, P.O. Box 46, Applethorpe.	MG
P. and B. H. Van Popering, 'Brunetta' Jersey Stud, Coominya Road, Lowood.	JS
E. M. Voight, 'Chelmadale' Stud, M.S. 825, Ipswich.	BF, AIS
Wal-Anne Pastoral Company, 'Wal-Anne' Stud, P.O. Box 2, Haden.	PH
M. G. and G. E. Weier, 10 Wickham Street, Laidley.	PH
B. G. and B. Wells, Bundilla Murray Grey Stud, Thornton, M.S. 182, Laidley.	MG
E. E. W. West, 'Belmadochie' Friesian Stud, 19 Oatlands Court, Samford.	FS
A. C. and V. J. Westphal, 'Alun Jersey Stud', M.S. 342, Roadvale.	JS
J. R. Williams, 'Forest Glen', Columboola.	BF
L. W. and N. E. Wilmot, Koetong Hereford Stud, P.O. Box 7, Applethorpe.	HF
W. G. Wilson, 'Tarko', M.S. 444, Jondaryan.	HF
R. S. Wilson, Calliope Station, Gladstone.	HF
S. J. and N. E. Wippell, 'Morocco', Roma.	HF
A. R. and G. G. Wockner, 'Durn' Stud, Maclagan.	AG

D. B. and V. M. Wolter, 'Cobba Poll Hereford' Stud, Beenleigh.	PH
O. J. and S. D. Woodcock, 'Kanara', Yelarbon.	BF
A. and A. Woodgate, 'Woodgate Park', Biddadabba, via Tamborine.	FS
G. T. and H. E. Woods, 'Hazelwood' Jersey Stud, M.S. 906, Mapleton.	JS
J. R. and A. Woods, 'Jarmal', M.S. 16, Maleny.	DM
K. V. Wright, 'Wattle Vale', M.S. 288, Boonah.	FS
J. B. Wyatt, 'Rokeby', Warwick.	HF
Dr. B. R. Yeates, 'Ugarapul', Boonah.	DM
G. S. Young and M. J. Cooper, 'Coograli', North Maleny Road, Maleny.	BF
R. and J. Ziesemer, Belmar Stud, Bell.	HF
E. F. and I. M. Zischke, 'Lynview' Jersey Stud, M.S. 231, Laidley.	JS

KEY

Angus—AG
Australian Illawarra Shorthorn—AIS
Ayrshire—AY
Braford—BF
Brahman—BM
Brangus—BS
Chianina—CH
Charolais—CL
Droughtmaster—DM
Friesian—FS
Guernsey—GS
Hereford—HF
Jersey—JS
Limousin—LM
Murray Grey—MG
Poll Hereford—PH
Poll Shorthorn—PS
Red Poll—RP
Santa Gertrudis—SG
Sahiway—SW
Shorthorn—SH
Simmental—SM
Mixed—MIXED
Commercial—COMM.

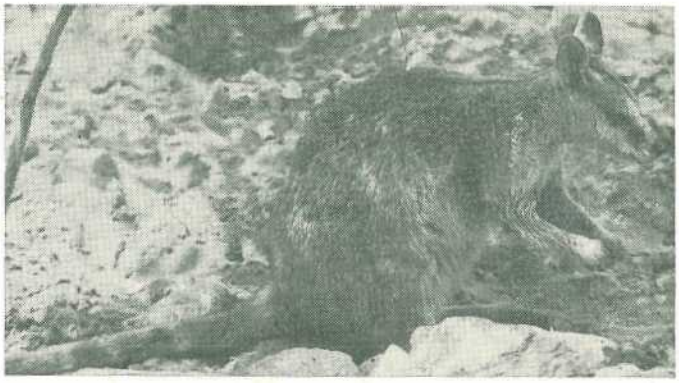
Brucellosis tested swine herds as at 31-5-78

Aboriginal and Island Affairs Department, Cherbourg.	LW
P. and N. Batterham, Raby Park, Inglewood.	L, LW
R. A. and B. E. Bool, Rossvale Stud, M.S. 223, Nobby.	LW, L
D. J. Brosnan, Bettafield, Mt. Murchison, via Biloela.	LW, L
F. D. and E. C. W. Corney, Pagel, Tara.	LW
N. J. Cotter, Olarey, Goomeri.	LW
R. H. Crawley, Rockthorpe, Linthorpe.	B
G. F. and A. M. Dean, Home Creek, Wooroolin.	LW, L, B
E. Diete, 'Ettrock', Ingoldsby.	X
Mrs W. S. Douglas and Son, Greylight, Goombungee.	W
R. and L. M. Duckett, Fairview, Capella.	L, LW
C. P. and B. J. Duncan, Colley, Flagstone Creek, Helidon.	LW
J. A. and B. L. Duncan, Ma Ma Creek.	LW
Dunlop Meats Pty. Ltd., Coondulla Stud, 8 Malkara Street, Townsville.	L, LW
J. and L. Fisher, Lyndhurst, Bell.	L, LW
L. Fletcher, 'Par-en-eri', P.O. Box 143, Mundubbera.	LW, L
K. J. and B. D. Fowler, Kenstan, M.S. 195, Pittsworth.	L, LW
K. P. Fowler, Northlea Stud Farm, Hogg Street, P.S. 1436, Toowoomba.	L, LW
N. E. P. and M. P. Fowler, care of Kewpie Enterprises, Kingaroy.	L, LW, X
K. H. and B. Franke, Delvue, Cawdor.	LW
W. A. Freeman, Trevlac, Rosewood.	LW
E. F. and N. E. Geysing, Oakhurst, via Maryborough.	LW
D. F. and R. F. Goschnick and W. M. and K. J. Pearce, 'Echoes', Bancroft, via Monto.	LW
T. G. and E. A. Gosdon, Naumia, Dalby.	L, LW
D. G. Grayson, Wodalla, Killarney.	L, LW
A. H. and R. N. Grundy, Markwell Piggeries, M.S. 499, Toowoomba.	L, LW
H. M. Prison, Etna Creek, via Rockhampton.	LW
H. M. State Farm, Numinbah.	B, LW
H. M. State Farm, Palen Creek.	LW
G. R. Handley, Locklyn Stud, Lockyer.	B
Mrs M. Handley, Meadow Vale, Lockyer.	B
R. D. and B. M. Heness, 'Russley', Goomeri.	L
D. F. and R. K. Hinchliffe, Oakview, Milman, via Rockhampton.	L, LW
R. F. and V. D. Hudson, Rondel, Hogg Street, Wilsonton.	L, LW
K. B. and I. R. Jones, 'Cefn', M.S. 544, Clifton.	LW, L
C. and D. I. Kajewski, Glenroy, Glencoe, via Toowoomba.	LW, L
R. E. and M. D. Kajewski, 'Robmar' Stud, Acland.	L
A. R. Kanowski, Exton, Pechey, via Crows Nest.	LW
S. E. Kanowski, Miecho, Pinelands, via Crows Nest.	T
C. F. Kimber, M.S. 698, Biggenden.	L
E. R. Kimber, Tarella, M.S. 805, Mundubbera.	LW, B
I. E. and C. C. Kimber, 'Splenda View', Coalstoun Lakes, M.S. 698, Biggenden.	L
V. F. and B. L. Kruger, Greyhurst, Goombungee.	LW
V. and C. A. Kuhl, 'The Mounts', Boodue, M.S. 222, Oakey.	LW
R. R. and L. M. Law, 'Summerset', M.S. 757, Kingaroy.	LW, L
A. L. Ludwig, Beauview, Cryna, via Beaudesert.	B
Maranoa Stud Piggery, Mitchell.	L, LW
K. Mathieson, Ideraway, Gayndah.	LW
W. Neuendorf, M.S. 794, Kalbar.	B
L. A. Peters, Moonlight, Bongeen.	L
D. O'Connor, Rollingstone.	L, LW, X
T. O'Connor Enterprises, 32 East Street, Toowoomba.	LW
G. R. and B. J. Patch, 'Kiara', Bell.	L, LW, X
Queensland Agricultural College, Lawes.	B, LW
V. V. Radel, Braedella, Coalstoun Lakes.	LW
Research Station, Biloela.	LW
Research Station, Hermitage.	B
A. B. Robin, Blaxland Road, Dalby.	LW, L
G. Rosenblatt, Rosevilla, Biloela.	L, LW
A. F. and V. M. Ruge, 'Alvir' Stud, Biggenden.	LW
D. W. and L. J. Sharp, 'Arolla' Lavella, via Millmerran.	LW, L
G. A. Smith, 'Miandetta', M.S. 162, Warwick.	X
R. A. H. and T. N. Smyth, Barambah Road, Goomeri.	LW
L. B. and L. J. Trout, 'Caminda', Crawford, via Kingaroy.	L, B
Wearmouth Piggeries, care of G. Varidel, Dalby.	X
Westbrook Training Centre, Westbrook.	B
L. J. Willett, Wongalea, Irvingdale, M.S. 232, Bowenville.	LW, L
K. Williamson, Cattermul Avenue, Kalkie, Bundaberg.	LW, L

KEY

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

The brush-tailed rock wallaby in Queensland



Photograph above. The paler, northern form of the brush-tailed rock wallaby. Note the median head stripe and darker ear margins, and the untapered tail.

THE brush-tailed rock wallaby *(Petrogale penicillata* (Griffith, Smith and Pidgeon)) is a common, easily-recognized, small kangaroo that prefers the specialized habitat of escarpments and rock-strewn hillsides.

In some areas, it is mistakenly known as 'tree-kangaroo' because of its habit of occasionally resting in the branches of a tree.

The general colouration of males and females from any one locality is similar, but there is considerable variation between animals from northern and southern Queensland.

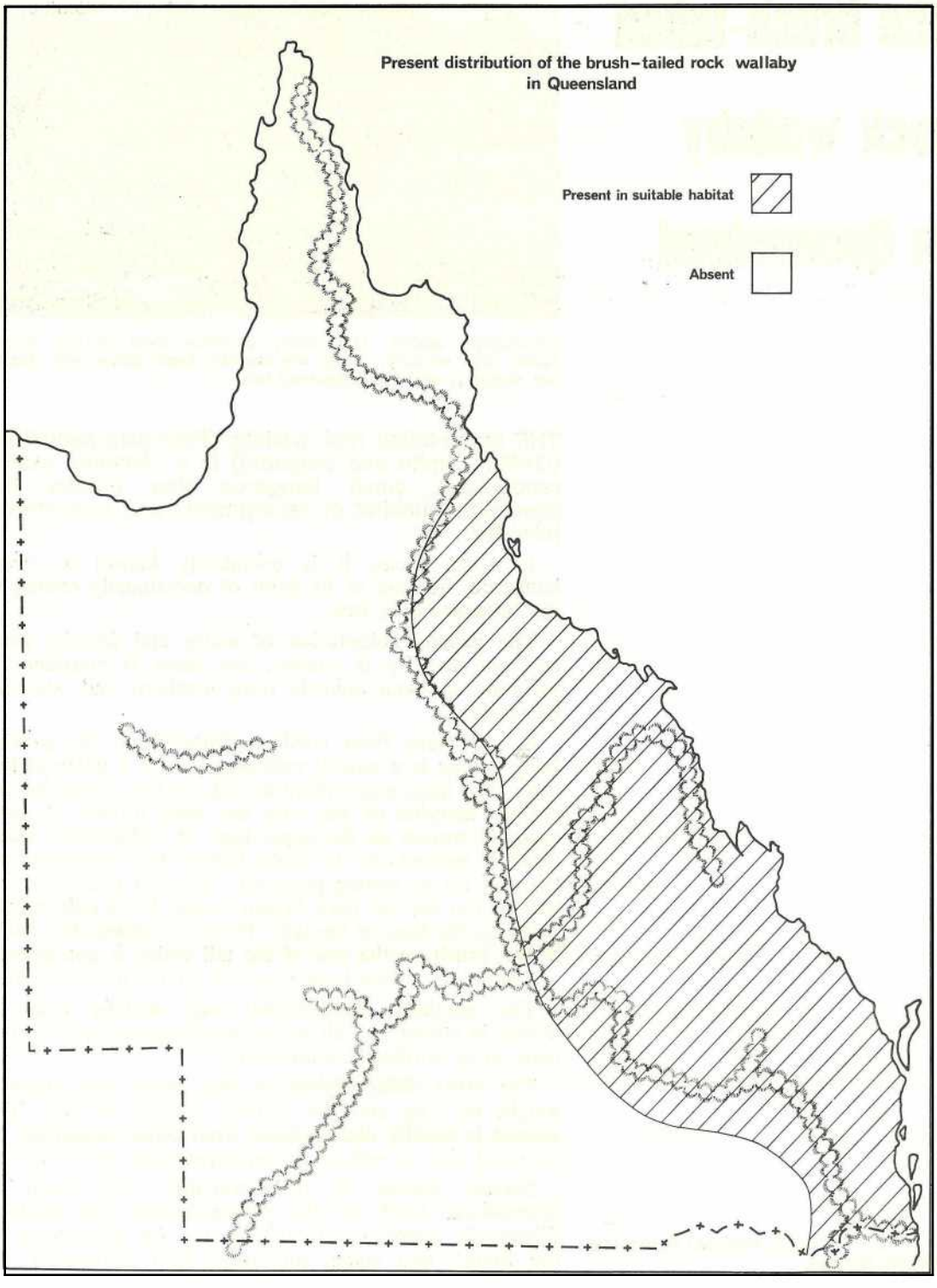
In specimens from northern Queensland, the general body colour is a patchy rufous-grey with a paler underside. The head may exhibit a dark median stripe and the outside margins of the ears are dark brown. A pale stripe is present on the upper legs. A conspicuous black mark is present on the body behind the upper part of the arm (in its resting position). The feet and the distal half of the tail are dark brown except for a pale rufous patch on the base of the tail. There is a distinctive, dark-brown brush on the end of the tail which is not tapered and which is carried high when the animal moves rapidly.

The southern brush-tailed rock wallaby form is darker in colour and all rufous markings are much richer than on its northern counter-part.

The sexes differ slightly in size; males may attain a weight of 5 kg and few females exceed 4·7 kg. The species is readily distinguished from other kangaroos by its small size as well as its preference for rocky habitat.

Several species of rock wallabies are found in Queensland (such as the yellow-footed rock wallaby (*Petrogale xanthopus* Gray) in the far south-west of the State) and some authorities also distinguish the

by P. M. JOHNSON, National Parks and Wildlife Service.


Present distribution of the brush-tailed rock wallaby in Queensland
Present in suitable habitat
Absent

northern brush-tailed rock wallaby by referring to it as *Petrogale inornata* Gould.

Distribution

The brush-tailed rock wallaby inhabits the coastal lands from the New South Wales border to Cairns; the western limits of distribution follows generally the Great Dividing Range.

Habitat types

Suitable habitat for this species includes forested areas on rocky hill terrain. It is not found in rain-forest.

Breeding

Breeding occurs throughout the year. Males reach maturity at about 590 days while females are capable of reproducing at about 540 days. Under normal conditions, a female gives birth to one young at an average interval of 204 days. The period from mating to birth, provided no young is in the pouch, ranges from 30 to 32 days.

Birth is followed immediately by mating and the resulting embryo ceases its development at an early stage. Development of this 'delayed' embryo is resumed if the first young is lost from the pouch; birth occurs some 28 to 30 days after the loss. If the first pouch young is not lost, the 'delayed' embryo recommences development to be born when the first young is ready to be evicted from the pouch at 189 to 227 days.

General notes

Brush-tailed rock wallabies usually live in colonies, the size of which varies with the area of suitable habitat. Animals may be observed at all times of the day, particularly in cooler weather. During the hot periods of summer days they retire to caves and other shelter. Males react aggressively to one another while adult females are more amicable.

Grazing is usually in close proximity to the resting areas; the animals move out in the evening and return in the morning. Heavy grazing by introduced stock in the vicinity of rock faces can have an adverse effect on populations of rock wallabies during dry times through competition and erosion.

Conservation

Under the current legislation (*Fauna Conservation Act* 1974–1976) the brush-tailed rock wallaby is protected. The specialized habitat requirements of this species—on otherwise unproductive and usually inaccessible lands—have to date provided an effective measure of protection.

Q.A.J. subscription changes

AS from 1 September this year, new subscription rates will apply to the *Queensland Agricultural Journal.*

The new rates are: Ordinary—$8.00 per annum

Concession rate—$3.00 per annum.

Subscribe now

'The Queensland Agricultural Journal'

Concession rate available

Persons eligible for concession rate include commercial farmers whose principal source of income is from primary production, students of agricultural courses, libraries and educational institutions (all resident in Queensland). Students' applications should be endorsed by the lecturer or teacher.

QUEENSLAND AGRICULTURAL JOURNAL

ORDER FORM

Subscription Rates—

Ordinary — $8.00 per annum (Australian Currency)

Concession rate — $3.00 per annum

NAME Mr / Mrs / Miss ..... (BLOCK LETTERS) ..... (INITIALS)

PRESENT ADDRESS ..... POSTCODE .....

PREVIOUS ADDRESS (if applicable) .....

OCCUPATION .....

I hereby enclose $ for years subscription (2 year limit).

Signature .....

New Subscriber ☐

Renewal ☐

(Tick the one that applies)

Office Use Only

63696—S. R. Hampson, Government Printer, Brisbane

Some of Queensland's aquatic plants

Water hyacinth
(Eichhornia crassipes)

A floating perennial forming dense mats over the water surface. The species forms a rosette (up to 40 cm across) of bright-green, shiny leaves. The leaves have rounded blades and a swollen, spongy leaf stalk. Long, fibrous roots hang in the water below the plant. Flowers are blue-mauve and very showy and are borne in dense spikes which project above the rest of the plant.

This species can be a serious pest of waterways where it hampers water traffic and makes access to the water difficult.

Control measures are of two kinds, mechanical and chemical. Most mechanical methods aim at dragging the plants on to the bank where they die of exposure. The plant is also susceptible to paraquat, diquat, 2,4-D and amitrole.

Azolla
(*Azolla pinnata* known as ferny azolla)
(*Azolla filiculoides* var. *rubra* known as Pacific azolla)

Both are similar-looking species of small, native, floating ferns. Each plant is from 1 cm to 4 cm long and has small, overlapping, scale-like leaves about 1·5 mm long. The roots rise on the underside of the plants and are feathery in ferny azolla and thread-like in Pacific azolla. Vegetative reproduction occurs by fragmentation of the plant body and this is its main means of reproduction.

The plants are often reddish in colour and when present in large numbers can cover the whole surface of the water with a reddish mat.

Azolla is usually not considered a pest. However, if present in sufficient quantity, it may block pump inlets or deter stock from watering.

It can be controlled by spraying with diesel distillate, power kerosene or diquat.

Another chemical, known as AF 101 or Salkill and shortly to be released on the market has been shown experimentally to control water hyacinth, water lettuce, salvinia and azolla, particularly with the addition of diuron.

by T. D. Stanley, Botany Branch.

Salvinia
(Salvinia molesta)

A free-floating fern, but not typically fern-like. At each node are two floating or emergent leaves and a third root-like, submerged leaf. True roots are absent. The floating leaves are rounded and 1 to 2 cm long with rows of stiff hairs on the green upper surface. The undersurface is spongy. Hairy, spore-bearing bodies (sporocarps) are borne in chains on the brown, root-like organs. The spores of this species are sterile as the species is a hybrid probably of horticultural origin.

The leaves of young plants on open water are open and float flat on the water surface; later, with age and crowding, the surface of each leaf folds along the midrib.

This species grows rapidly by extension of the stem and is capable of forming mats which can cover vast areas of water. It can interfere with water traffic and access to the water and, when rotting, may foul the water.

Salvinia can be controlled by spraying with paraquat or diquat.

Water lettuce
(Pistia stratiotes)

These free-floating plants form rosettes about 15 cm across. The leaf-blades are wedge-shaped, woolly, pale-green and arise from a short stalk. Several veins are visible on the leaf blade and are raised on the undersurface and are sunken in grooves on the upper surface. Flowers are inconspicuous and are borne at the base of the leaves. Many long, feathery roots hang in the water below the plant.

Young plants are produced at the ends of stolons from the mother plant.

Water lettuce has been used as an ornamental in fish ponds and aquaria. However, since 1967, it has been reported as a weed of open water from a number of localities in Queensland.

It can cover large areas of water and interfere with water traffic and access to the water.

The plant is susceptible to 2,4-D, paraquat and diquat. Mechanical methods of control, where the plants are dragged on to the bank, are also effective.

Some of Queensland's aquatic plants

Photographs by M. F. Olsen, Botany Branch.

Water hyacinth (Eichhornia crassipes).

Azolla (Azolla pinnata).

Salvinia (Salvinia molesta).

Water lettuce (Pistia stratiotes).